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

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 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	-	52.672	47.098	-	-	-	-	-	-	-	-	-
FG9: <i>Air and Missile Defense (AMD) Electronic Warfare</i>	-	52.672	47.098	-	-	-	-	-	-	-	-	-

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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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	52.980	26.982	0.500	-	0.500
Current President's Budget	52.672	47.098	0.000	-	0.000
Total Adjustments	-0.308	20.116	-0.500	-	-0.500
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-6.400			
• Congressional Rescissions	-	-			
• Congressional Adds	-	27.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.308	-0.984			
• Adjustments to Budget Years	-	-	-0.500	-	-0.500

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*

Congressional Add: *Program increase - cyber and supply chain resiliency*

Congressional Add: *Program increase - machine learning for integrated fires*

Congressional Add Subtotals for Project: FG9

Congressional Add Totals for all Projects

FY 2020	FY 2021
15.000	-
25.000	-
5.000	-
-	22.500
-	5.000
45.000	27.500
45.000	27.500

Change Summary Explanation

\$0.500 million of funds were realigned under PE 0604741A - Air Defense Command, Control and Intelligence - Eng Dev Project 126.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
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			
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
FG9: Air and Missile Defense (AMD) Electronic Warfare	-	52.672	47.098	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Beginning in FY 2022, 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.

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Electronic Protection Enhancements	7.672	19.598	-
Description: Provides Cyber and Electromagnetic Activities (CEMA) planning, conducts CEMA demonstrations and post-mission analysis.			
FY 2021 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
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 2020	FY 2021	FY 2022
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 to FY 2022 Increase/Decrease Statement: Funding realigned under PE 0604741A - Air Defense Command, Control and Intelligence - Eng Dev Project 126.				
Accomplishments/Planned Programs Subtotals		7.672	19.598	-
		FY 2020	FY 2021	
Congressional Add: Interoperability of integrated air and missile defense.		15.000	-	
FY 2020 Accomplishments: Continue efforts to accelerate the development of networked systems able to operate within rapidly evolving threat timelines and in degraded environments. FY20 planned activities include a Kill Chain Architecture Study, trades development, analysis, and acquisition of integration tools.				
Congressional Add: Artificial Intelligence and Machine Learning		25.000	-	
FY 2020 Accomplishments: - Integrate Machine Learning (ML) technology into Army Air and Missile Defense (AMD) weapon systems. - Design, code, and integrate ML technology into existing CEMA Detection Algorithm (CDA). - Assess applicability of ML CEMA algorithms for use in Army warfighter Training Aids, Devices, Simulator, and Simulations (TADSS). - Initiated efforts to detect and recognize the effects of cyber, Positioning, Navigation, and Timing (PNT), and Electronic Warfare (EW) attacks.				
Congressional Add: Cyber and Supply Chain Resiliency		5.000	-	
FY 2020 Accomplishments: - Develop innovative technology to identify and mitigate cyber and supply chain risks to PEO MS weapon system programs. - Build a coordinated and consolidated system security engineering support capability to achieve cyber and supply chain survivability and resiliency. - Develop processes to evaluate suppliers and quantify risks to the PEO MS weapon systems. - Improve information analytics and integrate technical disciplines while providing cooperative supply chain risk analyses and cyber risk identification.				
Congressional Add: Program increase - cyber and supply chain resiliency		-	22.500	

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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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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	FY 2020	FY 2021
<p>FY 2021 Plans: - Continue developing innovative technology to identify and mitigate cyber and supply chain risks to PEO MS weapon system programs.</p> <ul style="list-style-type: none"> - Build a coordinated and consolidated system security engineering support capability to achieve cyber and supply chain survivability and resiliency. - Continue to develop processes to evaluate suppliers and quantify risks to the PEO MS weapon systems. - Improve information analytics and integrate technical disciplines while providing cooperative supply chain risk analyses and cyber risk identification. 		
<p>Congressional Add: Program increase - machine learning for integrated fires</p> <p>FY 2021 Plans: - Continue Integration of Machine Learning (ML) technology into Army Air and Missile Defense (AMD) weapon systems.</p> <ul style="list-style-type: none"> - Continue design, code, and integrate ML technology into existing CEMA Detection Algorithm (CDA). - Assess applicability of ML CEMA algorithms for use in Army warfighter Training Aids, Devices, Simulator, and Simulations (TADSS). - Continue efforts to detect and recognize the effects of cyber, Positioning, Navigation, and Timing (PNT), and Electronic Warfare (EW) attacks. 	-	5.000
Congressional Adds Subtotals	45.000	27.500

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 2022 Army												Date: May 2021			
Appropriation/Budget Activity				R-1 Program Element (Number/Name)				Project (Number/Name)							
2040 / 4				PE 0603327A / Air and Missile Defense Systems Engineering				FG9 / Air and Missile Defense (AMD) Electronic Warfare							
Management Services (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 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	4.519	0.907	Nov 2019	0.926	Nov 2020	-		-		-	Continuing	Continuing	Continuing
Subtotal			4.519	0.907		0.926		-		-		-	Continuing	Continuing	N/A
Product Development (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 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	4.378	2.693	Nov 2019	2.568	Nov 2020	-		-		-	Continuing	Continuing	Continuing
Interoperability of Integrated AMD	SS/CPFF	Various : Various	35.000	14.968	Feb 2020	-		-		-		-	0.000	49.968	-
Cyber and Supply Chain Resiliency	Various	Various : Various	-	3.273	Mar 2020	5.000		-		-		-	0.000	8.273	-
Artificial Intelligence and Machine Learning	Various	Various : Various	-	14.667	Feb 2020	22.500		-		-		-	0.000	37.167	-
ALPS Development/ Integration	Various	Various : Various	36.326	0.458	Jan 2020	0.482	Jan 2020	-		-		-	0.000	37.266	-
Subtotal			75.704	36.059		30.550		-		-		-	Continuing	Continuing	N/A
Support (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 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	18.362	10.982	Feb 2020	8.801	Feb 2021	-		-		-	Continuing	Continuing	Continuing
Subtotal			18.362	10.982		8.801		-		-		-	Continuing	Continuing	N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2022 Army		Date: May 2021
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 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026			
	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-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 2022 Army		Date: May 2021
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

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