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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.

Proponents assert that federal support of information technology (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 FY2009 budget calls for $3.548 billion for the NITRD Program, an increase from the FY2008 projected budget of $3.341 billion. Because the NITRD Program "budget" consists of the budgets allocated to the 13 participating agencies, final budget figures are not available for FY2008.

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Overview of the Federal NITRD Program

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 IT 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 interest continues today. Such 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.

NITRD Structure

The Networking and Information Technology Research and Development (NITRD) Program is a collaborative effort in which 13 agencies coordinate and cooperate to help increase the overall effectiveness and productivity of federal IT R&D.[1] Of those 13 members, the majority of funding, in descending order, goes to the National Science Foundation, National Institutes of Health, Department of Energy (DOE) Office of Science, Defense Advanced Research Projects Agency (DARPA), and DOE National Nuclear Security Administration. Dr. Christopher Greer was named as the director of the NITRD Program in October 2007. **Figure 1** illustrates the organizational structure of the NITRD Program.

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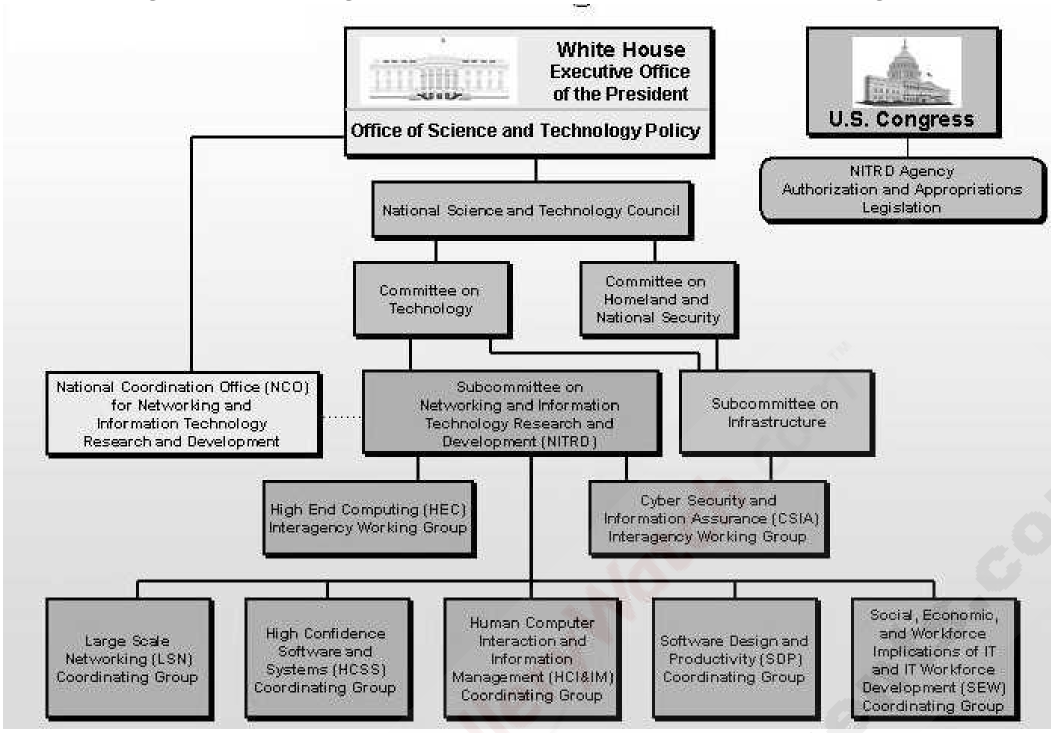
[1] The members of the NITRD Program, as listed in the FY2006 Supplement to the President's Budget, are: Agency for Healthcare Research and Quality (AHRQ); Defense Advanced Research Projects Agency (DARPA); Office of the Secretary of Defense, Defense Research & Engineering, and the DOD service research organizations; Department of Energy, National Nuclear Security Administration (DOE/NNSA); Department of Energy, Office of Science (DOE/SC); Department of Homeland Security (DHS); 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 at [http://www.nitrd.gov/about/history/agency-participants.pdf].

Figure 1. Management Structure of the NITRD Program



Source: NITRD Program website, [http://www.nitrd.gov].

