

**Fiscal Year (FY) 2005 Budget Estimates
Exhibit R-2, RDT&E Budget Item Justification**

February 2004

Appropriation/Budget Activity RDT&E, D BA3				R-1 Item Nomenclature: High Performance Computing Modernization Program PE-0603755D8Z				
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Cost (\$ in millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Total PE Cost	185.221	202.492	186.666	191.114	193.090	196.715	200.211

A. Mission Description and Budget Item Justification:

BRIEF DESCRIPTION OF ELEMENT

The Department of Defense (DoD) High Performance Computing (HPC) Program (HPCP) 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 high performance computing 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 HPCP has established and supports four major shared resource supercomputing centers (MSRCs) as well as several smaller, special-purpose distributed supercomputing centers (DCs). These centers 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 HPCP user base includes 4,320 Scientists and Engineers at over 100 sites (Department of Defense 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. The MSRCs are responsible for as large a fraction of DoD's S&T and T&E computational workload as feasible. These MSRCs provide extensive capabilities to address user requirements for hardware, software, and programming environments. A limited set of smaller shared resource centers, Distributed Centers (DCs), augment the MSRCs to form the total HPCP computational capability. Distributed Centers 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. The MSRCs and DCs are currently interconnected with all S&T and T&E user sites via the Defense Research and Engineering Network (DREN). Additionally, the Software Application Support Initiative 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 environment, 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 goals of the HPCP are to:

- Provide the best commercially available high-end HPC capability.
- Acquire and develop joint-need HPC applications, software tools and programming environments.
- Educate and train DoD's scientists and engineers to effectively use advanced computational environments.
- Link users and computer sites via high-capacity networks, facilitating user access and distributed computing environments.
- Promote collaborative relationships among the DoD HPC community, the National HPC community and MSIs in network, computer and computational science.

There are currently 13 distributed centers. In FY 2003 five existing centers were upgraded, and funding exists in the 2004 Procurement budget to upgrade or establish approximately four distributed centers. Currently supported distributed centers and their locations are as follows:

- Aberdeen Test Center, Aberdeen, MD
- Air Force Research Laboratory/ Information Directorate (AFRL/IF), Rome, NY
- Army High Performance Computing Research Center (AHPCRC), Minneapolis, MN
- Arnold Engineering Development Center (AEDC), Arnold AFB, TN
- Arctic Region Supercomputing Center (ARSC), Fairbanks, AK
- Fleet Numerical Meteorology and Oceanography Center, Monterey, CA
- Joint Forces Command (J9), Wright-Patterson AFB, OH and Maui, HI
- Maui High Performance Computing Center (MHPCC), Maui, HI
- Naval Air Warfare Center - Aircraft Division (NAWC-AD), Patuxent River NAS, MD
- Naval Research Laboratory (NRL-DC), Washington, DC
- Redstone Technical Test Center, Huntsville, AL
- Space and Missile Defense Command (SMDC), Huntsville, AL
- Space and Naval Warfare Systems Center, San Diego, San Diego, CA

In FY03 two MSRCs were upgraded and funding exists in the 2004 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
- Naval Oceanographic Office, Stennis Space Center, MS

The Defense Research and Engineering Network (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 9 years. Current site connectivity ranges from DS-3 to OC-12 (622 Mbps), with the four MSRCs moving to OC-48 during FY04. 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 HPCMP employs state-of-the-art WAN security as well as strong host and user security creating a Defense-In-Depth security architecture.

B. Program Change Summary: The Program was transferred by direction of Congress from the Department of the Air Force to the Department of Defense for FY 2004 execution.

	<u>FY 2003</u>	<u>FY 2004</u>	<u>FY 2005</u>
Previous President's Budget	209.642	0	0
Current FY 2005 President's Budget	185.221	202.492	186.666
Total Adjustments	24.421	202.492	186.666
Congressional program reductions	-7.986	-2.990	
Congressional rescissions			
Congressional increases		205.482	186.911
Reprogrammings	-12.858	-.245	
SBIR/STTR Transfer	-3.577		
Other			-.245

* The FY 2004 President's Budget Request (PBR) reflected the transfer of this program to the Air Force. Congressional action denied this transfer.

**Fiscal Year (FY) 2005 Budget Estimates
Exhibit R-2a, RDT&E Project Justification**

February 2004

Appropriation/Budget Activity RDT&E, D BA3				Project Name and Number High Performance Computing, PE-0603755D8Z				
Cost (\$ in millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	
High Performance Computing	185.221	202.492	186.666	191.114	193.090	196.715	200.211	

A. BRIEF DESCRIPTION OF ELEMENT

The Department of Defense (DoD) High Performance Computing (HPC) Program (HPCP) 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.

The HPCP has established and supports four major shared resource supercomputing centers (MSRCs) as well as several smaller, special-purpose distributed supercomputing centers (DCs).

The HPCP user base includes 4,320 Scientists and Engineers at over 100 sites (Department of Defense Laboratories and Test Centers, academic institutions and commercial businesses). The integrated HPC program consists of Shared Resource Centers.

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.

There are currently 13 distributed centers. In FY 2003 five existing centers were upgraded, and funding exists in the 2004 Procurement budget to upgrade or establish approximately four distributed centers.

In FY03 two MSRCs were upgraded and funding exists in the 2004 Procurement budget to upgrade 2 centers.

The Defense Research and Engineering Network (DREN) provides wide area network (WAN) connectivity among the Department's S&T and T&E communities.

The HPCMP employs state-of-the-art WAN security as well as strong host and user security creating a Defense-In-Depth security architecture.

