Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army											Date: May 2017	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603461A *I High Performance Computing Modernization Program*							
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	215.138	177.190	182.331	-	182.331	183.322	186.329	190.046	193.929	-	-
DS7: *High Performance Computing Modernization Program*	-	170.138	177.190	182.331	-	182.331	183.322	186.329	190.046	193.929	-	-
DW5: *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*	-	45.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

The High Performance Computing Modernization Program (HPCMP) addresses the supercomputing requirements of Department of Defense (DoD) scientists and engineers by: (1) demonstrating and maturing the most advanced, leading-edge computational architectures while exploiting the resulting systems by employing complementary specialized expertise; (2) demonstrating and maturing the Defense Research and Engineering Network (DREN), which investigates, demonstrates, and matures leading-edge digital networking and security technologies to securely deliver computational capabilities to the distributed DoD Research, Development, Test, and Evaluation (RDTE) community; and (3) leveraging specialized expertise from DoD, other federal departments and agencies, industry, and academia to demonstrate and mature leading-edge software application codes. DoD Supercomputing Resource Centers (DSRCs) provide extensive computational capabilities to demonstrate and mature emerging technologies that address the supercomputing requirements of the DoD RDTE community in the areas of hardware, software, and programming environments. All HPCMP sites are interconnected to each other, the DoD High Performance Computing (HPC) RDTE community, and other major defense sites via the DREN, a research network which investigates, demonstrates, and matures (a) state-of-the-art digital networking technologies to ensure a robust distributed environment and (b) the most advanced digital security capabilities to protect the intellectual property of the DoD and its contract entities as they employ HPCMP capabilities. The HPCMP's software application effort (a) optimizes, enhances, demonstrates, and matures critical DoD physics-based and engineering software to allow scientists and engineers to execute calculations with precision and efficiency on leading-edge supercomputers, (b) demonstrates and matures immersive collaborative programming environments to improve science and engineering workflows, and (c) demonstrates and matures leading-edge computational technology from academia and industry. These synergistic activities collectively demonstrate and mature horizontal technologies that are exploited across the DoD RDTE community, ensuring the DoD maintains the most advanced research and development ecosystem in computationally-intensive modeling and design.

Work in this Program Element (PE) supports the Army Science and Technology Innovation Enablers Portfolio.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army	Date: May 2017
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603461A *I High Performance Computing Modernization Program*

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	222.159	177.190	182.338	-	182.338
Current President's Budget	215.138	177.190	182.331	-	182.331
Total Adjustments	-7.021	0.000	-0.007	-	-0.007
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-7.021	-			
• Adjustments to Budget Years	0.000	0.000	-0.023	-	-0.023
• Civ Pay Adjustments	0.000	0.000	0.016	-	0.016

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: DW5: *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*		
Congressional Add: *Congressional Increase*	45.000	-
Congressional Add Subtotals for Project: DW5	45.000	-
Congressional Add Totals for all Projects	45.000	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / *High Performance Computing Modernization Program*	Project (Number/Name) DS7 / *High Performance Computing Modernization Program*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
DS7: *High Performance Computing Modernization Program*	-	170.138	177.190	182.331	-	182.331	183.322	186.329	190.046	193.929	-	-

