RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE January 1999
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-Wide / BA 3	R-1 ITEM NOMENCLATURE HIGH PERFORMANCE COMPUTING MODERNIZATION PE 0603755D8Z

COST *(In Millions)*	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Cost to Complete	Total Cost
Total Program Element (PE) Cost	139.023	152.585	159.099	145.140	139.109	144.297	147.248	150.275	Continuing	Continuing
HPCM/P476	139.023	152.585	159.099	145.140	139.109	144.297	147.248	150.275	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification

(U) BRIEF DESCRIPTION OF ELEMENT:

(U) The Department of Defense (DoD) High Performance Computing (HPC) Modernization Program (HPCMP) directly supports the needs of the warfighter for technological superiority and military dominance on the battlefield by providing the highest computational power available 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 quicker and with more precision than any potential adversary threatening national security. The results of these efforts feed directly into the acquisition process by increasing our fundamental understanding of the battlefield environment as well as improving upon weapon system design, development, test, evaluation, deployment, operations and sustainment. As such, high performance computing (HPC) has been identified as a key enabling technology essential to achieving the objectives of the DoD's Science and Technology (S&T) and Developmental Test and Evaluation (DT&E) programs.

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(U) The HPCMP has established and supports four major shared resource supercomputing centers as well as several smaller, special-purpose distributed supercomputing centers. These centers directly support the DoD S&T and DT&E laboratories and centers and are accessible to local and remote scientists and engineers via high-speed network access. Providing for the adaptation of broadband, widely-used applications and algorithms to address S&T and DT&E requirements, along with continued training of users as new system designs and concepts evolve, is an integral part of the program. The program pursues continuous interaction with the national HPC infrastructure, including academe, industry, and other government agencies to facilitate the sharing of knowledge, tools, and expertise.

(U) The HPCMP user base includes approximately 4,300 computational scientists and engineers and over 60 DoD laboratories and developmental test and evaluation facilities. The integrated HPCM program consists of a set of four large Major Shared Resources Centers (MSRCs) that are responsible for as large a fraction of DoD's S&T and DT&E computational workload as feasible. These MSRCs provide extensive capabilities to address user requirements for hardware, software, programming environments, and training. A limited set of smaller shared resource centers, Distributed Centers (DCs), augment the MSRCs to form the total HPCMP 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 expertise located at the remote sites. The MSRCs and DCs are currently interconnected with all S&T and DT&E user sites via the Defense Research and Engineering Network (DREN). Additionally the Common HPC Software Support Initiative (CHSSI) develops a set of critical common DoD applications programs that run efficiently on advanced HPC systems at the MSRCs and Distributed Centers.

(U) 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 and technology development for superior weapons, warfighting and related support systems. The goals of the HPCMP are to:

- Provide the best commercially available, state-of-the-art HPC capacity and capability to enable weapons development and more capable warfighting systems,
- Ensure development of software tools, supportive programming environments, and applications to exploit the capabilities of HPC,
- Expand and train the DoD HPC user base to more effectively use HPC,
- Link users and HPC centers through robust high speed networking (thus facilitating classified and unclassified access and the creation of collaborative work environments), and
- Engage, leverage, contribute to, and be a major participant in the national HPC infrastructure and exploit benefits for Defense R&D.

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(U) Four major contracts to support each of the MSRCs were competitively awarded during FY 1996. These contracts provide equipment for up to five years and comprehensive support services for the next five to eight years. The four MSRCs and their location are:

- Aeronautical Systems Center (ASC), Wright-Patterson Air Force Base, OH
- Army Corps of Engineers Waterways Experiment Station (CEWES), Vicksburg, MS
- Army Research Laboratory (ARL), Aberdeen Proving Ground, MD
- Naval Oceanographic Office (NAVO), Stennis Space Center, MS

(U) Nichols Research Corporation of Huntsville, AL was awarded contracts to support both the ASC and CEWES MSRCs. Grumman Data Systems of Herndon, VA was awarded the contract to support the NAVO MSRC. Finally, Raytheon E-Systems of Garland, TX was awarded the contract to support the ARL MSRC. Each of the MSRC contracts contains provisions, i.e. established contract options, to allow significant expansion of high performance computing systems and related support systems over the first five years of the contract. These contract options ensure that MSRC system expansions can take place in a timely fashion during each fiscal year.

