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The Federal Networking and Information Technology Research and Development Program: Funding Issues and Activities

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The Federal Networking and Information Technology Research and Development Program: Funding Issues and Activities

SUMMARY

In the early 1990s, Congress recognized that several federal agencies had ongoing high-performance computing programs, but no central coordinating body existed to ensure long-term coordination and planning. To provide such a framework, Congress passed the High-Performance Computing and Communications Program Act of 1991 (P.L. 102-194) to enhance the effectiveness of the various programs. In conjunction with the passage of the act, the White House Office of Science and Technology Policy (OSTP) released *Grand Challenges: High-Performance Computing and Communications*. That document outlined a research and development (R&D) strategy for high-performance computing and a framework for a multiagency program, the High-Performance Computing and Communications (HPCC) Program.

The HPCC Program has evolved over time and is now called the Networking and Information Technology Research and Development (NITRD) Program, to better reflect its expanded mission. The NITRD Program is composed of 12 agencies; its members work in collaboration to increase the overall effectiveness and productivity of federal information technology (IT) R&D. A National Coordinating Office coordinates the activities of the NITRD Program and reports to OSTP and the National Science and Technology Council.

Proponents assert that federal support of IT R&D has produced positive outcomes for the country and played a crucial role in supporting long-term research into fundamental aspects of computing. Such fundamentals provide broad practical benefits, but generally take years to realize. Additionally, the unanticipated results of research are often as important as the anticipated results.

Another aspect of government-funded IT research is that it often leads to open standards, something that many perceive as beneficial, encouraging deployment and further investment. Industry, on the other hand, is more inclined to invest in proprietary products and will diverge from a common standard when there is a potential competitive or financial advantage to do so.

Finally, proponents of government support believe that the outcomes achieved through the various funding programs create a synergistic environment in which both fundamental and application-driven research are conducted, benefitting government, industry, academia, and the public. Supporters also believe that such outcomes justify government's role in funding IT R&D, as well as the growing budget for the NITRD Program.

Critics assert that the government, through its funding mechanisms, may be picking "winners and losers" in technological development, a role more properly residing with the private sector. For example, the size of the NITRD Program may encourage industry to follow the government's lead on research directions rather than selecting those directions itself.

The FY2006 budget calls for $2.155 billion for the NITRD Program, a 4.5% decrease from the FY2005 budget of $2.256 billion. During the 109th Congress, one NITRD-related bill has been introduced, H.R. 28; it was approved by the House Committee on Science on March 17, 2005.

MOST RECENT DEVELOPMENTS

The FY2005 budget provides $2.256 billion for the Networking and Information Technology Research and Development (NITRD) Program,[1] a 4% decrease from FY2004. An in-depth overview of FY2004 and FY2005 NITRD activities, *Guide to the NITRD Program*, was released in December 2004.[2]

The President's FY2006 budget calls for $2.155 billion for the NITRD Program, a 4.5% decrease from FY2005. A significant part of this decrease can be attributed to the reduction in funding for NITRD activities within the National Aeronautics and Space Administration (NASA). Also, within NITRD, funding for high-end computing research and development (R&D) is down 6%, due in part to a decrease in funding for these activities at the Office of Science within the Department of Energy (DoE).

In the 109th Congress, one bill has been introduced and one hearing has been held related to the NITRD Program. On January 4, 2005, Representative Judy Biggert introduced H.R. 28, the High-Performance Computing Revitalization Act. The bill would amend the High-Performance Computing Act of 1991 and further delineate the responsibilities of the NITRD Program, including setting the goals and priorities for federal high-performance computing research, development, networking, and other activities and providing more specific definitions for the responsibilities of the PCAs. The bill was referred to the House Committee on Science, which approved the bill on March 17, 2005. The committee also approved, by voice vote, an amendment that stated that the results and benefits of federal supercomputing research should be shared with the private sector. The committee rejected, by a vote of 17-19, an amendment offered by Representative Brad Sherman that would have directed the National Science Foundation to investigate the societal, ethical, legal, and economic implications of computers that one day might be capable of mimicking human abilities to learn, reason, and make decisions.