A. Mission Description and Budget Item Justification

The High Performance Computing Modernization Program (HPCMP) addresses the supercomputing requirements of Department of Defense (DoD) scientists and engineers by (1) demonstrating and maturing the most advanced, leading-edge computational architectures and exploiting the resulting systems by employing complementary specialized expertise; (2) demonstrating and maturing the Defense Research and Engineering Network (DREN) which investigates, demonstrates, and matures leading-edge digital networking and security technologies to securely deliver computational capabilities to the distributed DoD Research, Development, Test, and Evaluation (RDTE) community; and (3) leveraging specialized expertise from DoD, other federal departments/agencies, industry, and academia to demonstrate and mature leading-edge software application codes. DoD Supercomputing Resource Centers (DSRCs) provide extensive computational capabilities and demonstrate and mature emerging technologies that address the supercomputing requirements of the DoD RDTE community in the areas of hardware, software, and programming environments. All HPCMP sites are interconnected to each other, the DoD High Performance Computing (HPC) RDTE community, and other major defense sites via DREN, a research network which investigates, demonstrates, and matures (a) state-of-the-art digital networking technologies to ensure a robust distributed environment and (b) the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities as they employ HPCMP advanced capabilities. The HPCMP's software application effort (a) optimizes, enhances, demonstrates, and matures critical DoD physics-based and engineering software to allow scientists and engineers to execute calculations with precision and efficiency on leading-edge supercomputers, (b) demonstrates and matures immersive collaborative programming environments to improve science and engineering workflows, and (c) demonstrates and matures leading-edge computational technology from academia and industry. These synergistic activities collectively demonstrate and mature horizontal technologies that are exploited throughout the DoD RDTE community, ensuring the DoD maintains the most advanced research ecosystem in the areas of computationally-intensive modeling and design.

Work in this Project supports the Army Science and Technology Innovation Enablers Portfolio.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Department of Defense Supercomputing Resource Centers	89.142	94.555	97.298
Description: The effort investigates, demonstrates, and matures general and special-purpose supercomputing environments that incorporate the most advanced, leading-edge computational architectures, distributed mass storage technologies, and data analysis methodologies; employs complementary specialized expertise to mature and exploit these environments; enables the			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
DoD RDTE community to effectively and efficiently investigate, demonstrate, and mature a broad range of technologies through advanced computational methods. ***FY 2016 Accomplishments:*** Refined and exploited the advanced capabilities of 20 (or more) previously demonstrated supercomputers (culminating in the ability to complete 16,900 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the following 11 computational technology areas (CTAs): (1) space and astrophysical sciences, (2) structural mechanics, (3) fluid dynamics, (4) chemistry and materials science, (5) electromagnetics and acoustics, (6) climate/weather/ocean modeling and simulation, (7) signal/image processing, (8) forces modeling and simulation, (9) electronics, networking, and systems, (10) environmental quality, and (11) integrated modeling and test environments; demonstrated the viability of two (or more) large, tightly-integrated supercomputers containing leading-edge (i.e., 2016) processor, memory, disk input/output (I/O), interconnect, and operating system (OS) capabilities (culminating in the ability to complete 10,000 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the 11 CTAs cited above; matured graphical user interface (GUI) access to supercomputers without requiring software to be added to the client machine to allow scientists and engineers located at sites with prohibitive security practices to apply supercomputing to DoD use cases; matured the ability to use both general-purpose and accelerated processors collectively in a single supercomputer (i.e. a hybrid supercomputer) to expand the breadth of DoD use cases that can be addressed by supercomputing; investigated data-intensive supercomputing architectures for DoD use cases in which it is more economical to move (in real-time) the executable code to the data (as opposed to the standard approach of moving the data to the executable code) to expand the breadth of DoD use cases that can be addressed by supercomputing. ***FY 2017 Plans:*** Will refine and exploit the advanced capabilities of 23 (or more) previously demonstrated supercomputers (culminating in the ability to complete 36,400 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the following 11 CTAs: (1) space and astrophysical sciences, (2) structural mechanics, (3) fluid dynamics, (4) chemistry and materials science, (5) electromagnetics and acoustics, (6) climate/weather/ocean modeling and simulation, (7) signal and image processing, (8) forces modeling and simulation, (9) electronics, networking, and systems, (10) environmental quality, and (11) integrated modeling and test environments; will demonstrate the viability of two (or more) large, tightly-integrated supercomputers containing leading-edge (i.e. 2017) processor, memory, disk I/O, interconnect, and OS capabilities (culminating in the ability to complete 11,000 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the 11 CTAs cited above; will further mature GUI access to supercomputers without requiring software to be added to the client machine to allow scientists and engineers at sites with prohibitive security practices to apply supercomputing to DoD use cases; will further mature the ability to use both general-purpose and accelerated processors collectively in a single supercomputer (i.e. a hybrid supercomputer) to expand the breadth of			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
DoD use cases that can be addressed by supercomputing; will mature data-intensive supercomputing architectures for DoD use cases in which it is more economical to move (in real-time) the executable code to the data (as opposed to the standard approach of moving the data to the executable code) to expand the breadth of DoD use cases that can be addressed by supercomputing. ***FY 2018 Plans:*** Will refine and exploit the advanced capabilities of previously demonstrated supercomputers (utilizing the existing capability complete 31,000 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the following 11 CTAs: (1) space and astrophysical sciences, (2) structural mechanics, (3) fluid dynamics, (4) chemistry and materials science, (5) electromagnetics and acoustics, (6) climate/weather/ocean modeling and simulation, (7) signal and image processing, (8) forces modeling and simulation, (9) electronics, networking, and systems, (10) environmental quality, and (11) integrated modeling and test environments. Will demonstrate the viability of two (or more) large, tightly-integrated supercomputers containing leading-edge (i.e. 2018) processor, memory, disk I/O, interconnect, and OS capabilities (adding an additional capability of 11,000 trillion floating point operations per second) to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the 11 CTAs cited above; will further mature GUI access to supercomputers without requiring software to be added to the client machine to allow scientists and engineers at sites with prohibitive security practices to apply supercomputing to DoD use cases; will further mature the ability to use both general purpose and accelerated processors collectively in a single supercomputer (i.e. a hybrid supercomputer) to expand the breadth of DoD use cases that can be addressed by supercomputing; will mature data-intensive supercomputing architectures for DoD use cases in which it is more economical to move (in real-time) the executable code to the data (as opposed to the standard approach of moving the data to the executable code) to expand the breadth of DoD use cases that can be addressed by supercomputing; will mature shared above secret capabilities to address critical DoD mission requirements.			
Title: Defense Research and Engineering Network ***Description:*** This effort investigates, demonstrates, and matures state-of-the-art digital networking technologies to ensure a robust distributed environment among HPCMP sites, the DoD HPC RDTE community, and other major defense sites; investigates, demonstrates, and matures the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities as they employ HPCMP advanced capabilities; employs complementary specialized expertise to mature and exploit this environment. ***FY 2016 Accomplishments:*** Refined and exploited DREN III (an advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDTE communities; refined and exploited the HPCMP's Defense Information Systems Agency (DISA)-accredited Level 3 computer network defense capability to effectively protect the intellectual property of the DoD and its contract entities, when employing HPCMP advanced capabilities; matured the advanced network technologies and complex information assurance mechanisms required to implement logically-separated (as opposed to physically-separated)	30.852	30.402	31.284