(U) There are currently 12 distributed centers. In FY 1998 five existing centers were upgraded. In FY 1999, one distributed center was retired. Also in FY 1999 multiple distributed center proposals will be evaluated resulting in three to five awards. The distributed centers and their locations are listed below:

- Arnold Engineering Development Center (AEDC), Arnold AFB, TN
- Air Armaments Center (ARC), Eglin AFB, FL
- Army High Performance Computing Research Center (AHPCRC), Minneapolis, MN
- Maui High Performance Computing Center (MHPCC), Maui, HI
- Naval Air Warfare Center (NAWC), Patuxent River NAS, MD
- Space and Naval Warfare Systems Center (SSCSD), San Diego, CA
- Naval Research Laboratory (NRL), Washington, DC
- Air Force Research Laboratory (AFRL-Rome), Rome, NY
- Space and Missile Defense Command (SMDC), Huntsville, AL
- Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI
- White Sands Missile Range (WSMR), NM

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- Redstone Technical Test Center (RTTC), Huntsville, AL

(U) In addition to the distributed centers listed above, the Arctic Region Supercomputer Center (ARSC) has been funded by Congress in FY 1996, FY 1997, 1998 and FY 1999 and is providing computational resources to the HPCMP user community.

(U) The Defense Research and Engineering Network (DREN) provides wide area network (WAN) connectivity among the Department's High Performance Computing resources (high performance computing systems and the HPC user base of scientist and engineers in the research, development test and evaluation community) The DREN is implemented through the DREN Intersite Services Contract (DISC) awarded to American Telephone and Telegraph (AT&T) in FY 1996. This contract allows the government to purchase high-speed network service to anywhere in the United States at bandwidths ranging from 3.0 megabits per second to 622 megabits per second (OC-12), with upgrade potential to 2.4 gigabits per second (OC-48) over the five year life of the contract.

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Total Program Element (PE) Cost	139.023	152.585	159.099	145.140	139.109	144.297	147.248	150.275	Continuing	Continuing
HPCM/P476	139.023	152.585	159.099	145.140	139.109	144.297	147.248	150.275	Continuing	Continuing

(U) Project Number and Title: P476 HPCM

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1998 Accomplishments:

(U) Shared Resource Centers: The program continued the modernization and sustainment of the Shared Resource Centers. Additional HPC systems, storage, and scientific visualization capabilities were acquired to populate and upgrade the established MSRCs to fulfill a substantial portion of the projected HPC requirements of the laboratories and R&D centers. Contract options were executed to upgrade performance at four MSRCs, minimally tripling their computing capability over the two year period (FY 1997 and FY 1998). The program assessed and prioritized HPC requirements for DCs and deployed new systems at five existing DCs to accomplish S&T and DT&E mission needs which cannot be met effectively or efficiently at the MSRCs.

(U) Networking: The DREN fully replaced the Interim DREN in FY1998. The DREN started operation with 10 service delivery points on 1 July 1997. By the end of FY 1998, a total of 60 government facilities and 4 Internet network access points (NAPs) will be connected via DREN. Full Internet Protocol (IP) service is extended to all sites and more robust Asynchronous Transfer Mode (ATM) ATM services are provided to sites with local infrastructures capable of supporting these services (21 sites). Current communications bandwidths provided to sites range from 3 megabits per second to 155 megabits per second. Collaborative work continued with the Federal networking community to assure DREN remains compatible with future technology changes. ($21.742 Million)

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(U) **Software Applications Support:** 34 individual Common High Performance Computing Software Support Initiative (CHSSI) projects completed alpha and in some cases beta testing in FY 1998. These testing efforts confirmed that sound engineering practices and principles are being employed. Comprehensive reviews were conducted across all 10 computational technology areas (CTAs). ($20.907 Million)

(U) **MSRC Sustainment:** The program sustained and supported the integration, operation, and use of existing HPC resources at the four MSRCs. ($72.073 Million)

(U) **Distributed Center Sustainment:** . The program funded sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center in accordance with FY 1998 Congressional language. Although not formally a HPCMP DC because it lacks a DoD sponsor, Arctic Region Supercomputer Center funding is included in the DC totals. The DC organization funds the sustainment and operations of the HPCMP equipment located at the site. Only a nominal amount of funding is allocated for DC program management. ($24.301 Million)