The House Committee on Science held a hearing on the federal R&D Budget for Fiscal Year 2006 on February 16, 2005.[3] This hearing covered the entire R&D budget and included an overview of NITRD activities by Dr. John Marburger, the Director of OSTP.

BACKGROUND AND ANALYSIS

The federal government has long played a key role in the country's information technology (IT) research and development (R&D) activities. The Government's support of R&D began because it had an important interest in creating computers that would be capable of addressing the problems and issues the government needed to solve and study. One of the first such problems was planning the trajectories of artillery and bombs; more recently such problems include simulations of nuclear testing, cryptanalysis, and weather modeling. That

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[1] The main website of the NITRD Program is [http://www.nitrd.gov].

[2] This report is available online at [http://www.nitrd.gov/pubs/blue05/].

[3] The charter and submitted testimony for this hearing is available online at [http://www.house.gov/science/hearings/full05/index.htm].

interest continues today. That complexity requires there be adequate coordination to ensure the government's evolving needs (e.g., homeland security) will continue to be met in the most effective manner possible.

Overview of the Federal NITRD Program

The NITRD Program is a collaborative effort in which 12 agencies coordinate and cooperate to help increase the overall effectiveness and productivity of federal IT R&D.[4] Of those 12 members, the majority of funding goes to the National Science Foundation, National Institutes of Health, National Aeronautics and Space Administration, Defense Advanced Research Projects Agency, and the Department of Energy, Office of Science. Figure 1 illustrates the management structure of the NITRD Program.

The National Coordinating Office (NCO) for IT R&D coordinates the activities of the NITRD Program. The Director of the NCO reports to the Director of OSTP. The NCO supports the Subcommittee on NITRD (also called the NITRD Subcommittee)[5] and the President's Information Technology Advisory Committee (PITAC)[6]:

- The NITRD Subcommittee provides policy, program, and budget planning for the NITRD Program and is composed of representatives from each of the participating agencies, OSTP, Office of Management and Budget, and the NCO. Six Coordinating Groups reporting to the NITRD Subcommittee focus their work in seven Program Component Areas (PCAs).[7]

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[4] The members of the NITRD Program, as listed in the FY2004 Supplement to the President's Budget are: Agency for Healthcare Research and Quality (AHRQ); Defense Advanced Research Projects Agency (DARPA); Department of Defense, Office of the Director, Defense Research & Engineering (DODDR&E); Department of Energy, National Nuclear Security Administration (DOE/NNSA); Department of Energy, Office of Science (DOE/SC); Environmental Protection Agency (EPA); National Aeronautics and Space Administration (NASA); National Institutes of Health (NIH); National Institute of Standards and Technology (NIST); National Oceanic and Atmospheric Administration (NOAA); National Security Agency (NSA); and National Science Foundation (NSF). The history of agency participation can be found online at [http://www.nitrd.gov/about/history/agency-participants.pdf].

[5] The Subcommittee on NITRD was previously called the Interagency Working Group for IT R&D (IWG/IT R&D).