The National Coordinating Office (NCO) coordinates the activities of the NITRD Program. On July 1, 2005, the NCO became the "National Coordination Office for Networking and Information Technology Research and Development." The Director of the NCO reports to the Director of OSTP. The NCO supports the Subcommittee on NITRD (also called the NITRD Subcommittee)[2] and the President's Information Technology Advisory Committee (PITAC).[3]

- 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. Two Interagency Working Groups and five Coordination Groups reporting to the NITRD

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

[3] 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. Additional information about the PITAC is available at [http://www.nitrd.gov/pitac]. The most recent PITAC Executive Order expired on June 1, 2005.

Subcommittee focus their work in eight Program Component Areas (PCAs).[4]

- 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.

- 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 December 1991, it was named the High Performance Computing and Communications (HPCC) Program, and when the NCO was created in September 1992, it was named the NCO for 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 at that time as the "Blue Book"). The name was changed to the National Coordination Office for Information Technology Research and Development per the

[4] The eight 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) *Cyber Security and Information Assurance* — to perform fundamental and applied R&D to improve the security and assurance of information systems; (4) *Human Computer Interaction and Information Management (HCI&IM)* — to develop new user interaction technologies, cognitive systems, information systems, and robotics that benefit humans; (5) *Large Scale Networking (LSN)* — to develop leading-edge network technologies, services, and techniques to enhance performance, security, and scalability; (6) *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; (7) *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 (8) *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/subcommittee/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 at [http://www.nitrd.gov/about/history/new-pca-names.pdf].

FY2001 Blue Book.[5] Most recently, on July 1, 2005, the name was changed to the National Coordination Office for Networking and Information Technology Research and Development. These changes were made to reflect the evolution of the program as it came to encompass a broader range of related topics.

NITRD Funding

The FY2009 budget calls for $3.548 billion for the NITRD Program, an increase from the FY2008 projected budget of $3.341 billion. Because the NITRD Program "budget" consists of the budgets allocated to the 13 participating agencies, final budget figures are not available for FY2008. The chronology of NITRD funding is detailed in **Table 1**.[6]

Table 1. NITRD Funding Chronology FY1991-FY2009
($ in millions)

Fiscal Year	Budget	Fiscal Year	Budget
FY1991	489	FY2001	1,929
FY1992	655	FY2002	1,830
FY1993	795	FY2003	1,976
FY1994	938	FY2004	2,115
FY1995	1,038	FY2005	2,256
FY1996	1,043	FY2006	2,855
FY1997	1,009	FY2007	2,967
FY1998	1,070	FY2008*	3,341
FY1999	1,312	FY2009**	3,548
FY2000	1,546		

*Final figure not yet available
**Requested

The Administration's American Competitiveness Initiative has increased the NITRD budgets of agencies that are part of the Initiative. The Initiative calls for a doubling over 10 years of the investment in three federal agencies that support basic research programs in the physical sciences and engineering: the National Science Foundation (NSF), the Department of Energy's Office of Science (DOE/SC), and the National Institute of Science and Technology (NIST) — are NITRD Program member agencies. All three received FY2007 NITRD budget increases that exceed

[5] That change was effective October 2000.

[6] The FY2008 budget request is available at [http://www.nitrd.gov/pubs/2008supplement/08-Supp-Web/TOC%20Pages/08supp-Budget.pdf].

the percentage increase in the overall Program budget, as follows: NSF, 12%; DOE/SC, 35%; and NIST, 10%. The aggregated NITRD budget increase for these three agencies from 2006 estimates to 2007 request is $186 million (17% above 2006 estimates), which accounts for over 85% of the overall NITRD Program budget increase for 2007.[7]

Recent NCO, PITAC, and Related Reports

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.