(U) **FY1999 Plans:**

(U) **Shared Resource Centers:** The program will sustain the existing capability and continue the modernization process by acquiring additional HPC systems, storage, and scientific visualization capabilities to populate and upgrade the established MSRCs to fulfill the projected HPC requirements of the laboratories and R&D centers. Contract options will continue to be executed to meet the required performance levels at the four MSRCs, minimally tripling their computing capabilities from the previous performance levels over the two year period (FY 1999 and FY 2000). The program will continue to identify evaluate and prioritize HPC requirements for DCs and will acquire and deploy new systems or upgrades to existing systems as needed to accomplish RDT&E mission needs.

(U) **Networking:** As researchers take greater advantage of their connectivity to high performance computing systems and other researchers, the bandwidth demands on DREN will continue to grow. As local infrastructures expand, more user sites will be able to take full advantage of the DREN ATM fabric. Thus the majority of the effort in FY 1999 will be to upgrade services to selected sites and increase bandwidth. Low end users will continue to be connected at 3 Mbps, mid and high range users will be connected at 155 Mbps (previous plans to connect high range users at 622 Mbps have been postponed due to funding reductions). Security enhancements will be implemented. Collaborative work will continue with the Federal networking community and standards associations to assure DREN remains compatible with future technology changes. Formal acquisition planning for the DREN follow-on contract will begin to assure new contracts are in place in FY 2001. ($22.691 Million)

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(U) **Software Applications Support:** Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others are begun. The CHSSI projects will continue developing shared scalable applications supporting software to exploit scalable HPC assets to their fullest. ($22.846 Million)

(U) **MSRC Sustainment:** The program will sustain and support the integration, operation and use of HPC computational resources at the four Major Shared Resource Centers. The additional funds requested will provide for a full year of sustainment and operations for those systems purchased and deployed in FY 1998. Partial year sustainment and operations for systems purchased and deployed in FY 1999 is included in the total FY 1999 funding requested. Funding is provided for a high performance visualization center.
($86.202 Million)

(U) **Distributed Center Sustainment:** The program will fund sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center in accordance with FY 1999 Congressional language. Although not formally a HPCMP DC because it lacks a DoD sponsor, Arctic Region Supercomputer Center funding is included in the DC totals. The DC organization funds the sustainment and operations of the HPCMP equipment located at the site. Only a nominal amount of funding is allocated for DC program management. Only a nominal amount of funding is allocated for DC program management. ($20. 846Million)

(U) **FY2000 Plans:**

(U) **Shared Resource Centers:** The program will sustain the existing capability and continue the modernization process by acquiring additional HPC systems, storage, and scientific visualization capabilities to populate and upgrade the established MSRCs to fulfill the projected HPC requirements of the laboratories and R&D centers. Contract options will continue to be executed to meet the required performance levels at the four MSRCs, minimally tripling their computing capabilities from the previous performance levels over the two year period (FY 1999 and FY 2000). The program will continue to identify evaluate and prioritize HPC requirements for DCs and will acquire and deploy new systems or upgrades to existing systems as needed to accomplish RDT&E mission needs. Formal acquisition planning efforts will begin to assure new contracts are in place to support FY 2001 and beyond procurements.

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(U) **Networking:** As researchers take greater advantage of their connectivity to high performance computing systems and other researchers, the bandwidth demands on DREN will continue to grow. As local infrastructures expand, more user sites will be able to take full advantage of the DREN ATM fabric. Thus the majority of the effort in FY 2000 will be to upgrade services to all sites and increase bandwidth. Low end users will continue to be connected at 3 Mbps, mid range users will be connected at 155 Mbps and high range users will be connected at 622 Mbps. 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 changes. Formal acquisition efforts will assure follow-on contracts are in place to support DREN services in FY2001 and beyond. ($29.517 Million)

(U) **Software Applications Support:** Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others are begun. The CHSSI projects will continue developing shared scalable applications supporting software to exploit scalable HPC assets to their fullest. ($22.535 Million)

