Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army												Date: March 2023
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 2022**	**FY 2023**	**FY 2024 Base**	**FY 2024 OCO**	**FY 2024 Total**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**	**Cost To Complete**	**Total Cost**
Total Program Element	-	222.220	301.964	255.772	-	255.772	259.736	261.100	262.339	265.199	0.000	1,828.330
DS7: *High Performance Computing Modernization Program*	-	182.220	251.964	255.772	-	255.772	259.736	261.100	262.339	265.199	0.000	1,738.330
DW5: *HIGH PERF COMP MODERN (HPCM) (CA)*	-	40.000	50.000	-	-	-	-	-	-	-	0.000	90.000

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.

The research cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	229.123	251.964	254.647	-	254.647
Current President's Budget	222.220	301.964	255.772	-	255.772
Total Adjustments	-6.903	50.000	1.125	-	1.125
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	50.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-6.903	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	1.125	-	1.125

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2022	FY 2023
Project: DW5: *HIGH PERF COMP MODERN (HPCM) (CA)*		
Congressional Add: *Program increase*	40.000	50.000
Congressional Add Subtotals for Project: DW5	40.000	50.000
Congressional Add Totals for all Projects	40.000	50.000

Change Summary Explanation

Increased funding due to revised economic assumptions.

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army			Date: March 2023
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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DS7: *High Performance Computing Modernization Program*	-	182.220	251.964	255.772	-	255.772	259.736	261.100	262.339	265.199	0.000	1,738.330
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

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) and acquisition engineering communities; 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 and acquisition engineering communities in the areas of hardware, software, and programming environments. 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 and acquisition engineering communities, ensuring the DoD maintains the most advanced research ecosystem in the areas of computationally-intensive modeling and design.

The research cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Engineer Research and Development Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2022	FY 2023	FY 2024
Title: Department of Defense Supercomputing Resource Centers	92.880	139.101	146.387
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: PB 2024 Army		Date: March 2023
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 2022	FY 2023	FY 2024
DoD RDTE and acquisition engineering communities to effectively and efficiently investigate, demonstrate, and mature a broad range of technologies through advanced computational methods. ***FY 2023 Plans:*** Accelerate the integration of commercial cloud computing, with the goal of making it broadly available to the entire HPCMP user community. Continue to integrate data-centric center methodologies into our supercomputing centers to improve the ability to rapidly extract information from complex computations. Continue to accelerate technology capabilities with a suite of supercomputers and high-end computing services to address DoD priorities that satisfy the diverse needs of DoD stakeholders including security, workload, and architecture requirements. Continue to demonstrate the potential benefits of emerging High End Computing technologies including multiple architectures (scientific, analytics, machine learning, etc.) that incorporate leading-edge processors, accelerators, memory, data I/0, interconnect, and OS capabilities. Continue to demonstrate new mechanisms to access and reduce barriers to supercomputers for non-traditional users and establish mechanisms for establishing hybrid cloud connectivity for HEC workflows. Continue to leverage data-intensive supercomputing architectures for DoD use cases in machine learning, artificial intelligence, and data sciences. Implement new capabilities for secure shared highly-classified supercomputing, transportable data-intensive computing at the tactical edge, and persistent data services. Add additional capacity and capability in HPC through strategic retention of HPC assets and conduct pilot projects for burst to commercial cloud computing. ***FY 2024 Plans:*** Will mature and demonstrate over 20 high-end computers across a full range of classifications at five geographically distributed DoD supercomputing resource centers to collectively provide between 110 and 115 quadrillion floating-point operations per second of capability. Will continue to conduct complex, tightly-coupled, large-scale, scientific and engineering simulations and analyses that mature and demonstrate capabilities for important DoD research, test, and development priorities. Will mature and demonstrate emerging data-intensive computing and persistent data services for DoD use cases. Will continue to mature new technologies for accelerating computations, storing/retrieving large volumes of data (over 200 quadrillion bytes in total), and providing on-demand and secure access to high-end computers. Will mature appropriate, approved solutions for sharing highly classified high-end computers among multiple special programs. Will mature and demonstrate seamless sharing of resources across DSRCs and transparent interfaces with cloud computing services for those DoD entities that demand a hybrid compute capability. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** Funding increase reflects the planned lifecycle of this effort.			
Title: Defense Research and Engineering Network	37.647	52.739	55.501
Description: The DREN 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 and acquisition engineering communities, and			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
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 2022	FY 2023	FY 2024
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 2023 Plans:*** Continue to refine and exploit DREN (an advanced digital DoD wide area research network and part of the DoDIN backbone) which provides robust, high-bandwidth, low-latency, low-jitter, and full-service network connectivity among the HPCMP and DoD RDTE/Acquisition Engineering (AE) communities with specific efforts targeted at the unique requirements of the T&E and AE communities. Complete transition activities for DREN 4. DREN 4 is the follow-on contract to DREN III, and will provide next-generation technical capabilities and significantly increased bandwidths to support the HPCMP and DoD RDTE/AE communities. Continue to enhance and refine the protection of all external DREN boundaries to enhance 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. Continue to establish and enhance network transport to the commercial cloud for those HPCMP and DoD RDTE/AE communities moving computation, data storage, and other requirements to the cloud environment. Continue to mature the advanced network technologies and complex cybersecurity mechanisms required to implement logically-separated networked COIs at multiple classification levels. Removal of DREN under-provisioning. ***FY 2024 Plans:*** Will mature and demonstrate secure, advanced networking across a full range of classifications to provide over 1500 Gigabits per second of aggregate bandwidth to more than 215 CONUS and 12 OCONUS sites to implement computational workflows that employ various combinations of high-end computing resources, research assets, test center devices, weapon/platform prototypes, and live participants to mature and demonstrate capabilities for important DoD research, test, and engineering priorities. Will expand DREN installation in the Pacific and other regions of interest to meet test requirements in response to emerging threats. Will continue to mature and enhance the secure protection of DREN from external and internal threats to effectively protect the intellectual property of the DoD and its contract entities engaged in research, test, and engineering missions. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** Funding increase reflects the planned lifecycle of this effort.			
Title: Software Applications ***Description:*** This effort optimizes, enhances, demonstrates, and matures software applications to provide for the adaptation of widely used applications and algorithms to address RDTE and acquisition engineering communities 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	51.693	51.202	53.884

