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Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Army										Date: February 2018		
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 7: Operational Systems Development					R-1 Program Element (Number/Name) PE 0607865A / Patriot Product Improvement							
COST (\$ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
Total Program Element	-	48.073	90.217	65.369	-	65.369	42.803	61.495	78.745	94.510	Continuing	Continuing
DV8: Patriot Product Improvement	-	48.073	90.217	65.369	-	65.369	42.803	61.495	78.745	94.510	Continuing	Continuing

Note

Beginning FY17, funding specific to LTAMD-C realigned to PE 0604114A, Lower Tier Missile Defense (LTAMD) Capability.

A. Mission Description and Budget Item Justification

PATRIOT is an advanced Surface-to-Air guided missile system with a high probability of kill, capable of operation in the presence of Electronic Countermeasures (ECM) and able to conduct multiple simultaneous engagements against high performance air breathing targets and ballistic missiles likely to be encountered by U.S. Forces. The PATRIOT Product Improvement Program provides for the upgrade of the PATRIOT System through individual materiel changes and upgrades to the PATRIOT system to address operational lessons learned, enhancements to joint force interoperability, and other system performance improvements to provide overmatch capability with the emerging threat.

The hardware and software funding provides for the identification, analysis, design and test improvements to the PATRIOT system against the evolving threat. This effort supports work with national agencies to evaluate, assess, and develop means to mitigate threat trends and specific threat developments potentially impacting system performance. Specific improvements may be developed and fielded under this task if warranted. The effort maintains the Mission Tailoring Database, responding to immediate tactical concerns. Database updates are fielded between major software upgrades as necessary.

Funding provides authority to identify, analyze, design and test materiel solutions to counter cybersecurity and electronic warfare shortcomings to all elements of the Lower Tier Battle Space.

FY2019 base dollars in the amount of \$65.369 million support the continuance of Software Improvement for Threat Evolution, Advanced Electronic Counter Measures (AECM), Assured Positioning, Navigation and Timing (PNT), Combat ID enhancements, Tasks 2, 6, and 7 activities, listed under project DV8.

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B. Program Change Summary (\$ in Millions)	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total
Previous President's Budget	49.482	90.217	69.976	-	69.976
Current President's Budget	48.073	90.217	65.369	-	65.369
Total Adjustments	-1.409	0.000	-4.607	-	-4.607
• Congressional General Reductions	-0.016	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.393	-			
• Adjustments to Budget Years	-	-	-4.607	-	-4.607
Change Summary Explanation					
FY2019: Program Office core employee labor costs moved from RDTE to OMA as part of an OSD auditability directive.					

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Appropriation/Budget Activity 2040 / 7					R-1 Program Element (Number/Name) PE 0607865A / Patriot Product Improvement				Project (Number/Name) DV8 / Patriot Product Improvement			
COST (\$ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
DV8: Patriot Product Improvement	-	48.073	90.217	65.369	-	65.369	42.803	61.495	78.745	94.510	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Beginning FY17, funding specific to LTAMD-C realigned to PE 0604114A, Lower Tier Missile Defense (LTAMD) Capability.

A. Mission Description and Budget Item Justification

Software and hardware improvements for threat evolution: Performs necessary analysis and development efforts to maintain PATRIOT system effectiveness against evolving threat technologies and specific threat capabilities. This effort identifies evolving threats and threat characteristics that might present a challenge to PATRIOT's current capabilities and develops initial concepts to maintain system effectiveness relative to these threats.

Upper-Tier Debris Mitigation (UTDM): Implements algorithms to mitigate system impacts of debris from Upper Tier intercepts associated with operating in the Ballistic Missile Defense System (BMDS) environment. Debris from Upper Tier intercepts can cause significant radar loading effects and the potential for erroneous engagements and missile wastage on debris.

Radar Digital Processor (RDP) Waveform Suite: Develops a comprehensive set of waveforms in the RDP to improve PATRIOT radar capabilities against current and evolving threats, including support to Task 6 and 7 efforts (see below), and implements advanced data collection enabled by the RDP to support further system improvements. The new waveforms enabled by the RDP allow capability improvements in Discrimination, Combat ID, Electronic Protection, Search, Tracking, and other areas of need.

THAAD/PATRIOT Interoperability: Implements improvements to THAAD/PATRIOT Interoperability and addresses Joint Defense Network deficiencies that impact Tactical Ballistic Missile battle management and force/engagement operations. Efforts will be concentrated on joint, collaborative force operations (defense design and planning) and enhanced Tactical Digital Information Link - Joint interoperability.