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
networking communities-of-interest (COIs); demonstrated hardware architecture and software stack enhancements for network sensors to simultaneously allow (1) active support for the HPCMP's DISA-accredited Level 3 computer network defense capability and (2) active experimentation for novel, adaptive, cyber-security detection and intervention methods; demonstrated (in coordination with White House Office of Science and Technology Policy (OSTP), the National Science Foundation (NSF), and Army Research Laboratory (ARL)) the ability to employ software-defined networks (SDNs) to allow traditional Internet protocol (IP) and experimental protocol networks to coexist within a common DoD networking infrastructure; matured (in collaboration with the DoD Chief Information Officer's Office, United States (U.S.) Cyber Command, the NSA, DISA, and ARL) a DoD enterprise information system continuous monitoring (ISCM) capability to ingest robust, diverse host-based and network-based near-real-time information to provide a persistent situational awareness.			
FY 2017 Plans: Will further refine and exploit DREN III (an advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDTE communities with specific efforts targeted at the unique requirements of the T&E community; will initiate strategic technical planning for DREN IV, a follow-on to DREN III, with next-generation technical capabilities and significantly increased bandwidths to support the HPCMP and DoD RDTE communities; will further refine and exploit the HPCMP's DISA-accredited Level 3 computer network defense capability to effectively protect the intellectual property of the DoD and its contract entities as they utilize HPCMP advanced capabilities; will mature the advanced network technologies and complex cybersecurity mechanisms required to implement logically-separated networked COIs at multiple classification levels; will continue to demonstrate hardware architecture and software stack enhancements for network sensors to simultaneously allow (1) active support for the HPCMP's DISA-accredited Level 3 computer network defense capabilities and (2) active experimentation for novel, adaptive cybersecurity detection and intervention methods; will continue to demonstrate the ability to employ SDNs to allow traditional IP and experimental protocol networks to coexist within a common DoD networking infrastructure; will mature an ISCM capability to ingest robust, diverse, host-based and network-based near-real-time information to provide a persistent situational awareness (SA); will improve cybersecurity methods to aid in the detection of insider threats.			
FY 2018 Plans: Will continue to refine and exploit DREN III (an advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDTE communities with specific efforts targeted at the unique requirements of the Test & Evaluation (T&E) and Acquisition Engineering communities; will continue strategic technical planning and acquisition strategy development for DREN IV, a follow-on to DREN III, with next-generation technical capabilities and significantly increased bandwidths to support the HPCMP and DoD RDTE communities; will continue to refine and exploit the HPCMP's DISA-accredited Tier 2 cybersecurity service provider capability to effectively protect the intellectual property of the DoD and its contract entities as they utilize HPCMP advanced capabilities; will continue to mature the advanced network technologies and complex cybersecurity mechanisms required to implement logically-separated networked COIs at multiple			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
classification levels; will continue to demonstrate hardware architecture and software stack enhancements for network sensors to simultaneously allow (1) active support for the HPCMP's DISA-accredited Tier 2 cybersecurity service provider capabilities and (2) active experimentation for novel, adaptive cybersecurity detection and intervention methods; will continue to demonstrate the ability to employ SDNs to allow traditional IP and experimental protocol networks to coexist within a common DoD networking infrastructure; will continue to mature an ISCM and cyber situational awareness capability to ingest robust, diverse, host-based and network-based near-real-time information by harnessing HPC resources for advanced mission essential task elements; improve cybersecurity methods to aid in the detection of insider threats.			
Title: Software Applications	50.144	52.233	53.749