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
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 2022	FY 2023	FY 2024
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, most demanding 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 2023 Plans: Continue to mature and advance multi-disciplinary software technology in support of current and future defense programs, building a foundation for powerful decision support applications synthesized using advanced machine learning methodologies. Multi-disciplinary technology for aeronautical systems of all types (i.e., fixed and rotary-wing aircraft, munitions, missiles, rockets, etc.), this endeavor will continue to mature model-centric conceptual design software technology to support high-fidelity digital simulations of weapons and weapon support systems across the product lifecycle. This application of physics-based analysis of alternatives, technology trade-space exploration, and analysis of cost implications will improve application. Continue mature software improvements necessary to deploy production quality physics-based design analysis tools for future hypersonic weapon systems (High Speed Strike, Tactical Boost-Glide, and Manned/Unmanned Conventional Prompt Global Strike). For fixed-wing aircraft, a) continue incorporating new generation of high order accuracy solvers; b) continue implementing hypersonic terminal maneuvers; and c) continue incorporating hypersonic long-duration/heat soak algorithms. For rotorcraft, will continue 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. RF antenna design and analysis will continue to mature computational electromagnetics capabilities to assist in design and evaluation of next generation radar for aircraft, ships, and ground-based platforms; continue demonstrating capability for assessment of electromagnetic hazards on ordnance and optimizing computational methods for electronic warfare assessments and evaluation of multiple antenna systems on a single platform a specific area of focus will be the application of antenna evaluation software on naval platforms. Continue to include efforts in aircraft radar signature prediction capabilities that effectively include propulsion system inlet and exhaust critical to design and evaluation of 6th generation fighter/attack aircraft. Continue efforts to incorporate high-resolution (XBand frequencies) virtual test and analysis capabilities for fighter-scale aircraft. For Naval Ships (surface and submarine), continue incorporation of; a) hullform optimization; b) multi-hull seakeeping capabilities; and c) virtual ship powering algorithms. Continue to incorporate 6-D0F submarine maneuvering. Continue development of ship shock virtual test and analysis capabilities incorporating the			

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
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 2022	FY 2023	FY 2024
results of recent CVN-78 shock trials in preparation for establishing alternatives for future ship classes including FFG-62. For Ground Vehicles continue to expand autonomy capabilities associated with ground mobility test requirements. Execute fact finding investigations to understand how physics-informed machine learning more fully can impact DoD priorities and effectively support decision makers throughout weapon system development, deployment, and operation life-cycle. Reintroduction of in-situ HEC subject matter experts to improve S&T efforts directly supporting technology transfer into programs of record and prototype efforts. ***FY 2024 Plans:*** Will mature and demonstrate 12 software applications for high-end computers to be used by over 150 DoD stakeholder organizations in air, land, and sea programs of record (PORs) as well as future concept development for DoD's highest priorities. Will mature and demonstrate software tools and environments for high-end computers and provide training to over 3000 users to improve resource effectiveness and impact. Will mature software applications for the operation of DSRC high-end computers in support of over 2000 users and operational staff. ***FY 2023 to FY 2024 Increase/Decrease Statement:*** Funding increase reflects the planned lifecycle of this effort.			
Title: SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC §638 ***FY 2023 Plans:*** Funding transferred in accordance with Title 15 USC §638 ***FY 2023 to FY 2024 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC §638	-	8.922	-
Accomplishments/Planned Programs Subtotals	182.220	251.964	255.772

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army			Date: March 2023
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) (CA)*	

COST ($ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DW5: *HIGH PERF COMP MODERN (HPCM) (CA)*	-	40.000	50.000	-	-	-	-	-	-	-	0.000	90.000
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project enables the Defense Research, Development, Test and Evaluation (RDT&E) 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.

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2022	FY 2023
Congressional Add: Program increase	40.000	50.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for High Performance Computing Modernization Program		
FY 2023 Plans: Congressional Interest Item funding provided for High Performance Computing Modernization Program		
Congressional Adds Subtotals	40.000	50.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
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) (CA)*

D. Acquisition Strategy

N/A