Leadership Under Challenge: Information Technology R&D in a Competitive World. This report assesses global U.S. competitiveness in networking and information technology and provides recommendations aimed at ensuring that the NITRD Program is appropriately focused and implemented. The report makes specific recommendations for Federal R&D that would enhance U.S. competitiveness in this economically critical area. In developing the report, the PCAST consulted extensively with experts from industry and academia. The PCAST concluded that while the United States is still in a leadership position, other nations are challenging that lead in a number of areas and that the NITRD Program must focus on visionary research and work with universities to keep the United States at the cutting edge. Some of the report recommendation areas follows:

- Both the U.S. federal government and the private sector need to address the demand for skilled IT professionals, including such steps as updating curricula, increasing fellowships, and simplifying visa processes.
- With respect to the federally-funded research portfolio, the NITRD Program should emphasize larger-scale and longer-term, multidisciplinary IT R&D and innovative, higher-risk projects.
- The United States should give priority to R&D in economically important areas, including IT systems connected with and embedded in the physical world, software, use and management of digital data, and advanced Internet capabilities. The PCAST noted that with an annual federal investment of over $3 billion in the NITRD Program, changes in the Program's interagency process to strengthen assessment and planning are needed.[8]

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[7] The FY2007 NITRD Budget request is at [http://www.nitrd.gov/pubs/2007supplement/].

[8] This report responds to reporting requirements of the High-Performance Computing Act of 1991 (Public Law 102-194) and the Next Generation Internet Research Act of 1998 (Public Law 105-305). The laws call for a President's Information Technology Advisory Committee (PITAC) to assess periodically what is now known as the NITRD Program. Executive Order 13385, signed on September 29, 2005, assigned the PITAC's

(continued...)

Federal Plan for Cyber Security and Information Assurance Research and Development. In April 2006, the NITRD Subcommittee released its "Federal Plan for Cyber Security and Information Assurance Research and Development."[9] This report sets out a framework for multi-agency coordination of federal R&D investments in technologies that can better secure the interconnected computing systems, networks, and information that together make up the U.S. IT infrastructure. The plan outlines strategic objectives for coordinated federal R&D in cyber security and information assurance (CSIA) and presents a broad range of CSIA R&D technical topics, identifying those topics that are multi-agency technical and funding priorities. The plan's findings and recommendations address R&D priority setting, coordination, fundamental R&D, emerging technologies, roadmapping, and metrics.

NSA Superconducting Technology Assessment. In August 2005, NSA released its "Superconducting Technology Assessment"[10] as part of its participation in the High-End Computing PCA of the NITRD Program. NSA had been concerned about projected limitations of conventional technology and wanted to explore possible alternatives to meet its future mission-critical computational needs. This report presented the results of the technology assessment, which found the following.

- Government investment is necessary, because private industry currently has no compelling financial reason to develop alternative technologies for mainstream commercial applications.
- With aggressive federal investment (estimated between $372 and $437 million over five years), by 2010 next generation technologies would be sufficiently mature to allow the initiation of the design and construction of an operational petaflops[11]-scale system.
- Although significant risks exist, the panel has developed a roadmap that identifies the needed technology developments with milestones and demonstration vehicles.

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[8] (...continued)
responsibilities to PCAST. This report is available at [http://www.nitrd.gov/pcast/reports/PCAST-NIT-FINAL.pdf].

[9] This report is available at [http://www.nitrd.gov/pubs/csia/csia_federal_plan.pdf].

[10] This report is available at [http://www.nitrd.gov/pubs/nsa/sta.pdf].

[11] In computing, "flops" or "FLOPS" is an abbreviation of Floating Point Operations Per Second. This is used as a measure of a computer's performance, especially in fields of scientific calculations that make heavy use of floating point calculations. A petaflops-scale machine operates at 10^{15} flops.

Computational Science: Ensuring America's Competitiveness. In June 2005, the PITAC released "Computational Science: Ensuring America's Competitiveness."[12] The report identified obstacles to progress in this field, including "rigid disciplinary silos in academia that are mirrored in federal research and development agency organizational structures." According to the report, these "silos stifle the development of multi-disciplinary research and educational approaches essential to computational science." The report recommends the following.

- Both academia and government fundamentally change their organizational structures so that they promote and reward collaborative research.
- The National Science and Technology Council commission the National Academies to convene one or more task forces to develop and maintain a multi-decade roadmap for computational science, with a goal of assuring continuing U.S. leadership in science, engineering, and the humanities.
- The federal government establish national software sustainability centers to harden, document, support, and maintain long-term vital computational science software.
- The federal government provide long-term support for computational science community data repositories. These should include defined frameworks, metadata structures, algorithms, data sets, applications, and review and validation infrastructure. It should also require funded researchers to deposit their data and research software in these repositories or with other approved access providers.
- The federal government provide long-term funding for national high-end computing centers at levels sufficient to ensure the regularly scheduled deployment and operation of the fastest and most capable high-end computing systems that address the most demanding computational problems.
- The federal government implement coordinated, long-term computational science programs that include funding for interconnecting the software sustainability centers, national data and software repositories, and national high-end leadership centers with the researchers who use those resources.
- The federal government should rebalance its R&D investments to: (a) create a new generation of well-engineered, scalable, easy-to-use software suitable for computational science that can reduce the

[12] This report is available at [http://www.nitrd.gov/pitac/reports/20050609_computational/computational.pdf].