Description: This effort optimizes, enhances, demonstrates, and matures software applications to provide for the adaptation of widely used applications and algorithms to address RDTE requirements. The Computational Research Engineering Acquisition Tools and Environments (CREATE) initiative demonstrates and matures advanced application codes to allow scientists and engineers to use supercomputers to design and analyze virtual prototypes of DoD ships, fixed-wing aircraft, rotorcraft, ground vehicles, and radio frequency (RF) antennas; HPCMP Institutes demonstrate and mature advanced supercomputing application codes to address critical high-impact DoD challenges (e.g. blast protection for platforms and personnel, high-power microwaves and lasers, munition sensitivities, and mobile network designs/prototypes); High Performance Computing Applications Software Initiative (HASI) projects address the need to mature and refine critical DoD software that can take advantage of new and emerging hardware advances; the Frontier initiative represents and supports the DoD's highest-priority, highest-impact computational work, both from a technical and mission-relevance standpoint; the Productivity, Enhancement, Technology Transfer, and Training (PETTT) initiative (1) optimizes and enhances critical DoD physics-based and engineering software to allow scientists and engineers to execute scientific calculations with precision and efficiency on leading-edge supercomputers, (2) demonstrates and matures immersive collaborative programming environments to improve science and engineering workflows, and (3) demonstrates and matures leading-edge computational technology from academia and industry. ***FY 2016 Accomplishments:*** Matured jet engine propulsion portion of fixed-wing aircraft model to account for engine dynamics under transient flight conditions (i.e., complex maneuvers); matured rotorcraft model to address the intricate maneuvers required to analyze the Joint Multi-Role (JMR) Helicopter (an anticipated replacement for over 4,000 medium-lift helicopters); matured coupled-physics model for conducting analysis of alternatives (AoA) for fixed-wing aircraft concept designs to investigate (a) next generation cargo aircraft (i.e., potential future replacements for the C-130 and C-17) and (b) advanced precision-guided Army parachutes for deployment of equipment and supplies to ground troops; matured RF electromagnetic (EM) model to assess the ability to shrink antennas for F-22s and F-35s using advanced materials (e.g., meta-materials – artificial substances engineered to have properties not found in nature); matured multi-physics ship model to allow refined ship/shock analysis for underwater/surface explosions, capturing the effects of moderate and severe structural damage; matured multi-physics ship model to allow detailed propeller analysis,			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
capturing the effects of cavitation [i.e., the creation of voids/bubbles]; matured model for conducting AoAs for concept ship designs by incorporating cost as a design variable; matured suite of computational models which couple (a) high-fidelity multi-body dynamics simulations for wheeled and tracked vehicles, (b) vehicle powertrain model (i.e., components necessary to generate power and deliver that power to the road/surface), (c) a physics-based model of the surrounding environment to virtually test vehicle mobility across a wide range of scenarios and analyze (d) mobility performance from a driver perspective. Matured model for examining personnel/platform blast protection (e.g. determining blast effects on (a) wheeled APCs and (b) vehicle occupants in support of Occupant Centric Platform (OCP) and Warrior Injury Assessment Manikin (WIAMAN) blast experiments); investigated, demonstrated, and matured computational models via PETTT to address critical DoD HPC RDTE needs by improving the capability and scalability of software to address DoD critical problems in the areas of computational fluid dynamics, computational chemistry and materials, computational structural mechanics, and climate, weather and ocean modeling to optimize utilization of new and emerging hardware configurations.			
FY 2017 Plans: Will mature multi-disciplinary software technology in support of current and future defense programs. For fixed-wing aircraft, this includes, but is not limited to, analysis capabilities for coupled aerodynamics, structural dynamics, propulsion, and flight controls in support of flight certifications (e.g., air worthiness, store carriage and release, etc.) and mission planning for fielded and new systems and associated upgrades. Also, it will support Defense acquisition decisions associated with exploration and design analysis of future manned and unmanned aerial vehicle concepts. For rotorcraft, exemplars include aeromechanics analysis associated with maneuvers, airframe-propulsion system integration, and weapons carriage and release, as well as infrared suppression analysis, chaff trajectory prediction, and debris ingestion analysis. These capabilities are being deployed in support of the Future Vertical Lift (FVL) Program, as well as for sustainment of existing rotorcraft-based programs and associated upgrades, such as the Improved Turbine Engine Program (ITEP). Will mature capability for automated mesh generation for advanced aircraft and for hydrodynamic (steering and resistance) assessments for advanced submarines. Will mature conceptual and early modeling capabilities in sync with detailed design and analyses representations to realize full-lifecycle management of systems and platforms; will further mature computational