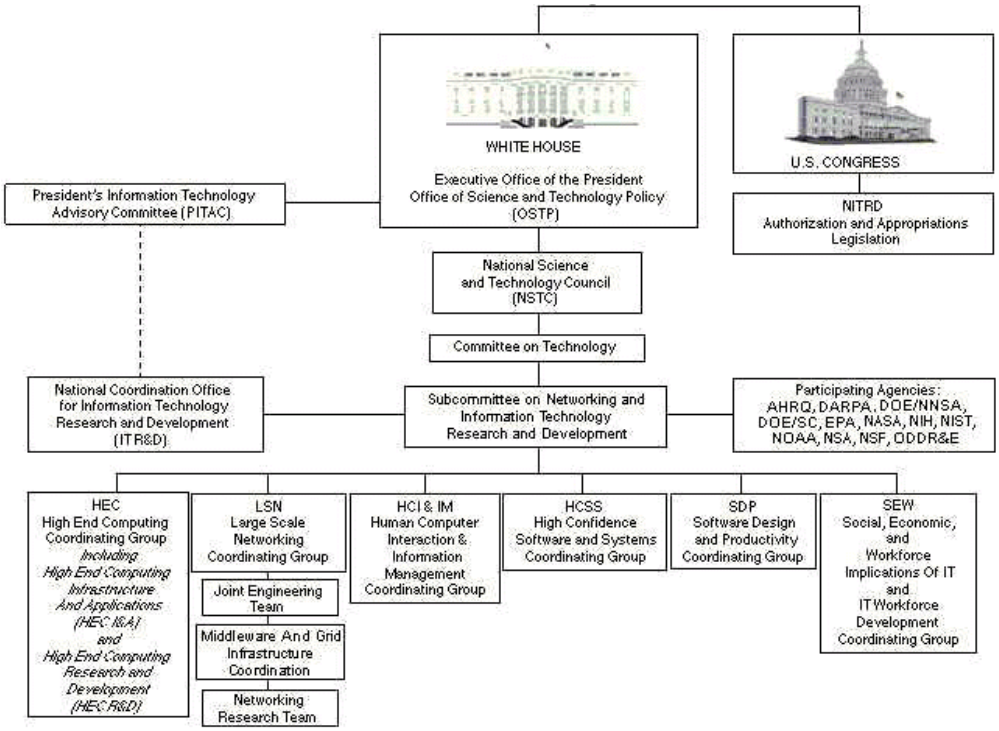
[6] The PITAC was established on February 11, 1997 to provide the President, OSTP, and the federal agencies involved in IT R&D with guidance and advice on all areas of high performance computing, communications, and information technologies. Representing the research, education, and library communities and including network providers and representatives from critical industries, the Committee advises the Administration's effort to accelerate development and adoption of information technologies. The membership roster of the PITAC is available online at [http://www.nitrd.gov/pitac/members.html].

[7] The seven PCAs are: (1) *High-End Computing Infrastructure and Applications (HEC I&A)* — to extend the state of the art in high-end computing systems, applications, and infrastructure; (2) *High-End Computing R&D (HEC R&D)* — to optimize the performance of today's high-end computing systems and develop future generations of high-end computing systems; (3) *Human Computer Interaction and Information Management (HCI&IM)* — to develop new user interaction

(continued...)

- The PITAC is composed of representatives of private industry and academia who are appointed by the President. The group provides expert independent advice to the President on the federal role in maintaining U.S. preeminence in advanced IT and works with the NITRD Program agencies and the NITRD Subcommittee.

Figure 1: Management Structure of the NITRD Program[8]