> complexity and time to solution for today's challenging scientific applications and can create accurate simulations that answer new questions; (b) design, prototype, and evaluate new hardware architectures that can deliver larger fractions of peak hardware performance on scientific applications; and (c) focus on sensor- and data-intensive computational science applications in light of the explosive growth of data.

Cyber Security: A Crisis of Prioritization. In February 2005, the PITAC released "Cyber Security: A Crisis of Prioritization."[13] That report outlined four key findings and recommendations on how the federal government could "foster new architectures and technologies to secure the Nation's IT infrastructure." Specifically, the PITAC urged the government to

- significantly increase support for fundamental research in civilian cyber security in 10 priority areas;
- intensify federal efforts to promote the recruitment and retention of cyber security researchers and students at research universities;
- increase support for the rapid transfer of federally-developed cybersecurity technologies to the private sector; and
- strengthen the coordination of federal cybersecurity R&D activities.

Also in February 2005, the NCO released the FY2006 Supplement to the President's Budget.[14] The supplement provides a brief technical outline of the FY2006 budget request for the NITRD Program. The FY2007 Supplement has not yet been released.

NITRD Enabling and Governing Legislation

The NITRD Program is governed by two laws. The first, the High-Performance Computing Act of 1991, P.L. 102-194,[15] expanded federal support for high-performance computing R&D and called for increased interagency planning and coordination. The second, the Next Generation Internet Research Act of 1998, P.L. 105-305,[16] amended the original law to expand the mission of the NITRD Program to cover Internet-related research, among other goals.

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[13] This report is available at [http://www.nitrd.gov/pitac/reports/20050301_cyber security/cybersecurity.pdf].

[14] This report is available at [http://www.nitrd.gov/pubs/2006supplement].

[15] 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 at [http://www.nitrd.gov/congressional /laws/pl_102-194.html].

[16] 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 at [http://www.nitrd.gov/congressional/laws/pl_h_105-305.html].

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 the following.

- Setting goals and priorities for federal high-performance computing research, development, and networking.
- Providing for the technical support and research and development of high-performance computing 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.[17]

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.

[17] 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,[18] but no central coordinating body existed to ensure long-term coordination and planning. To provide such a framework, Congress passed the High-Performance Computing Program Act of 1991 to improve the interagency coordination, cooperation, and planning of agencies with high performance computing 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 communications 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 R&D and combating terrorism;
- funding grants to academic institutions; and
- 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."[19] One of the most significant of the CSTB's observations

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[18] "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, pp. 5-6.

[19] National Research Council, *Innovation in Information Technology*, 2003, p. 1. This report (continued...)

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.

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."[20] 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.[21]

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 sees a potential competitive or financial advantage; this has happened, for example with standards for instant messaging.[22]

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.[23] 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.

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[19] (...continued)
discusses all federal funding for R&D, not only the NITRD Program.

[20] Ibid, p. 4.

[21] Ibid, p. 4.

[22] Ibid, p. 18.

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

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.[24]

Activity in the 110th and 109th Congress

There has been no NITRD-specific activity in the 110th Congress. The 109th Congress introduced one bill and held three hearings related to the NITRD Program.

Major Legislation, 109th Congress

Representative Judy Biggert introduced H.R. 28, the High-Performance Computing Revitalization Act on January 4, 2005. The bill would have amended 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 reported the bill on April 12, 2005.[25] 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. H.R. 28 was agreed to by voice vote in the House on April 26, 2005, and received in the Senate, where it was read twice and referred to the Committee on Commerce, Science, and Transportation, on April 27, 2005.[26] No further action was taken.

