

OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

APPROPRIATION/ BUDGET ACTIVITY
RDTE, Defense Wide BA 03

PE NUMBER AND TITLE
0603755D8Z - High Performance Computing Modernization Program

COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total Program Element (PE) Cost	198.367	205.017	208.079	215.278	200.933	211.363	218.506
P507 High Performance Computing Modernization Program (HPCMP)	198.367	205.017	208.079	215.278	200.933	211.363	218.506

A. Mission Description and Budget Item Justification: The Department of Defense (DoD) High Performance Computing (HPC) Modernization Program (HPCMP) supports warfighter needs for technological superiority and military dominance on the battlefield by providing advanced computational services to U.S. weapons system scientists and engineers. Exploiting continuous HPC technology advances, the DoD research, development, test and evaluation (RDT&E) community is able to resolve critical scientific and engineering problems more quickly and with more precision. This feeds directly into the acquisition process by improving weapons system designs through an increased fundamental understanding of materials, aerodynamics, chemistry, fuels, acoustics, signal image recognition, electromagnetics, and other areas of basic and applied research as well as enabling advanced test and evaluation (T&E) environments that allow synthetic scene generation, automatic control systems and virtual test environments. HPC has been identified as a key enabling technology essential to achieving the DoD's science and technology (S&T) and T&E objectives.

The HPCMP supports four major shared resource supercomputing centers (MSRCs) and two allocated distributed centers (ADCs) established by congressional direction are also partially supported (Arctic Region Supercomputing Center, Fairbanks, AK; Maui High Performance Computing Center, Maui, HI). Two other congressionally established ADCs that provide supercomputing services to the DoD do not receive HPCMP support; the Army High Performance Computing Research Center, Minneapolis, MN and the Space and Missile Defense Command, Huntsville, AL receive Army operational support. Prior to FY 2008, smaller, special-purpose dedicated distributed centers were annually established or upgraded through a competitive selection process. These centers are retired as their systems become obsolete and funding for specialized programs is now provided through dedicated HPC project investments (DHPCPIs). DHPCPIs support a one-time need with no legacy in the HPCMP. Centers and DHPCPIs directly support the DoD S&T and T&E laboratories and test centers and are accessible to local and remote scientists and engineers via high-speed network access. In FY 2009 and continuing into FY 2010, the significant investments will be made in mass data storage systems to replace systems reaching the end of their useful life. An integral part of the program is providing for the adaptation of broadband, widely used applications and algorithms to address S&T and T&E requirements, along with continued training of users in new system designs and concepts. The HPCMP pursues continuous interaction with the national HPC infrastructure, including academia, industry, and other government agencies to facilitate sharing of knowledge, tools, and expertise.

HPCMP users average more than 5,000 scientists and engineers at approximately 180 locations (DoD Laboratories, Test Centers, academic institutions and commercial businesses). The integrated HPCMP consists of Shared Resource Centers; the Defense Research and Engineering Network; and Software Application Support. MSRCs are responsible for as large a part of DoD's S&T and T&E computational workload as feasible providing extensive capabilities to address user requirements for hardware, software, and programming environments. ADCs and DHPCPIs augment the MSRCs to form total HPCMP computational capability. DHPCPIs address critical HPC requirements that cannot be met at MSRCs, such as real-time, and near real-time computing requirements, and leverage significant HPC and mission expertise located at these remote sites. All elements of the HPCMP are interconnected with all S&T and T&E user sites via the Defense Research and Engineering Network. The Software Application Support component develops critical common DoD applications programs that run efficiently on advanced HPC systems, supports technology transition activities with academic and commercial institutions, trains users, builds collaborative programming environments, and develops mechanisms to protect high value HPC application codes. Additional funding for Computational Research and Engineering Acquisition Tools and Environments (CREATE) has been provided by the DoD, beginning in FY 2008. CREATE will produce supercomputer-based engineering design and test tools improving the acquisition process for major weapons systems across the DoD.