Advanced Electronic Counter Measures (AECM): This task investigates the implications of advanced technology Digital Radio Frequency Memory available on airborne platforms that enables new ECM techniques which could adversely affect Air and Missile Defense System effectiveness.

Task 2: Implements improved ground system and interceptor capabilities (PATRIOT Advanced Capability-2/Guidance Enhanced Missiles, PATRIOT Advanced Capability-3, and Missile Segment Enhancement) to counter emerging Tactical Ballistic Missile threats.

Task 6: Software improvements enhance discrimination of higher altitude Tactical Ballistic Missile Re-entry Vehicles (RVs) from associated objects to support the full engagement capabilities of the interceptor. Longer-range detection, track, and improved high-altitude discrimination are required to achieve the required lethality

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performance against the RV and to mitigate missile wastage against separation debris. This task leverages the signal processing capabilities of the Radar Digital Processor, and supports the high altitude engagements required by the PATRIOT Advanced Capability-3 (PAC-3) and PAC-3 Missile Segment Enhancement (MSE) missiles.				
Task 7: Performs analysis on existing and evolving Tactical Ballistic Missile countermeasures to determine the effects on PATRIOT system effectiveness. Develops hardware and software concepts to address countermeasure effects to ensure the PATRIOT system maintains its effectiveness. Develops detailed system requirements to implement concepts; design/code/test software implementation leveraging Radar Digital Processor, Modernized Adjunct Processor, Enhanced Weapons Control Computer - Emulator and Flight Solution Computer-Redesign processing capabilities. Implements simulation based concepts to define tradespace and establish system requirements.				
Assured Positioning, Navigation, and Timing (PNT): Efforts will develop and test the military's improved Global Position M-Code with Patriot Major End Items (MEI) integrating the improved anti-jamming and secure access of military GPS signals. This effort meets the requirement for Assured PNT through M-Code as mandated by FY2011 National Defense Act, public law 111-383 & 913.				
Combat ID Enhancements: Develop and implement improvements to the Radar Digital Processor-Capability Combat ID capabilities and additional Non-Cooperative Target Recognition techniques to further mitigate misclassification and fratricide risk, and to provide the Warfighter with improved situational awareness.				
Anti-Radiation Missile (ARM) Asset Defense: Provides improved capability for PATRIOT to protect other Army and Joint Services Sensors from ARM attacks. Builds on an initial capability provided in Post-Deployment Build-7 by determining remaining gaps, identifying and evaluating alternatives, and implementing further improvements.				
Tactical Telemetry Ground Station: Develops a ground-based telemetry receive station to be deployed with the tactical units and collect PAC-3 telemetry data for tactical engagements. This data will be used to assess missile and system effectiveness in tactical environments against real-world threats, and will support the development of operational improvements (Firing Doctrine and other system settings) and system software improvements to mitigate stressing threat behaviors.				
U.S. Government and contractor support for PIP efforts.				
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2017	FY 2018	FY 2019
Title: PATRIOT Product Improvement		48.073	90.217	65.369
Description: Continuous Improvement to Counter the Evolving Threat.				
FY 2018 Plans:				
-Continued Software Improvement for Threat Evolution, Upper-Tier Debris Mitigation (UTDM), THAAD/PATRIOT Interoperability and Advanced Electronic Countermeasures (AECM).				
-Began Tactical Telemetry Ground Station development.				
-Continued Combat ID enhancements, PNT and ARM Asset Defense development.				