(U) **MSRC Sustainment:** The program will sustain and support the integration, operation and use of HPC computational resources at the four Major Shared Resource Centers. Partial year sustainment and operations for systems purchased and deployed in FY 2000 and cost saving resulting in the retirement of older HPC systems are included in the total FY 2000 funding requested. Formal acquisition planning efforts will begin to evaluate options for sustainment support in FY2001 and beyond. ($86.201 Million)

(U) **Distributed Center Sustainment:** A one year budget adjustment provides sustainment and operations for the Maui High Performance Computing Center and the Arctic Region Supercomputer Center. The DC organization funds the sustainment and operations of the HPCMP equipment located at the site. Only a nominal amount of funding is allocated for DC program management. ($20.846 Million)

(U) **FY2001 Plans:**

(U) **Shared Resource Centers:** The program will sustain the existing capability and continue modernizing HPC systems, storage, and scientific visualization capabilities to fulfill a significant portion of the projected the R&D & laboratory and center HPC requirements. New contracts will be awarded to provide the next generation of HPC capability.

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(U) **Networking:** As researchers take greater advantage of their connectivity to high performance computing systems and other researchers, the bandwidth demands on DREN will continue to grow. Network services provided under DISC will transition to the follow-on service provider. 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. ($32.900 Million)

(U) **Software Applications Support:** Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others are begun. The CHSSI projects will continue developing shared scalable applications supporting software to exploit scalable HPC assets to their fullest. ($22.446 Million)

(U) **MSRC Sustainment:** The program will sustain and support the integration, operation and use of HPC computational resources at the four Major Shared Resource Centers. ($88.948 Million)

(U) **Distributed Center Sustainment:** . The DC organization funds the sustainment and operations of the HPCMP equipment located at the site. Only a nominal amount of funding is allocated for DC program management. ($0.846 Million)

(U) **ACQUISITION STRATEGY:** Not Applicable

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(U) B. Program Change Summary	FY1998	FY1999	FY2000	FY2001	Total Cost
Previous President's Budget	126.211	140.927	139.548	146.206	Continuing
Appropriated Value	149.880	153.927			Continuing
Adjustments to Appropriated Value					
a. Congressionally Directed undistributed reduction	(9.613)	(1.342)			
b. Rescission/Below-threshold Reprogramming, Inflation Adjustment	(1.244)		(.449)	(1.066)	
c. Other			20.000		Continuing
Current President's Budget	139.023	152.585	159.099	145.140	Continuing

Change Summary Explanation:

(U) **Funding:** The funding adjustment in FY 1998 is based on congressional adjustments in the Defense Appropriations Act and program budget reductions. The funding adjustments in FY 2000 are a result of revised inflation factors and program budget increases (including a FY 2000 specific program budget increase). The reduction in FY 2001 is a result of revised inflation factors and program budget decisions.

(U) **Schedule:** Not Applicable

(U) **Technical:** In accordance with FY 1999 congressional language, the High Performance Computing Modernization Program used additional FY 1999 RDT&E funding for operations, sustainment and upgrades at the Maui High Performance Computing Center and the Arctic Region Supercomputing Center.

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(U) C. Other Program Funding Summary Cost

Procurement Line P-1 Line, PROCUREMENT, DEFENSE-WIDE (OSD High Performance Computing - Major Equipment)

($ in Millions)

FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Complete	Total Cost
87.100	91.435	62.705	40.422	50.796	49.748	50.782	52.392	Continuing	Continuing

MILESTONE SCHEDULE:	Fiscal Years
Milestone II Decision Review	1Q 1996
Awards for MSRC Contracts (Performance Level 1)	2Q, 3Q, 4Q 1996
Award for DREN (DISC)	4Q 1996
MSRC Performance Level 1 Capability Installed	1Q 1997-4Q 1997
In-Process Review	3Q 1997
FY 1997 HPC Modernization Plan Updated	3Q 1997
MSRC Performance Level 2 Capability Installed	2Q 1997- 3Q 1998
DREN Initial Performance Capability	3Q 1997
FY 1998 HPC Modernization Plan Updated	2Q 1998
IDREN to DREN Transition Complete	4Q 1998
MSRC Performance Level 3 Capability Installed	2Q 1999- 3Q 2000
MSRC Follow-on Contract(s) (Recompete)	2Q 2001
DREN Follow-on Contract (Recompete)	1Q 2001

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(U) **D. Schedule Profile** Not Applicable