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Modernization of DoD HPC capability and fulfillment of the program's vision and goals requires an on-going strategy that addresses all HPC aspects. While advancing the level of hardware performance is critical to success, the higher objective is enabling better scientific research, test and evaluation environments, and technology development for superior weapons, warfighting, and related support systems. Program goals are to acquire, deploy, operate and maintain best-value supercomputers; acquire, develop, deploy and support software applications and computational work environments that enable critical DoD research, development and test challenges to be analyzed and solved; acquire, deploy, operate and maintain a communications network that enables effective access to supercomputers and to distributed S&T/T&E computing environments; continuously educate the RDT&E workforce with the knowledge needed to employ computational modeling effectively and efficiently; and promote collaborative relationships among the DoD and the national computational science communities, and minority serving institutes.

<u>B. Program Change Summary</u>	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008)	208.463	187.587	208.488
Current BES/President's Budget (FY 2009)	198.367	205.017	208.079
Total Adjustments	-10.096	17.430	-0.409
Congressional Program Reductions		-1.790	
Congressional Rescissions			
Congressional Increases		19.220	
Reprogrammings	-5.603		
SBIR/STTR Transfer	-4.436		
Other	-0.057		-0.409

<u>C. Other Program Funding Summary</u>	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
0902198DZ Major Equipment OSD	50.089	50.784	52.565	53.959	56.290	57.029	57.831

Comment: FY 2007 funds provided upgrades to the following DHPCPIs through the annual competitive process mentioned earlier: Joint Air Force Weather Agency, Offutt AFB, NE / Fleet Numerical Meteorology & Oceanography Center, Monterey, CA; U.S. Joint Forces Command, Norfolk, VA; and the Naval research Laboratory, Washington, DC. Funding exists in the 2008 Procurement budget to provide for approximately four Dedicated High Performance Computing Project Investments.

In FY 2007 two MSRCs were upgraded and funding exists in the FY 2008 Procurement budget to upgrade 2 centers. The four MSRCs are: Army Research Laboratory (ARL),

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Aberdeen Proving Grounds, MD; Aeronautical Systems Center (ASC), Wright-Patterson AFB, OH; US Army Engineer Research and Development Center, Vicksburg, MS; and Naval Research Laboratory, Washington, DC.

D. Acquisition Strategy Not applicable for this item.

E. Performance Metrics: Not Applicable.

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COST (\$ in Millions)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
P507 High Performance Computing Modernization Program	198.367	205.017	208.079	215.278	200.933	211.363	218.506	

A. Mission Description and Budget Item Justification: The Department of Defense (DoD) High Performance Computing (HPC) Modernization Program supports the needs of the warfighter for technological superiority and military dominance on the battlefield by providing advanced computational services to U.S. weapons system scientists and engineers. By exploiting continuous advances in HPC technology, the defense research, development, test and evaluation (RDT&E) community is able to resolve critical scientific and engineering problems more quickly and with more precision. The results of these efforts feed directly into the acquisition process by improving weapons system designs through an increased fundamental understanding of materials, aerodynamics, chemistry, fuels, acoustics, signal image recognition, electromagnetics, and other areas of basic and applied research as well as enabling advanced test and evaluation environments that allow synthetic scene generation, automatic control systems and virtual test environments. As such, HPC has been identified as a key enabling technology essential to achieving the objectives of the DoD's science and technology (S&T) and test and evaluation (T&E) programs.