electromagnetics capabilities to assist in design and evaluation of next generation radar for aircraft, ships, and ground-based platforms; will demonstrate capability for assessment of electromagnetic hazards on ordnance, will optimize computation methods for electronic warfare assessments and evaluation of multiple antenna systems on a single platform; will further mature multi-physics ship model to allow 1) refined ship and shock analysis for underwater/ surface explosions, capturing the effects of moderate and severe structural damage; 2) detailed propeller analysis, capturing the effects of cavitation, i.e., the creation of voids and bubbles; will further mature model for conducting AoAs for concept ship designs by incorporating cost as a design variable. Will further optimize suite of computational models which couple (a) high-fidelity multi-body dynamics simulations for wheeled and tracked vehicles, (b) a vehicle powertrain model (i.e. components necessary to generate power and deliver that power to a surface), (c) a physics-based model of the surrounding environment to virtually test vehicle mobility across a wide range of scenarios, and (d) mobility performance analysis from a driver perspective; will			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603461A / *High Performance Computing Modernization Program*	**Project (Number/Name)** DS7 / *High Performance Computing Modernization Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
further mature model for examining personnel/platform blast protection, e.g. determining blast effects on both wheeled APCs and vehicle occupants in support of OCP and WIAMAN blast experiments. Frontier projects will advance and mature DoD's highest-priority, highest-impact computational efforts, including simulation of hypersonic vehicles, simulation of stratified turbulence to enable predictive modeling of vehicles, sensors, and weapons operating in the ocean and atmosphere, simulation and studies to support development of the Navy's electromagnetic railgun launcher technologies, and three-dimensional simulations of complex engine sprays under real engine conditions. The PETTT initiative will optimize and enhance critical DoD physics-based and engineering software to allow scientists and engineers to execute scientific calculations with precision and efficiency on leading-edge supercomputers. New programming languages, algorithms, computational techniques, workflow environments, and data management and analysis techniques will be used to efficiently leverage the power of next generation supercomputers. ***FY 2018 Plans:*** Will mature multi-disciplinary software technology in support of current and future defense programs. For aeronautical systems of all types (i.e., fixed and rotary-wing aircraft, munitions, missiles, rockets, etc.), this endeavor will mature model-centric conceptual design software technology to support pre Milestone-A Defense acquisition processes, enabling application of physics-based analysis of alternatives, technology trade-space exploration, and cost implications. For fixed-wing aircraft, this will include, but will not be limited to, high-fidelity physics-based analysis capabilities for coupled aerodynamics, structural dynamics, propulsion, and flight controls in support of flight certifications (e.g., air worthiness, store carriage and release, etc.), mission planning for fielded and new systems and associated upgrades, and acquisition decisions associated with exploration and design analysis of future manned and unmanned aerial vehicle concepts. Additionally, it will include implementation of foundational software improvements necessary to begin development of physics-based design analysis tools for future hypersonic weapon systems (High Speed Strike, Tactical Boost-Glide, and Manned/Unmanned Conventional Prompt Global Strike). For rotorcraft, exemplars will include aeromechanics analysis associated with maneuvers, airframe-propulsion system integration, and weapons carriage and release, as well as infrared suppression analysis, chaff trajectory prediction, debris ingestion analysis, and loads prediction capability necessary for structural airworthiness assessments. These capabilities will be deployed in support of the FVL Program, as well as for sustainment of existing rotorcraft-based programs and associated upgrades, such as the ITEP. For RF antenna design analysis, will further mature computational electromagnetics capabilities to assist in design and evaluation of next generation radar for aircraft, ships, and ground-based platforms; will demonstrate capability for assessment of electromagnetic hazards on ordnance and will optimize computational methods for electronic warfare assessments and evaluation of multiple antenna systems on a single platform. For Naval Ships (surface and submarine), will further mature conceptual and early modeling capabilities in sync with detailed design and analyses, to realize full-lifecycle management of systems and platforms, and for conducting AoAs.			
Accomplishments/Planned Programs Subtotals	170.138	177.190	182.331