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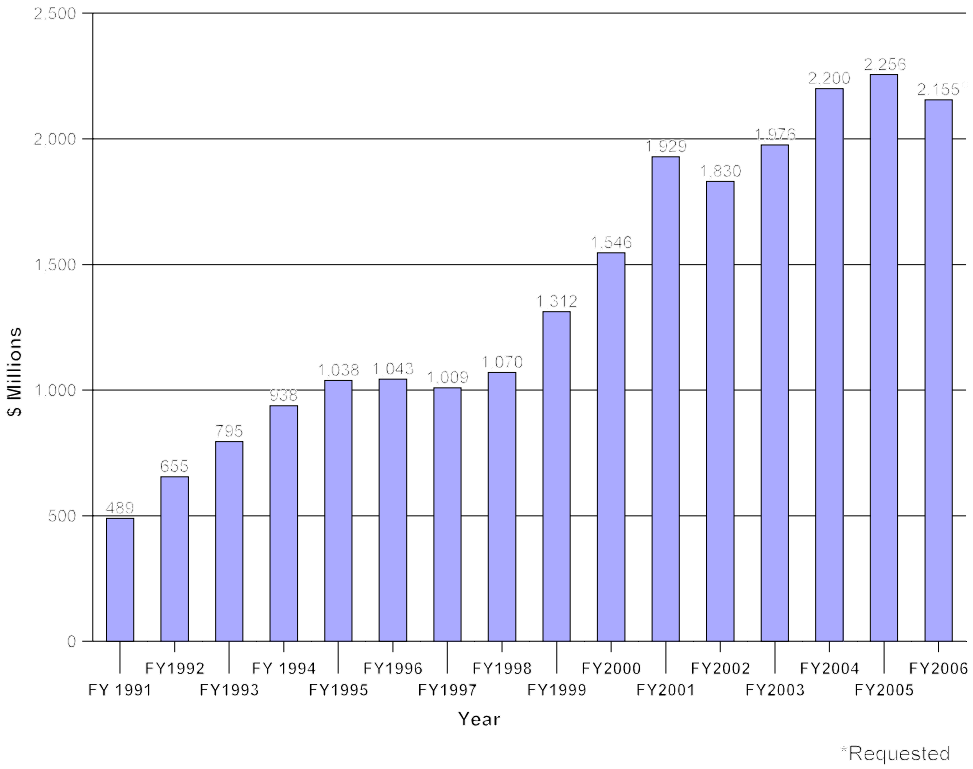
[7] (...continued)
technologies, cognitive systems, information systems, and robotics that benefit humans; (4) *Large Scale Networking (LSN)* — to develop leading-edge network technologies, services, and techniques to enhance performance, security, and scalability; (5) *Software Design and Productivity (SDP)* — to advance concepts, methods, techniques, and tools that improve software design, development, and maintenance to produce more usable, dependable and cost-effective software-based systems; (6) *High Confidence Software and Systems (HCSS)* — to develop the scientific foundations and IT to achieve affordable and predictable high levels of safety, security, reliability, and survivability, especially in U.S. national security and safety-critical systems; and (7) *Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW)* — to study the impact of IT on people and social and economic systems; develop the IT workforce; and develop innovative IT applications in education and training. Additional information about the program component areas is available online at [http://www.nitrd.gov/iwg/index.html]. HEC R&D and HEC I&A are both covered by the HEC Interagency Working Group. A diagram illustrating the evolution of the PCAs, 1992-present, is available online at [http://www.nitrd.gov/about/history/new-pca-names.pdf].

[8] This diagram is available on the NITRD Program website, [http://www.nitrd.gov]. The Defense Information Systems Agency does not appear in the diagram; however it is included in the list of NITRD Program Agencies on page 2 of the FY2004 Supplement to the President's Budget.

The NITRD Program is funded out of each member agency's individual budget, rather than in a single appropriations bill (e.g., NITRD Program activities conducted by the National Institutes of Health (NIH) are funded through the NIH appropriations bill). The program's NCO is not explicitly funded; rather, the NITRD member agencies contribute toward NCO operations.

The NITRD Program has undergone a series of structural changes since its inception in 1991 and both it and the NCO have had a number of different names over the years. When the program was created in September 1992, it was named the National Coordination Office for High Performance Computing and Communications (HPCC). The name was changed to the National Coordination Office for Computing, Information, and Communications per the FY1997 Supplement to the President's Budget (also known as the "Blue Book") and then to its current name, the National Coordination Office for Information Technology Research and Development, per the FY2001 Blue Book (that change was effective October 2000). These changes were made to reflect the evolution of the program as it came to encompass a broader range of related topics. The chronology of funding since the NITRD Program was created as the HPCC Program in 1991 is detailed in Figure 2.

Figure 2: History of NITRD Program Funding[9]



[9] This chart was developed using data available in the FY2004 Supplement to the President's Budget (available online at [http://www.nitrd.gov/pubs/blue04/]) and the President's proposed FY2005 budget (available online at [http://www.whitehouse.gov/omb/budget/fy2005/pdf/spec.pdf]).

Enabling/Governing Legislation

The NITRD Program is governed by two laws. The first, the High-Performance Computing Act of 1991, P.L. 102-194,[10] expanded federal support for high-performance computing R&D and called for improving interagency planning and coordination. The second, the Next Generation Internet Research Act of 1998, P.L. 105-305,[11] amended the original law to expand the mission of the NITRD Program to cover Internet-related research, among other goals.