The HPC Modernization Program supports four major shared resource supercomputing centers (MSRCs). The program also partially supports operations at two allocated distributed centers (ADCs) established by congressional direction. These centers are the Arctic Region Supercomputing Center (ARSC), Fairbanks, AK and the Maui High Performance Computing Center, Maui, HI. Two other ADCs, also congressionally established, do not receive programmed support through HPC Modernization Program funding, but provide supercomputing services to the DoD. The Army High Performance Computing Research Center (AHPCRC), Minneapolis, MN and the Space and Missile Defense Command, Huntsville, AL, receive their support for operations through the Army. During FY2006 and prior years, there were also several smaller, special-purpose dedicated distributed centers (DDCs) that were annually established or upgraded based through a competitive selection process. However, these other centers were retired as their systems became obsolete and funding for specialized programs is currently provided through dedicated HPC project investments (DHPCPIs). DHPCPIs support a one-time need and have no legacy within the HPC Modernization Program. Centers and DHPCPIs directly support the DoD S&T and T&E laboratories and test centers and are accessible to local and remote scientists and engineers via high-speed network access. An integral part of the program is providing for the adaptation of broadband, widely used applications and algorithms to address S&T and T&E requirements, along with continued training of users as new system designs and concepts evolve. The program pursues continuous interaction with the national HPC infrastructure, including academia, industry, and other government agencies to facilitate the sharing of knowledge, tools, and expertise.

The HPC Modernization Program user base includes an average of more than 5,000 scientists and engineers at approximately 180 locations (DoD Laboratories and Test Centers, academic institutions and commercial businesses). The integrated HPC program consists of Shared Resource Centers; the Defense Research and Engineering Network; and Software Application Support. MSRCs are responsible for as large a fraction of DoD's S&T and T&E computational workload as feasible. MSRCs provide extensive capabilities to address user requirements for hardware, software, and programming environments. ADCs, and DHPCPIs augment the MSRCs to form the total HPC Modernization Program computational capability. DHPCPIs address critical HPC requirements that cannot be met at MSRCs, such as real-time, and near real-time computing requirements, and leverage significant HPC and mission expertise located at these remote sites. All elements of the HPC Modernization Program are interconnected with all S&T and T&E user sites via the Defense Research and Engineering Network (DREN). Additionally, the Software Application Support component develops critical common DoD applications programs that run efficiently on advanced HPC systems, supports technology transition activities with academic and commercial institutions, trains users, builds collaborative programming

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environments, and develops mechanisms to protect high value HPC application codes. True modernization of DoD's HPC capability and fulfillment of the program's vision and goals requires an on-going program strategy that addresses all aspects of HPC. While advancing the level of hardware performance is critical to success, the higher objective is to enable better scientific research, test and evaluation environments, and technology development for superior weapons, warfighting, and related support systems. The Program goals are to (1) Acquire, deploy, operate and maintain best-value supercomputers; (2) Acquire, develop, deploy and support software applications and computational work environments that enable critical DoD research, development and test challenges to be analyzed and solved; (3) Acquire, deploy, operate and maintain a communications network that enables effective access to supercomputers and to distributed S&T/T&E computing environments; (4) Continuously educate the RDT&E workforce with the knowledge needed to employ computational modeling effectively and efficiently; and (5) Promote collaborative relationships among the DoD computational science community, the national computational science community and minority serving institutes.

The DREN provides wide area network (WAN) connectivity among the Department's S&T and T&E communities. The DREN is implemented through an Intersite Services Contract awarded to MCI (WORLDCOM) during FY 2002. DREN currently provides services to sites throughout the continental United States, Alaska, Hawaii, and can be extended overseas where necessary. Minimal access is DS-3 (45 Mbps) with potential high-end access of OC-768 (40 Gbps) over the next 7 years. Current site connectivity ranges from DS-3 to OC-48 (2 Gbps). A Secret DREN using common Secret systems high key with NSA certified Type-1 encryptors that can transport classified traffic at OC-3 (155 Mbps) has also been deployed. The HPC Modernization Program employs state-of-the-art WAN security and strong host and user security creating a defense-in-depth security architecture.

B. Accomplishments/Planned Program:

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Selected Resource Centers:	102.371	110.935	102.373

FY2007 Accomplishments: The program sustained and supported the integration, operation and use of HPC computational resources at four Major Shared Resource Centers. The program also partially sustained and supported the integration, operation and use of HPC computational resources at two Allocated Distributed Centers.

