

Computing Research in the FY 2009 Budget Request

Peter Harsha, Computing Research Association

HIGHLIGHTS

- Funding for the Networking and Information Technology Research and Development (NITRD) program would increase 6.2 percent in the President's FY 2009 budget request (see Table I-9).
- The National Science Foundation (NSF), the primary supporter of university-led computer science research in the United States, would see its share of the NITRD program increase \$158.8 million or 17 percent to \$1.1 billion in FY 2009 under the President's plan.
- In July 2007, the President's Council of Advisors for Science and Technology (PCAST) released the first full review of the priorities and goals of the NITRD program in eight years. Its recommendations will likely form the basis for new NITRD authorizing legislation in 2008.

INTRODUCTION AND BACKGROUND

The importance of computing research in enabling the new economy is well documented. The resulting advances in information technology have led to significant improvements in product design, development and distribution for American industry, provided instant communications for people worldwide, and enabled new scientific disciplines like bioinformatics and nanotechnology that show great promise in improving a whole range of health, security, and communications technologies. Former Federal Reserve Board Chairman Alan Greenspan has said that the growing use of information technology has been the distinguishing feature of this "pivotal period in American economic history." Recent analysis suggests that the remarkable growth the U.S. experienced between 1995 and 2002 was spurred by an increase in productivity enabled almost completely by factors related to IT. A report by the Information Technology and Innovation Foundation released in March

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2007 noted: “In the new global economy information and communications technology (IT) is the major driver, not just of improved quality of life, but also of economic growth... In fact, in the United States IT was responsible for two-thirds of total factor growth in productivity between 1995 and 2002 and virtually all of the growth in labor productivity.”

Information technology has also changed the conduct of research. Innovations in computing and networking technologies are enabling scientific discovery across every scientific discipline—from mapping the human brain to modeling climatic change. Researchers, faced with research problems that are ever more complex and interdisciplinary in nature, are using IT to collaborate across the globe, simulate experiments, visualize large and complex datasets, and collect and manage massive amounts of data.

According to a 1995 report by the National Research Council, a significant reason for this dramatic advance in computing technology and the subsequent increase in innovation and productivity is the “extraordinarily productive interplay of federally funded university research, federally and privately funded industrial research, and entrepreneurial companies founded and staffed by people who moved back and forth between universities and industry.” That report, and a subsequent 1999 report by the President’s Information Technology Advisory Committee (PITAC), emphasized the “spectacular” return on the federal investment in long-term IT research and development.

However, in that 1999 report PITAC—a congressionally-chartered, presidentially-appointed committee charged with assessing the overall federal investment in IT R&D—also determined that federal support for IT R&D was inadequate and too focused on near-term problems; long-term fundamental IT research was not sufficiently supported relative to the importance of IT to the United States’ economic, health, scientific and other aspirations; critical problems in computing were going unsolved; and the rate of introduction of new ideas was dangerously low. The PITAC report included a series of recommendations, including a set of research priorities and an affirmation of the committee’s unanimous opinion that the federal government has an “essential” role in supporting long-term, high-risk IT R&D. This opinion was buttressed by the inclusion of a recommendation for specific increases in funding levels for federal IT R&D programs beginning in FY 2000 and continuing

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through FY 2004—an increase of \$1.3 billion in additional funding over those five years.

Though the funding levels actually appropriated to federal IT R&D programs never approached the level of the PITAC recommendations—federal agencies received \$2.2 billion in FY 2004 for IT R&D, \$476 million short of the final PITAC recommendation—the PITAC report has done much to shape the current federal IT R&D effort. As of FY 2008, that effort is now a \$3.3 billion, multi-agency enterprise called the Networking and Information Technology Research and Development (NITRD) program and coordinated by the Interagency Working Group (IWG) on Information Technology Research and Development of the National Science and Technology Council (NSTC). NITRD is the successor of the High Performance Computing and Communications Program established by Congress in 1991. NITRD agencies now coordinate research in eight Program Component Areas (PCAs).¹ The National Science Foundation (NSF) is the lead agency in NITRD.²

CURRENT POLICY ENVIRONMENT

Over the last twelve months there have been two significant developments in federal computing research policy. The first was the passage of the High Performance Computing Research and Development Act (H.R. 1068), which was ultimately incorporated into the America COMPETES Act that became law in August, 2007 (P.L. 110-69). The

¹ They are: High End Computing Infrastructure and Applications; High End Computing Research and Development; Human Computer Interaction and Information Management; Large Scale Networking; Software Design and Productivity; High Confidence Software and Systems; Social, Economic, and Workforce Implications of IT; and Cyber Security and Information Assurance.