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Appropriation/Budget Activity 2040 / 7				R-1 Program Element (Number/Name) PE 0607865A / Patriot Product Improvement				Project (Number/Name) DV8 / Patriot Product Improvement				
B. Accomplishments/Planned Programs (\$ in Millions) -Continued Tasks 2, 6, and 7 activities. -Began Radar Digital Processor (RDP) Waveform Suite activities. -U.S. Government and contractor support to counter emerging threat. FY 2019 Plans: -Continues Software Improvement for Threat Evolution and Advanced Electronic Countermeasures (AECM). -Continues Combat ID enhancements and Assured Positioning, Navigation, and Timing (PNT). -Continues Tasks 2, 6, and 7 activities. -U.S. Government and contractor support to counter emerging threat. FY 2018 to FY 2019 Increase/Decrease Statement: FY2018 PIP funding of \$90.2M was reduced to \$65.4M in FY2019. Scheduled improvements are constrained by budget allocation for each respective fiscal year. Current funding profile will enable the development of a capability to address evolving threats; however, any further reductions in funding will increase risk in delivering a mature, fully tested Combat ID capability in PDB-8.1.										FY 2017	FY 2018	FY 2019
Accomplishments/Planned Programs Subtotals										48.073	90.217	65.369
C. Other Program Funding Summary (\$ in Millions)												
<u>Line Item</u>	<u>FY 2017</u>	<u>FY 2018</u>	<u>FY 2019</u> <u>Base</u>	<u>FY 2019</u> <u>OCO</u>	<u>FY 2019</u> <u>Total</u>	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>	
• C50700: Patriot Mods (C50700)	197.107	496.073	313.228	-	313.228	292.218	209.387	146.657	160.679	Continuing	Continuing	
Remarks The improvements/enhancements developed through the PATRIOT Product Improvement Program (PIP) are interrelated with the hardware kits that are procured and installed under the Missile Procurement, Army (MIPA) appropriation's PATRIOT Mods program and maximizes PAC-3 MSE capabilities.												
D. Acquisition Strategy The design objective of the PATRIOT system was to provide a baseline system capable of modification to cope with continuing threat evolution. This program minimizes technological risks and provides a means of enhancing system capability through planned upgrades of deployed systems. The PATRIOT Product Improvement Program upgrades the PATRIOT system to address operational lessons learned, enhancements to joint force interoperability and communications, and other system performance improvements to provide overmatch capability against the emerging threat. Upgrades are implemented through individual hardware and software materiel changes and fielded incrementally. This program encompasses several changes which will require the use of a variety of acquisition methods to develop, test, procure and field. Future hardware and software capabilities will be incorporated into future Post Deployment Build (PDB) releases.												
E. Performance Metrics N/A												

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Army												Date: February 2018			
Appropriation/Budget Activity 2040 / 7						R-1 Program Element (Number/Name) PE 0607865A / Patriot Product Improvement				Project (Number/Name) DV8 / Patriot Product Improvement					
Management Services (\$ in Millions)				FY 2017		FY 2018		FY 2019 Base		FY 2019 OCO		FY 2019 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	MIPR	RSA, AL : RSA, AL	3.621	2.379	Oct 2016	5.177	Oct 2017	2.538	Oct 2018	-		2.538	Continuing	Continuing	Continuing
U.S. Contracts	Various	Multiple : Multiple	3.761	1.600	Feb 2017	1.600	Feb 2018	1.600	Feb 2019	-		1.600	Continuing	Continuing	Continuing
Subtotal			7.382	3.979		6.777		4.138		-		4.138	Continuing	Continuing	N/A
Product Development (\$ in Millions)				FY 2017		FY 2018		FY 2019 Base		FY 2019 OCO		FY 2019 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
Software Improvement for Threat Evolution	Various	Multiple : Multiple	31.370	7.729	Jan 2017	9.246	Jan 2018	9.018	Jan 2019	-		9.018	Continuing	Continuing	-
Upper Tier Debris Mitigation (UTDM)	Various	Multiple : Multiple	1.000	-		4.000	Jan 2018	-		-		-	Continuing	Continuing	-
Radar Digital Processor (RDP) Development	Various	Raytheon : Andover, Massachusetts	49.835	-		-		-		-		-	0.000	49.835	49.835
RDP Waveform Suite	Various	Raytheon : Andover, Massachusetts	-	-		2.500	Jan 2018	-		-		-	Continuing	Continuing	-
THAAD PATRIOT Interoperability	Various	Raytheon : Andover, Massachusetts	3.200	-		4.000	Jan 2018	-		-		-	Continuing	Continuing	-
Advanced Electronic Counter Measures (AECM)	Various	Multiple : Multiple	41.700	8.304	Jan 2017	15.158	Jan 2018	18.576	Jan 2019	-		18.576	Continuing	Continuing	-
Task 2 Non-Ballistic Tactical Ballistic Missile (TBM)	Various	Multiple : Multiple	24.700	5.400	Feb 2017	8.000	Feb 2018	4.400	Feb 2019	-		4.400	Continuing	Continuing	-
Task 6 Discrimination Improvements	Various	Multiple : Multiple	22.000	6.000	Feb 2017	9.500	Feb 2018	3.700	Feb 2019	-		3.700	Continuing	Continuing	-
Task 7 TBM Countermeasures / Effectors	Various	Multiple : Multiple	13.000	4.000	May 2017	10.700	May 2018	10.000	May 2019	-		10.000	Continuing	Continuing	-
Assured PNT	Various	Multiple : Multiple	-	7.440	Jan 2017	3.600	Jan 2018	3.300	Jan 2019	-		3.300	Continuing	Continuing	-
Combat ID Enhancements	Various	Multiple : Multiple	10.816	4.621	May 2017	9.000	May 2018	11.537	May 2019	-		11.537	Continuing	Continuing	-