FY 2008/2009 Plans: Since 1994, the program has sustained and regularly modernized HPC systems, storage, and scientific data analysis and visualization capabilities to fulfill a significant portion of the science and technology (S&T) and test and evaluation (T&E) community HPC requirements. For several years two other Allocated Distributed Centers, sustained and supported by the Army have received modernization funding through congressional adjustments to the program's annual budget request. These efforts are planned to continue into future years with no set completion date. Beginning in FY 2009 and continuing into FY 2010, the program will make significant investments in mass data storage systems to replace systems that will reach the end of their life cycle.

<u>Accomplishments/Planned Program Title:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Networking:	32.739	28.157	29.682

FY2007 Accomplishments: The DREN provided high speed wide area network services to over 130 locations throughout the United States. Also, the DREN expanded internet protocol version 6 (IPv-6) testing for the Department of Defense and upgraded full point-to-point encryption of the network. DREN continued collaborative work with the federal networking community and standards associations.

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FY 2008/2009 Plans: Network services to link all elements of the program will be provided by the Defense Research and Engineering Network (DREN) as well as operation of security systems and enhancements. Collaborative work with the federal networking community and standards associations will continue to assure that the DREN will remain compatible with future technology change. These efforts are planned to continue into future years with no set completion date.

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

Software Applications:

57.244

65.925

76.024

FY2007 Accomplishments: Development efforts in software programs continued to mature as other projects were completed, and others begun. Software Institutes and portfolios developed shared scalable applications to exploit scalable HPC assets. An Academic Outreach Program was supported to encourage and support computational science in universities across the United States. The User Productivity Enhancement and Technology Transfer (PET) effort provided computational and computer science support to the DoD HPC user community through interaction and collaborative projects with academic and industrial partners. Efforts were maintained in to develop technologies and methodologies to protect and limit end-use of high performance computing applications software while minimizing the burden on authorized end-users.

FY 2008/2009 Plans: Additional program funding for Computational Research and Engineering Acquisition Tools and Environments (CREATE) has been provided by the DoD, beginning in FY2008. CREATE will produce supercomputer-based engineering design and test tools to improve the acquisition process for major weapons systems across the Department. Development efforts in software programs will continue to mature as other projects are completed, and others begun with a greater emphasis on engineering applications. Software Institutes and portfolios will continue to develop shared scalable applications to exploit scalable HPC assets. An Academic Outreach Program will continue be supported to encourage and support computational science in universities across the United States. The Programming Environments and Training effort will provide computational and computer science support to the DoD HPC user community through interaction and collaborative projects with academic and industrial partners. On-going efforts will be maintained to develop technologies and methodologies to protect and limit end-use of high performance computing applications software while minimizing the burden on authorized end-users. These efforts are planned to continue into future years with no set completion date.

Accomplishments/Planned Program Title:

FY 2007

FY 2008

FY 2009

C. Other Program Funding Summary

FY 2007

FY 2008

FY 2009

FY 2010

FY 2011

FY 2012

FY 2013

0902198DZ Major Equipment OSD

50.089

50.784

52.565

53.959

56.290

57.029

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Comment: Comment: The following DHPCPIs were also provided upgrades with FY2007 procurement funding through the annual competitive process mentioned earlier: Joint Air Force Weather Agency, Offutt AFB, NE / Fleet Numerical Meteorology & Oceanography Center, Monterey, CA; U.S. Joint Forces Command, Norfolk, VA; and the Naval Research Laboratory, Washington, DC. Funding exists in the FY2008 procurement budget to provide for approximately four DHPCPIs.

In FY 2007 two MSRCs were upgraded and funding exists in the FY 2008 Procurement budget to upgrade 2 centers. The four MSRCs are: Army Research Laboratory (ARL), Aberdeen Proving Grounds, MD; Aeronautical Systems Center (ASC), Wright-Patterson AFB, OH; US Army Engineer Research and Development Center, Vicksburg, MS; and Naval Oceanographic Office, Stennis Space Center, MS.

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D. Acquisition Strategy Not applicable for this item.

E. Major Performers Not applicable for this item.