High-Performance Computing Act of 1991. This law was the original enabling legislation for what is now the NITRD Program. Among other requirements, it called for:

- Setting goals and priorities for federal high-performance computing research, development, and networking
- Technical support and research and development of software and hardware needed to address fundamental problems in science and engineering
- Educating undergraduate and graduate students
- Fostering and maintaining competition and private sector investment in high-speed data networking within the telecommunications industry
- Promoting the development of commercial data communications and telecommunications standards
- Providing security, including protecting intellectual property rights
- Developing accounting mechanisms allowing users to be charged for the use of copyrighted materials.

This law also requires an annual report to Congress on grants and cooperative R&D agreements and procurements involving foreign entities.[12]

Next Generation Internet Research Act of 1998. This law amended the High-Performance Computing Act of 1991. The act had two overarching purposes. The first was to authorize research programs related to high-end computing and computation, human-centered systems, high confidence systems, and education, training, and human resources. The second was to provide for the development and coordination of a comprehensive and integrated U.S. research program to focus on (1) computer network infrastructure that would promote interoperability among advanced federal computer networks, (2) economic high-speed data access that does not impose a "geographic penalty", and (3) flexible and extensible networking technology.

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[10] High Performance Computing Act of 1991, P.L. 102-194, 15 U.S.C. 5501, 105 Stat. 1595, December 9, 1991. The full text of this law is available online at [http://www.nitrd.gov/congressional /laws/pl_102-194.html].

[11] Next Generation Internet Research Act of 1998, P.L. 105-305, 15 U.S.C. 5501, 112 Stat. 2919, October 28, 1998. The full text of this law is available online at [http://www.nitrd.gov/congressional/laws/pl_h_105-305.html].

[12] The first report mandated information on the "Supercomputer Agreement" between the United States and Japan be included in this report. A separate one-time only report was required on network funding, including user fees, industry support, and federal investment.

Context of Federal Technology Funding

In the early 1990s, Congress recognized that several federal agencies had ongoing high-performance computing programs,[13] but no central coordinating body existed to ensure long-term coordination and planning. To provide such a framework, Congress passed the High-Performance Computing and Communications Program Act of 1991 to enhance the effectiveness of the various programs.

In conjunction with the passage of the act, OSTP released, "Grand Challenges: High-Performance Computing and Communications." That document outlined an R&D strategy for high-performance computing and a framework for a multi-agency program, the HPCC Program.

The NITRD Program is part of the larger federal effort to promote fundamental and applied IT R&D. The government sponsors such research through a number of channels, including:

- Federally-funded research and development laboratories, such as Lawrence Livermore National Laboratory
- Single-agency programs
- Multi-agency programs, including the NITRD Program, but also programs focusing on nanotechnology and combating terrorism
- Funding grants to academic institutions
- Funding grants to industry.

In general, supporters contend that federal funding of IT R&D has produced positive results. In 2003, the Computer Science and Telecommunications Board (CSTB) of the National Research Council (NRC) released a "synthesis report" based on eight previously released reports that examined "how innovation occurs in IT, what the most promising research directions are, and what impacts such innovation might have on society."[14] One of the most significant of the CSTB's observations was that the unanticipated results of research are often as important as the anticipated results. For example, electronic mail and instant messaging were by-products of [government-funded] research in the 1960s that was aimed at making it possible to share expensive computing resources among multiple simultaneous interactive users.

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[13] "High-performance" computing is a term that encompasses both "supercomputing" and "grid computing." In general, high-performance computers are defined as stand-alone or networked computers that can perform "very complex computations very quickly." Supercomputing involves a single, stand-alone computer located in a single location. Grid computing involves a group of computers, in either the same location or spread over a number of locations, that are networked together (e.g., via the Internet or a local network). House of Representatives, Committee on Science, *Supercomputing: Is the United States on the Right Path* (Hearing Transcript), [http://commdocs.house.gov/committees/science/hsy88231.000/hsy88231_0f.htm], 2003, p. 5-6.

[14] National Research Council, *Innovation in Information Technology*, 2003, p. 1. This report discusses all federal funding for R&D, not only the NITRD Program.