B. Accomplishments/Planned Program

Shared Resource Centers	FY 2003	FY 2004	FY 2005
Accomplishment/ Effort/Subtotal Cost	104.126	120.372	99.368

FY 2003 Accomplishments:

Shared Resource Centers: The program sustained existing capability and continued modernizing 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. Acquisition activities for follow-on technical support contracts at the MSRCs were completed.

MSRC Sustainment: The program sustained and supported the integration, operation and use of HPC computational resources at the four MSRCs. (\$79.401 million)

Distributed Center Sustainment: Due to program funding limitations recognized in 1996, a decision was made to typically only support investments in HPC systems at new or existing DCs with HPCP procurement funding. In return for the HPCMP investment, the DC organization agrees to appropriately fund the sustainment and operations of the HPCP equipment located at the site. There are two exceptions. The program budget includes funds for sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center in FY 2002. (\$24.725 million)

FY 2004 Plans:

Shared Resource Centers: The program sustained existing capability and continued modernizing 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.

MSRC Sustainment: The program will sustain and support the integration, operation, and use of HPC computational resources at the four MSRCs. (\$ 78.106 million)

Distributed Center Sustainment: Due to program funding limitations recognized in 1996, a decision was made to typically only support investments in HPC systems at new or existing DCs with HPCP procurement funding. In return for the HPCP investment, the DC organization agrees to appropriately fund the sustainment and operations of the HPCP equipment located at the site. There are two exceptions. The program budget includes funds for sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center. FY 2004 funding was increased \$18.100 million by Congress. (\$ 42.266 million)

FY 2005 Plans:

Shared Resource Centers: The program sustained existing capability and continued modernizing 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.

MSRC Sustainment: The program will sustain and support the integration, operation and use of HPC computational resources at the four MSRCs. (\$76.833 million)

Distributed Center Sustainment: Due to program funding limitations recognized in 1996, a decision was made to typically only support investments in HPC systems at new or existing DC with HPCP procurement funding. In return for the HPCP investment, the DC organization agreed to appropriately fund the sustainment and operations of the HPCP equipment located at the site. There are two exceptions. The program budget includes funds for sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center. (\$22.535 million)

Defense Research and Engineering Network	FY 2003	FY 2004	FY 2005	
Accomplishment/ Effort/Subtotal Cost	31.697	32.554	29.347	

FY 2003 Accomplishments:

Operation of security systems and enhancements continued. Collaborative work continued with the Federal networking community and standards associations to assure DREN remained compatible with future technology change. A follow-on contract was awarded to MCI WorldCom Communications, Inc; however, transition of network services was delayed into FY2003 due to protests, but completed. DREN was configured to support an IPv6 Test bed in support DoD IPv6 transition testing needs.

FY 2004 Plans:

Network services will be provided. Operation of security systems and enhancements will continue. The DREN will expand internet protocol (IPv-6) testing for the Department of Defense and upgrade to full point-to-point encryption of the network. Collaborative work will continue with the Federal networking community and standards associations to assure DREN remains compatible with future technology change.

FY 2005 Plans:

Network services will be provided. Operation of security systems and enhancements will continue. Collaborative work will continue with the Federal networking community and standards associations to assure DREN remains compatible with future technology change.

Software Applications Support	FY 2003	FY 2004	FY 2005	
Accomplishment/ Effort/Subtotal Cost	49.398	49.566	57.951	

FY 2003 Accomplishments:

Development efforts in the CHSSI program continued to mature as some CHSSI projects were completed, and others begun. The CHSSI projects continued developing shared scalable applications to exploit scalable HPC assets. The Programming Environments and Training effort continued to provide computational and computer science support to the DoD HPC user community through interaction and collaborative projects with academic and industrial partners. A program was established 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. This effort is intended to strengthen DoD's protection mechanisms thus reducing the risk that these high value applications could be employed by an unauthorized user.

FY 2004 Plans:

Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others begin. A new Academic Outreach Program will be implemented to encourage and support computational science in universities across the United States. New CHSSI Institutes will be created to better develop shared scalable applications to exploit scalable HPC assets. The Programming Environments and Training effort will continue to provide computational and computer science support to the DoD HPC user community through interaction and collaborative projects with academic and industrial partners. Efforts will continue 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 2005 Plans:

Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others begin. The CHSSI projects will continue developing shared scalable applications to exploit scalable HPC assets. The Programming Environments and Training effort will continue to provide computational and computer science support to the DoD HPC user community through interaction and collaborative projects with academic and industrial partners. Efforts will continue 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.

C. Other Program Funding Summary:

		FY 2003	FY 2004	FY2005 ¹	FY 2006 ²	FY 2007	FY2008	FY2009
0902198DZ	Major Equipment OSD	47,212	48,535	50,147	51,018	52,111	53,490	54,591

Acquisition Strategy. N/A

Major Performers:

Five major contracts to support the MSRCs were competitively awarded between fourth quarter FY 2002 and first quarter FY 2003. These contracts provide comprehensive support services for up to eight years.

- Computer Science Corporation, Huntsville, AL (awarded two contracts)
- Lockheed Martin of Herndon, VA
- Raytheon E-Systems, Garland, TX

The DREN is implemented through the follow-on DREN Intersite Services Contract (DISC) awarded in FY 2002 and fully transitioned in FY 2003

- MCI WorldCom Communications, Inc, McLean, VA (FY 2002 - FY 2012)

Two contracts to provide programming environment and training services were awarded in FY 2001.

- Mississippi State University, Starkville, MS
- High Performance Technologies, Inc. (HPTi), Arlington, VA.

Other Major Contracts.

- Instrumental, Inc., Garland, TX (FY 2003)
- University of Alaska., Fairbanks, AK (FY 2002)