² Other agencies include the Agency for Healthcare Research and Quality (AHRQ), Defense Advanced Research Projects Agency (DARPA), National Security Agency (NSA), Department of Defense Service Research Organizations, Department of Defense Office of the Secretary of Defense (OSD), Department of Energy (DOE) National Nuclear Security Administration (NNSA), DOE Office of Science, 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 Archives and Records Administration (NARA), and the Department of Homeland Security (DHS).

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bill amended the High Performance Computing and Communications Act of 1991—the bill that established what would ultimately become the NITRD program—to attempt to provide sustained, transparent access for the research community to federal high performance computing assets, assure a balanced research portfolio and beef up interagency planning.

The bill had appeared in various forms in the 106th through 109th Congresses, but had never gained the full approval of the Congress—almost always for reasons unrelated to the content of the bill itself. However, despite some concern about jurisdictional “friction” in the Senate that could have derailed the bill’s inclusion in the COMPETES Act, Senate and House conferees ultimately agreed to allow the House version of the bill into COMPETES with only one addition: an extra section that authorizes efforts in “Advanced Information and Communications Technology Research” at NSF.³ Otherwise, the HPC R&D Act remained essentially unchanged in its final version.

In addition to striking provisions of the old HPCC Act of 1991 that were no longer relevant to the NITRD program (because they referred to programs that had already ended or technologies that had already been superseded), the new Act contains two provisions requested by many in the computing research community. The first requires the White House Office of Science and Technology Policy (OSTP) to develop and maintain a research, development and deployment roadmap for the provision of federal high-performance computing systems. The second provides an explicit requirement that the President’s advisory committee for information technology (a role now filled by the President’s Council of Advisors for Science and Technology (PCAST)), review not only the goals of NITRD, but the funding levels as well and report the results of that review to Congress every two years.

The reason for this second request had to do with some frustration within the computing research community over the absence of such a comprehensive review of the NITRD program since the 1999 PITAC report *Investing in Our Future*. In the intervening eight years, the PITAC had reviewed portions of the NITRD program—primarily specific

³ The new “Advanced Information and Communications Technology Research” program will include research in such areas as affordable broadband access, network security, protocols and architectures, trusted software, privacy and implementation of equitable access to national advanced fiber optic research and educational networks.

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research areas like cyber security, computational science and health and information technology—but never examined the full scope of the research program and never examined whether the current cross-agency coordination mechanisms were adequate to achieve the program’s goals.

However, at about the same time as the HPC R&D Act was enacted as part of the COMPETES Act, PCAST, which had been charged with taking over the PITAC’s responsibility for reviewing the NITRD program, released a report that was almost completely responsive to the new reporting requirement in the HPC R&D Act.⁴ That report, released in early September 2007 and called *Leadership Under Challenge: Information Technology R&D in a Competitive World*, marked the second significant computing research policy development in 2007.

The report makes a strong case that America’s current global success relies in large part on our lead in information technologies, but that our favorable position in developing and adopting new networking and information technologies is far from assured. Other nations have recognized the value of leadership in IT and are mounting challenges, the report notes. Our current success rests on our leadership throughout the IT ecosystem—in the market positions of US IT firms, our IT commercialization systems and in the position of U.S. higher education and research systems. The committee concluded that the enabling foundation for that ecosystem was clear: early and continuing federal investments in IT R&D. Included with these findings are 35 recommendations for a range of players in the IT ecosystem, including federal agencies, the NITRD National Coordinating Office (NCO), OSTP, and the university and industrial research communities. Stated simply, the recommendations fit under four overarching themes: 1) Address the demand for skilled IT professionals by revamping curricula, increasing fellowships, and simplifying visa processes; 2) Emphasize larger-scale, longer-term, multidisciplinary IT R&D and innovative, higher-risk research; 3) Give priority to R&D in IT systems connected with the physical world, software, digital data and networking; and 4) Develop and implement strategic and technical plans for the NITRD program.

⁴ The only significant shortcoming of the new PCAST review of NITRD compared to the HPC R&D Act’s new requirements was its failure to review not just the program goals but the funding levels as well.

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It is that last overarching recommendation that is likely to form the basis of some legislative activity in the coming months. The PCAST report contains a number of specific recommendations for plans and studies to be drawn up and conducted by both the NCO and OSTP. Ensuring those recommendations get acted upon likely will be the focus of legislation under consideration by the House Science and Technology Committee (which has jurisdiction over both OSTP and the NITRD NCO). Though the committee anticipates introducing a bill by summer 2008, staff for Committee Chairman Bart Gordon (D-TN) predict they will not be able to move the bill much further than the committee by the end of the session. However, Chairman Gordon hopes that work this year will leave the committee well-positioned to act on the bill in the 111th Congress.