Additionally, the report noted that federally funded programs have played a crucial role in supporting long-term research into fundamental aspects of computing. Such "fundamentals" provide broad practical benefits, but generally take years to realize. Furthermore, supporters state that the nature and underlying importance of fundamental research makes it less likely that industry would invest in and conduct more fundamental research on its own. As noted by the CSTB, "companies have little incentive to invest significantly in activities whose benefits will spread quickly to their rivals."[15] Further, in the Board's opinion:

> government sponsorship of research, especially in universities, helps develop the IT talent used by industry, universities, and other parts of the economy. When companies create products using the ideas and workforce that result from federally-sponsored research, they repay the nation in jobs, tax revenues, productivity increases, and world leadership.[16]

Another aspect of government-funded IT R&D is that it often leads to open standards, something that many perceive as beneficial, encouraging deployment and further investment. Industry, on the other hand, is more likely to invest in proprietary products and will diverge from a common standard if it is sees a potential competitive or financial advantage; this has happened, for example with standards for instant messaging.[17]

Finally, proponents of government R&D support believe that the outcomes achieved through the various funding programs create a synergistic environment in which both fundamental and application-driven research are conducted, benefitting government, industry, academia, and the public. Supporters also believe that such outcomes justify government's role in funding IT R&D, as well as the growing budget for the NITRD Program.

Critics assert that the government, through its funding mechanisms, may be setting itself up to pick "winners and losers" in technological development, a role more properly residing with the private sector.[18] For example, the size of the NITRD Program may encourage industry to follow the government's lead on research directions rather than selecting those directions itself.

Overall, CSTB states that, government funding appears to have allowed research on a larger scale and with greater diversity, vision, and flexibility than would have been possible without government involvement.[19]

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[15] Ibid, p. 4.

[16] Ibid, p. 4.

[17] Ibid, p. 18.

[18] Cato Institute, *Encouraging Research: Taking Politics Out of R&D*, September 13, 1999, [http://www.cato.org/pubs/wtpapers/990913catord.html].

[19] National Research Council, *Innovation in Information Technology*, 2003, p. 22.

NCO and Related Activities

As explained earlier, the NCO provides technical and administrative support to the NITRD Program, the NITRD Subcommittee, and the PITAC. This includes supporting meetings and workshops and preparing reports. The NCO interacts with OSTP and OMB on NITRD Program and PITAC matters.

At the request of OSTP and the NSTC, the NCO has supported the work of the HECRTF. The task force was charged in 2003 with developing a five-year plan to guide federal investment in high-end computing R&D. At the request of the task force and the NCO, the Computing Research Association sponsored a workshop, *Workshop on the Road Map for the Revitalization of High End Computing*, in June 2003.[20] The report from the workshop, released in January 2004, detailed findings in eight areas, for example, how to encourage the development of more advanced enabling technologies, such as power management systems, and commercial, off-the-shelf technologies. The task force released its report, the *Federal Plan for High-End Computing*,[21] in May 2004. The report presented a plan for R&D in HEC hardware, software, and systems; federal agency access to capability and capacity HEC resources; and improving how federal agencies procure HEC systems.

In September 2004, the NCO and the NITRD Subcommittee released the Interagency Coordination Report for FY2004. The report provides a comprehensive description of the FY2004 activities of the NITRD Program.[22]

Issues for Congress

Federal IT R&D is a multi-dimensional issue, involving many government agencies working together towards shared and complementary goals. Most observers believe that success in this arena requires ongoing coordination among government, academia, and industry.

In a July 2003 hearing, the House Committee on Science began investigating issues related to U.S. competitiveness in high-performance computing and the direction the IT R&D community has been taking. Those issues and others remain salient and may merit further investigation if the United States is to implement a comprehensive IT R&D policy. Included among the possible issues Congress may wish to pursue are: the United States' status as the global leader in high-performance computing research; the apparent bifurcation of the federal IT R&D research agenda between grid computing and supercomputing capabilities; the possible over-reliance on commercially available hardware to satisfy U.S. research needs; and the potential impact of deficit cutting on IT R&D funding.