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Product Development (\$ in Millions)				FY 2017		FY 2018		FY 2019 Base		FY 2019 OCO		FY 2019 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
Flat Panel Array Concept Development	Various	Multiple : Multiple	3.300	-		-		-		-		-	0.000	3.300	3.300
Anti-Radiation Missile (ARM) Asset Defense	Various	Raytheon : Andover, Massachusetts	2.000	-		3.000	Jan 2018	-		-		-	Continuing	Continuing	-
Tactical Telemetry Ground Station	Various	Multiple : Multiple	-	-		4.036	Jan 2018	-		-		-	Continuing	Continuing	-
Subtotal			202.921	43.494		82.740		60.531		-		60.531	Continuing	Continuing	N/A
Remarks The contract method type Sole Source/Various is Fixed Price Level of Effort which includes Cost Plus Fixed Fee for material, ODC, and travel.															
Test and Evaluation (\$ in Millions)				FY 2017		FY 2018		FY 2019 Base		FY 2019 OCO		FY 2019 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
RDEC and Other Govt Agencies	MIPR	RDEC and OGA'S : RSA, AL	3.912	0.600	Jan 2017	0.700	Jan 2018	0.700	Jan 2019	-		0.700	Continuing	Continuing	Continuing
Subtotal			3.912	0.600		0.700		0.700		-		0.700	Continuing	Continuing	N/A
			Prior Years	FY 2017		FY 2018		FY 2019 Base		FY 2019 OCO		FY 2019 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals			214.215	48.073		90.217		65.369		-		65.369	Continuing	Continuing	N/A
Remarks															

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Exhibit R-4, RDT&E Schedule Profile: PB 2019 Army			Date: February 2018		
Appropriation/Budget Activity 2040 / 7		R-1 Program Element (Number/Name) PE 0607865A / <i>Patriot Product Improvement</i>		Project (Number/Name) DV8 / <i>Patriot Product Improvement</i>	

Event Name	FY 2017				FY 2018				FY 2019				FY 2020				FY 2021				FY 2022				FY 2023			
	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
Software Build																												
Software Build																												
Advanced Electronic Counter Measures (AECM)																												
AECM																												
Software Improvement for Threat Evolution																												
Software Threat																												
Combat ID Enhancements																												
Combat ID Enhancements																												
PDB 8 IOC																												
PDB 8 Fielding																												
PDB 8.1																												
PDB 8.1																												
Task 2 Non-Ballistic Tactical Ballistic Missile (TBM)																												
Task 2 Non-Ballistic TBM																												
Task 6 Discrimination Improvements																												
Task 6 Discrimination Improvements																												
Task 7 TBM Countermeasures / Effectors																												
Task 7 TBM Countermeasures																												
Assured PNT																												
Assured PNT																												
Tactical Telemetry Ground Station																												
Tactical Telemetry Ground Station																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2019 Army			Date: February 2018
Appropriation/Budget Activity 2040 / 7	R-1 Program Element (Number/Name) PE 0607865A / <i>Patriot Product Improvement</i>	Project (Number/Name) DV8 / <i>Patriot Product Improvement</i>	

Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
Software Build	4	2005	4	2023
Advanced Electronic Counter Measures (AECM)	1	2014	4	2023
Software Improvement for Threat Evolution	1	2014	4	2023
Combat ID Enhancements	1	2014	4	2023
PDB 8 IOC	4	2018	4	2018
PDB 8 Fielding	2	2018	4	2022
PDB 8.1	2	2016	4	2022
Radar Digital Processor Development	1	2012	3	2016
Task 2 Non-Ballistic Tactical Ballistic Missile (TBM)	1	2015	4	2023
Task 6 Discrimination Improvements	1	2014	4	2023
Task 7 TBM Countermeasures / Effectors	1	2015	4	2023
Assured PNT	1	2017	4	2021
Lower Tier Air & Missile Defense-Capability (LTAMD-C) Concept Study	1	2014	4	2016
Tactical Telemetry Ground Station	2	2018	4	2023