BUDGET REQUEST

Eight agencies included requests for FY 2009 funding as part of the NITRD activity. Under the President's plan, NSF would once again be designated as the lead agency for the initiative. For FY 2009, the President has requested \$3.5 billion for the NITRD initiative, an increase of 6.2 percent over FY 2008 (see Table I-9). The main growth in the NITRD budget would occur in the three agencies that are the focus of the President's American Competitiveness Initiative. NSF, DOE and NIST's IT R&D budgets would see increases of 17.0 percent, 13.4 percent, and 8.1 percent, respectively compared to their FY 2008 budgets. The remainder of the participating agencies would see flat or declining budgets under the President's plan.

National Science Foundation: The National Science Foundation is the only federal science agency with the mandate to support the broad range of sciences—a commitment that also extends to NSF's participation in NITRD, where it serves as the "lead agency" for the program and the only one supporting research in each of the eight NITRD PCAs. Under the President's plan, the agency would spend \$1.1 billion on NITRD-related research in FY 2009, an increase of \$159 million, or 17 percent.

The locus of NSF's NITRD activity is the foundation's Computing and Information Science and Engineering (CISE) directorate, which would account for \$639 million of NSF's NITRD-related R&D in FY 2009, an increase of \$104 million (or 19.5 percent) over the FY 2008 enacted level. CISE would continue to be the lead directorate for the Foundation-wide "Cyber-enabled Discovery and Innovation" initiative, which would

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more than double to \$100 million in FY 2009—including \$33 million in CISE—compared to \$48 million overall in FY 2008. Additionally, the Foundation requests two new Foundation-wide initiatives that have computing-related foci. The first is a \$20 million investment in “Science and Engineering Beyond Moore’s Law,” which aims to “position the U.S. at the forefront of communications and computation capability beyond the physical and conceptional limitations of current systems.” That program would be led by the Mathematics and Physical Sciences directorate, but CISE would control \$6 million in awards. The second is a \$15 million investment (\$3.5 million in CISE) in “Adaptive Systems Technology” that focuses on “generating pathways and interfaces between human and physical systems that will revolutionize the development of novel adaptive systems.”

Additionally, within CISE, the request includes \$78 million for a new Computing Fundamentals focus. This funding would be set aside for basic, potentially transformative research answering fundamental questions in computing that have the potential for “significant, enduring impact.” Foci include cyber-physical systems, data-intensive computing, software for complex systems, cybersecurity, network science and engineering and understanding “what is computable?” when humans and machines work together to solve problems neither can solve alone.

NSF’s Office of Cyberinfrastructure (OCI) would also see a significant increase in the President’s budget for FY 2009. Under the Administration’s plan, the office would grow 18.8 percent over FY 2008 to \$220 million. OCI supports the development, acquisition and operation of “state-of-the-art cyberinfrastructure resources,” which include everything from information technology resources and tools such as supercomputers, high-capacity mass-storage systems, system software suites and programming environments, to scalable interactive visualization tools, productivity software libraries and tools, and large-scale data repositories and information management systems. In FY 2009, the office plans to boost its support for software and services for complex science, engineering, and cyber services. In addition, OCI would spend an additional \$27 million on sustaining the operations of university supercomputing centers and to bridge them to the TeraGrid or Extensible Terascale Facility.

Department of Defense (DOD): Overall funding for IT R&D at DOD agencies would decrease by 1.0 percent to \$1.2 billion in FY 2009, but

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not all defense agencies would see a decrease. While the National Security Agency (NSA) and the service labs would see decreases of 13 percent and 6 percent respectively, the Defense Advanced Research Projects Agency (DARPA) would see its budget climb \$39.5 million in FY 2009 to \$570.2 million, an increase of 7.4 percent.

The bulk of DARPA's increase would go towards increased investments in its High Performance Computing Systems program, increases to support math and computer science institutes and partnerships and new efforts in large scale networking. These increases are offset somewhat by requested decreases to "selected information assurance projects" that are transitioning and a reduction to DARPA's participation in the Human-Computer Interaction PCA for programs that have completed work on software tools for collaborative cognition programs.

In February 2007, DARPA also reorganized the program offices largely responsible for its IT R&D efforts. The Information Exploitation Office (IXO), which focused on developing sensor and information systems technology for use in the battlespace, has been merged with the Information Processing Technology Office (IPTO)—which focused on inventing the networking, computing, and software technologies vital to the DOD mission—to form a new office called the Information Processing Techniques Office (IPTO). Some in the computing research community have concerns that the move might drive DARPA's IT R&D further toward a more development-oriented approach and away from more fundamental research efforts in IT, but staff in the new office have emphasized they plan to focus on both technology (which tends to be research-focused) and systems (which tend to be development-focused). The new office is headed by former IPTO Deputy Director Dr. Chuck Morefield.