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[20] Materials related to this panel and the report itself are available online at [http://www.cra.org/Activities/workshops/nitrd/]. Additional materials related to the HECRTF are available at [http://www.itrd.gov/hecrtf-outreach/index.html].

[21] This report is available online at [http://www.nitrd.gov/pubs/2004_hecrtf/20040702_hecrtf.pdf].

[22] This report is available online at [http://www.nitrd.gov/pubs/20041007_icr.pdf].

Many Members of Congress as well as those in the research community have expressed concern over whether the United States is maintaining its position as the global leader in high-performance computing R&D. That concern has been highlighted by the fact that Japan now has the fastest and most efficient supercomputer in the world.[23] While this may be reason for some concern, it also may be an indicator of how the United States' research agenda has become bifurcated, with some in the R&D community with some in the R&D community focusing on traditional supercomputing capabilities and others focusing more on cluster computing or grid computing. Each type of computing has its advantages, based on its application. Stand-alone supercomputers are often faster and are generally used to work on a specific problem. For example, cryptanalysis and climate modeling applications require significant computing power and are best accomplished using specialized, stand-alone computers. Cluster computing, however, allows the use of commercially available hardware, which helps contain costs. The cluster configuration is useful for applications in which a problem can be broken into smaller independent components.[24]

Without a clear plan as to how to proceed, pursuing two disparate research agendas (with goals that could be viewed as being at odds with each other) could split the research community even further, damaging its ability to provide leadership in either area. The NITRD Program already is working on a "roadmap" for future directions in supercomputing; therefore, one possible course for Congress at this time would be to monitor closely the work of the High-End Computing Revitalization Task Force and provide input or a more visible forum for discussion (i.e., additional hearings involving task force participants). Congress may wish to conduct its own inquiry into the debate over grid versus stand-alone computing. For example, at the July 2003 hearing, one of the overarching questions the panelists were asked to address was whether federal agencies were pursuing conflicting R&D goals and, if so, what should and could be done to ensure they moved toward a more coordinated, unified goal.

Another issue is whether the United States is relying too heavily on commercially available hardware to satisfy its R&D needs. While use of computers designed for mass-market commercial applications can certainly be a part of a successful high-end computing R&D plan, Congress may wish to monitor how this reliance may be driving the new emphasis on grid computing.

As noted earlier, critics of IT R&D funding often state that industry should conduct more fundamental R&D on their own, without government backing, and that fiscal restraint dictates that less funding should be made available. Conversely, supporters of government funding would point out that IT R&D has a very long cycle from inception to application and that any reductions in funding now could have a significant negative impact for many years to come in terms of innovation and training of researchers. Therefore, Congress may monitor and assess the potential impact of deficit-cutting plans on progress in IT R&D.

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[23] House of Representatives, Committee on Science, *Supercomputing: Is the United States on the Right Path*? (Hearing Transcript), [http://commdocs.house.gov/committees/science/hsy88231.000/hsy88231_0f.htm], 2003, p. 13.

[24] Ibid, p. 6-7.

Activity in the 109th Congress

To date, the 109th Congress has introduced one bill and held one hearing related to the NITRD Program.

Legislation. Representative Judy Biggert introduced H.R. 28, the High-Performance Computing Revitalization Act, to amend the High-Performance Computing Act of 1991. The bill would further delineate the responsibilities of the NITRD Program, including setting the goals and priorities for federal high-performance computing research, development, networking, and other activities and providing more specific definitions for the responsibilities of the PCAs. Introduced on January 4, 2005, and referred to the House Committee on Science, which approved the bill on March 17, 2005. The committee also approved, by voice vote, an amendment that stated that the results and benefits of federal supercomputing research should be shared with the private sector. The committee rejected, by a vote of 17-19, an amendment offered by Representative Brad Sherman that would have directed the National Science Foundation to investigate the societal, ethical, legal, and economic implications of computers that one day might be capable of mimicking human abilities to learn, reason, and make decisions.