Hearings, 109th Congress

On July 17, 2006, the Senate Committee on Commerce, Science and Transportation's Subcommittee on Technology, Innovation, and Competitiveness, held a hearing to discuss issues related to supercomputing research. In particular, the witnesses expressed concern that although supercomputers are now faster than ever, U.S. government investment in supercomputers had decreased significantly over the past decade, leaving such investment to the private sector. However, a number of witnesses noted that the Bush Administration's FY2007 budget calls for increased supercomputing research investment and that a consistent investment over the next few years would prompt industry and academia to invest more steadily as well.

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

[25] See H.Rept. 109-36.

[26] See H.Rept. 109-36.

On February 16, 2005, the House Committee on Science held a hearing to discuss the federal R&D Budget for FY2006.[27] This hearing covered the entire R&D budget and included an overview of NITRD activities by Dr. John Marburger, the Director of OSTP.

On May 12, 2005, the House Committee on Science held a hearing entitled, "The Future of Computer Science Research in the U.S."[28] That hearing focused on three primary areas of investigation.

- What effects are shifts in federal support for computer science (e.g., shifts in the balance between short- and long-term research, shifts in the roles of different agencies) having on academic and industrial computer science research and development?
- What impacts will these changes have on the future of the U.S. information technology industry and on innovation in this field?
- Are the federal government's current priorities related to computer science research appropriate? If not, how should they be changed?
- What should the federal government be doing to implement the recommendations of the recent PITAC report on cybersecurity?

At this hearing, the committee heard testimony from Dr. Marburger, OSTP; Dr. Anthony J. Tether; DARPA; Dr. William A. Wulf, National Academy of Engineering; and Dr. Tom Leighton, Akamai Technologies and member of the PITAC. Testimony from Drs. Marburger and Tether stressed the growing budget of computer research and their belief that the overall health of the U.S. science and technology research community remains strong. However, Doctors Wulf and Leighton, representing the research community, stated that they believed government needed to provide even more funding, as industry was not willing to fund the levels of fundamental research they believed necessary to sustain the United States' research needs.

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.

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

[28] The charter and submitted testimony for this hearing is available at [http://www.house.gov/science/press/109/109-71.htm].

Through hearings, the House Committee on Science has been 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 maintain 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.

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 was highlighted in 2003 when Japan briefly surpassed the United States in possessing the fastest and most efficient supercomputer in the world.[29] While this was a reason for some concern, it was also viewed by some as an indicator of how the United States' research agenda had become bifurcated, 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.[30] Therefore, one possible course for Congress could be to monitor closely the work that was begun by the High-End Computing Revitalization Task Force and is now being performed by the NITRD Program's High-End Computing Interagency Working Group and provide ongoing feedback and guidance.

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 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 a 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

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[29] 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.

[30] Ibid, p. 6-7.

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.

For Additional Reading

CRS Reports

CRS Report RL33345: *Federal Research and Development Funding: FY2007*, coordinated by Michael E. Davey.

CRS Report RL33511, *Federal Research and Development: Budgeting and Priority-Setting Issues, 109th Congress*, by Genevieve J. Knezo.

Websites

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

Reports and Documents

"Federal Plan for Cyber Security and Information Assurance Research and Development," Subcommittee on NITRD, April 2006, available at [http://www.nitrd.gov/pubs/csia/csia_federal_plan.pdf].

"Networking and Information Technology Research and Development: FY2007 Supplement to the President's Budget," Subcommittee on Networking and Information Technology Research and Development, National Science and Technology Council, February 2006, available at [http://www.nitrd.gov/pubs/2007supplement/]

"Superconducting Technology Assessment," National Security Agency, August 2005, available at [http://www.nitrd.gov/pubs/nsa/sta.pdf].

"Computational Science: Ensuring America's Competitiveness," President's Information Technology Advisory Committee, June 2005, available at [http://www.nitrd.gov/pitac/reports/20050609_computational/computational.pdf].

"Networking and Information Technology Research and Development: FY2006 Supplement to the President's Budget," Subcommittee on Networking and Information Technology Research and Development, National Science and Technology Council, February 2005, available at [http://www.nitrd.gov/pubs/2006supplement/].

"Cyber Security: A Crisis of Prioritization," President's Information Technology Advisory Committee, February 2005, available at [http://www.nitrd.gov/pitac/reports/20050301_cybersecurity/cybersecurity.pdf].