Elsewhere in DOD, the service labs would see a reduction of \$34.8 million in FY 2009 to \$548 million, though the NITRD NCO indicates this is solely because of the elimination of "Congressional add-ons from 2008." Otherwise, under the President's plan the labs would continue their efforts in high end computing, cyber security, human-computer interaction, large scale networking, high confidence software and systems and software design.

NSA would see its IT R&D budget decline \$17.8 million to \$119.3 million. The decrease is related to the completion of the development of

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the El Dorado computing system and a decrease in the amount of funding needed for the Integrated High End Computing program.

Health and Human Services (HHS): NIH constitutes the bulk of funding in IT R&D at HHS. For FY 2009, the President's plan includes \$555.5 million in IT R&D funding at HHS, a decrease of 0.2 percent, or \$1.1 million less than the FY 2008 level. Within HHS, NIH participates in NITRD by supporting research that advances its mission of developing the basic knowledge for the understanding, diagnosis, treatment, and prevention of human disease. IT research in this area includes applying the power of computing to manage and analyze biomedical data and to model biological processes. NIH would receive \$509.6 million in FY 2009. AHRQ focuses on research into state-of-the-art IT for use in health care applications such as computer-based patient records, clinical decision support systems, and standards for patient care data. AHRQ would be funded at \$44.8 million for IT R&D under the request.

Department of Energy (DOE): IT R&D activities in DOE's Office of Science, NNSA, and, for the first time, the Office of Nuclear Energy and the Office of Fossil Energy constitute DOE's participation in NITRD. The Office of Science focuses on computational and networking tools that enable researchers to model, simulate, analyze, and predict complex physical, chemical and biological phenomena important to the department's overall mission. NNSA supports research developing new means of assessing the performance, safety, and reliability of nuclear weapons systems through high-fidelity computer models and simulations. Under the President's plan DOE NITRD funding would be \$494 million for FY 2009, an increase of 13.4 percent, or \$58.6 million.

The Office of Science's Advanced Scientific Computing Research (ASCR) program makes up the bulk of the department's participation in NITRD. For FY 2009, ASCR would grow to \$368.8 million, up 5 percent over FY 2008. ASCR's mission is to underpin and enable the efforts of programs within DOE SC, as well as "to provide the high-performance computational and networking resources that are required for world leadership in science." Included in the ASCR budget request is \$93.2 million for applied mathematics and computer science research, \$58.1 million for the Scientific Discovery through Advanced Computing program (SciDAC), and \$217.5 million for high-performance computing and network facilities and testbeds. NNSA would see an increase of \$1.2 million in NITRD-related funding to \$29.5 million for FY 2009.

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National Aeronautics and Space Administration (NASA): The President's request includes \$70.7 million for NASA IT R&D in FY 2009, down from \$72.3 million in FY 2008. NASA ascribes this decrease to a change in accounting procedures and not to actual cuts to IT R&D efforts. Within its NITRD-related efforts, NASA supports research in Cyber Security and Information Assurance, Large Scale Networking, and High Confidence Software and Systems, in order to focus on R&D aimed at implementing its "Vision for Space Exploration."

Department of Commerce (DOC): The DOC request for FY 2008 contains NITRD-related funding requests from two agencies: NOAA and NIST. NIST IT R&D efforts include working with industry, educational, and government organizations to make IT systems more useable, secure, scalable, and interoperable. In addition, NIST works to apply IT to specialized areas like biotechnology and manufacturing, and to encourage industry to accelerate development of IT innovations. The President's request includes \$67.0 million for NIST in FY 2009, an increase of \$5 million over FY 2008. NOAA supports IT research in emerging computer technologies for improved climate modeling and weather forecasting, and for improved communications technologies to disseminate weather products and warnings to emergency responders, policymakers, and the general public. The President's request includes \$23.3 million for NOAA in FY 2009, an increase of \$1 million.

Environmental Protection Agency (EPA): The EPA would receive \$6 million in FY 2009 under the President's plan, the same as it received in FY 2008. EPA intends to use that funding to support IT technologies that facilitate ecosystem modeling, risk assessment, and environmental decision making at the federal, state, and local levels.

National Archives and Records Administration (NARA): In 2006, the NSTC invited NARA to become a member of the NITRD program in recognition of the research NARA sponsors on problems that must be solved for effective lifecycle management of records in the context of e-government. The research focuses on the management and preservation of electronic records and fosters the development of advanced technologies for the management of electronic records for the current and future operations needs of government. For FY 2009, the agency requests \$4.5 million, the same as it received in FY 2008.