Hearings. The House Committee on Science held a hearing to discuss the Federal R&D Budget for Fiscal Year 2006 on February 16, 2005.[25] This hearing covered the entire R&D budget and included an overview of NITRD activities by Dr. John Marburger, the Director of OSTP.

Relevant Laws

P.L. 102-194, the High-Performance Computing Act of 1991, expanded federal support for research, development, and application of high-performance computing; and called for improving the interagency planning and coordination of federal research and development on high-performance computing and maximizing the effectiveness of the federal government's high-performance computing efforts.

P.L. 105-305, the Next Generation Internet Research Act of 1998, amended the High-Performance Computing Act of 1991 to authorize appropriations for fiscal years 1999 and 2000 for the Next Generation Internet program; and required the President's Information Technology Advisory Committee to monitor and give advice concerning the development and implementation of the Next Generation Internet program and report to the President and the Congress on its activities.

P.L. 108-423, the Department of Energy High-End Computing Revitalization Act, requires the Secretary of Energy to develop and deploy high-end computing systems for advanced scientific and engineering applications. Among other specific requirements, the law requires that the Department of Energy's high-end computing program support individual investigators and multi-disciplinary teams of investigators; conduct research on multiple computing architectures; conduct research on algorithms, programming environments, tools,

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[25] The charter and submitted testimony for this hearing is available online at [http://www.house.gov/science/hearings/full05/index.htm].

languages, and operating systems; support technology transfer to the private sector; and coordinate with industry and other Federal agencies. Further, it requires the Secretary to establish and operate Leadership Systems facilities that would provide the U.S. research community with sustained access to high-performance computing resources and to establish at least one High-End Software Development Center to concentrate efforts to develop, test, maintain, and support optimized software tools for HEC.

LEGISLATION

H.R. 28 (Biggert)

High-Performance Computing Revitalization Act. The bill would amend the High-Performance Computing Act of 1991 and further delineate the responsibilities of the NITRD Program, including setting the goals and priorities for federal high-performance computing research, development, networking, and other activities and providing more specific definitions for the responsibilities of the PCAs. The bill was referred to the House Committee on Science on January 4, 2005; it was approved on March 17, 2005. The committee also approved, by voice vote, an amendment that stated that the results and benefits of federal supercomputing research should be shared with the private sector. The committee rejected, by a vote of 17-19, an amendment offered by Representative Brad Sherman that would have directed the National Science Foundation to investigate the societal, ethical, legal, and economic implications of computers that one day might be capable of mimicking human abilities to learn, reason, and make decisions.

FOR ADDITIONAL READING

CRS Reports

CRS Report RL32799, *Federal Research and Development Funding: FY2006*, by Michael E. Davey.

CRS Issue Brief IB10088, *Federal Research and Development: Budgeting and Priority-Setting Issues, 108th Congress*, by Genevieve J. Knezo.

CRS Report RL31175, *High Performance Computers and Export Control Policy: Issues for Congress*, by Glenn J. McLoughlin and Ian F. Fergusson.

Websites

The National Coordination Office for Information Technology Research and Development, [http://www.nitrd.gov/].

The President's Information Technology Advisory Committee, [http://www.nitrd.gov/pitac/index.html].

The Interagency Working Group for Information Technology Research and Development, [http://www.nitrd.gov/iwg/index.html].

Reports and Documents

"Supplement to the President's Budget for FY2005, Networking and Information Technology Research and Development," Subcommittee on Information Technology Research and Development and National Science and Technology Council, December 2004, available online at [http://www.nitrd.gov/pubs/blue05/].

"Federal Plan for High-End Computing," Office of Science and Technology Policy, Executive Office of the President, May 2004, available online at [http://www.nitrd.gov/pubs/2004_hecrtf/20040702_hecrtf.pdf].

"The Technology Industry at an Innovation Crossroads," Electronic Industries Association, May 2004, [http://www.eia.org/docs/innovation_playbook.pdf].

"Workshop on the Roadmap for the Revitalization of High-End Computing," Computing Research Associates, 2004, [http://www.nitrd.gov/hecrtf-outreach/ 20040112_cra_hecrtf_report.pdf].

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