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / *High Performance Computing Modernization Program*	Project (Number/Name) DW5 / *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
DW5: *HIGH PERF COMP MODERN (HPCM) CONGR ADDS (CAS)*	-	45.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

This is a Fiscal Year 2016 Congressional increase to the High Performance Computing Modernization Program.

This Project enables the Defense Research, Development, Test and Evaluation (RDTE) community to resolve critical scientific and engineering problems more quickly, and with more precision, using advanced, physics-based computer simulation supported by high performance computing (HPC) technology. The computational expertise and resources enable Department of Defense (DoD) personnel to analyze phenomena that are often impossible, not cost effective, too time-consuming, or too dangerous to study any other way. The High Performance Computing Modernization Program (HPCMP) supports the requirements of the DoD's scientists and engineers in three major areas of effort: supercomputing resource centers, the Defense Research and Engineering Network (DREN), and software applications. DoD Supercomputing Resource Centers (DSRCs) provide extensive capabilities and demonstrate new technologies that address user requirements for hardware, software, and programming environments. Efforts of the DSRCs are augmented by dedicated HPC project investments (DHPIs) that address near real-time and real-time HPC requirements. All sites in the HPC Modernization Program are interconnected to one another, the user community, and major defense sites via the DREN, a research network which matures and demonstrates state-of-the-art computer network technologies. The Software Application effort optimizes and improves the performance of critical common DoD applications programs to run efficiently on advanced HPC systems, matures and demonstrates leading-edge computational technology from academic and commercial partners, and provides collaborative programming environments.

Work in this Project supports the Army Science and Technology Innovation Enablers Portfolio.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Plan.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Congressional Increase	45.000	-
FY 2016 Accomplishments: Congressional increase for the High Performance Computing Modernization Program.		
Congressional Adds Subtotals	45.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A