

Computing Research in the FY 2008 Budget Request

Peter Harsha, Computing Research Association

HIGHLIGHTS

- Funding for the Networking and Information Technology Research and Development (NITRD) program would increase 0.4 percent in the President's FY 2008 request versus the FY 2007 request (see Table I-9).

- The National Science Foundation (NSF) and the National Security Agency (NSA) are the only agencies that would see significant increases to their computing research efforts under the President's plan. The National Aeronautics and Space Administration (NASA) and the Department of Energy (DOE) would both see modest increases, while the remainder of the agencies participating in the NITRD program would see either flat budgets or moderate to significant declines.

- The President's Council of Advisors for Science and Technology will release in 2007 the first independent, full review of the NITRD program and its goals in eight years. Two additional studies of the IT R&D "ecosystem" are in progress and could see release in the coming months.

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

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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 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

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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 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 have 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 2007, that effort is now a \$3.0 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 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

While the evidence continues to mount that the development of information and communications technologies has profoundly affected

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 (DOD) Service Research Organizations, DOD Office of the Secretary of Defense (OSD), Department of Energy (DOE) National Nuclear Security Administration (NNSA), DOE Office of Science, Environmental Protection Agency (EPA), NASA, National Institutes of Health (NIH), National Institute of Standards and Technology (NIST), National Oceanic and Atmospheric Administration (NOAA), National Archives and Records Administration, and the Department of Homeland Security (DHS).

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the way the world works³—from the conduct of business, to improvements to our health and welfare, to the process of discovery—there appears to be a strong desire within federal advisory boards and Congress to understand more fully the ecosystem that enables innovation in information technology. Of most interest to federal policymakers is the role played by the federal government's link in this chain of IT innovation: the NITRD program. There are currently at least three ongoing studies of this IT ecosystem—and at least two (and perhaps all three) are expected to result in reports released in 2007.

The one likely to make the most impact is a review of the NITRD program and its goals by the President's Council of Advisors for Science and Technology (PCAST). In September 2005, the President dissolved the then-standing PITAC and incorporated its responsibilities into a newly-expanded (for the purpose) PCAST. In March 2006, PCAST created a Subcommittee on IT, co-chaired by PCAST members George Scalise (also President of the Semiconductor Industry Association) and Daniel Reed (Director of the Renaissance Computing Institute at the University of North Carolina, also Chair of the Computing Research Association), and tasked them with undertaking a full review of the NITRD program. The committee was charged with assessing progress made in implementing NITRD, the need to revise the program, assessing the balance between the components of the program, and whether the R&D undertaken by the program is helping to maintain United States leadership in IT and to ensure its future competitiveness.

The PCAST subcommittee held 10 meetings and workshops on the issue with community and federal government stakeholders between March 2006 and February 2007 and commissioned a large-scale review of all the available global data on the relative standing of the U.S. in the IT sector. After digesting all of this input, the subcommittee is expected to issue its first set of draft findings and recommendations in April 2007, with a final report expected during the summer of 2007. As this will be the first broad review of the NITRD program since the 1999 PITAC report that helped shape the current federal investment in research, many members of the computing community have shown great interest in what the committee has to say.

³ The ITIF study mentioned above, *Digital Prosperity: Understanding the Economic Benefit of the Information Technology Revolution* does a nice job of compiling the evidence of the impact of IT. See <http://itif.org/index.php?id=34>

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The other effort to understand the current IT ecosystem—and particularly the federal government’s role in supporting innovation—that is expected to see release in 2007 is a study for the Director of Defense Research and Engineering (DDR&E) at DOD. This study was originally requested in the FY 2006 Defense Authorization bill by members of the Senate Armed Services Committee who were concerned with understanding the impact of DARPA’s declining support for university computer science research on the DOD mission.⁴ However, since that original request, DDR&E has expanded the study to encompass the entire federal portfolio for computing research, arguing that in order to understand the impact of DARPA’s declining support on the agency mission, the study group needed to understand whether the “hole” from DARPA’s absence from this important portion of the portfolio was being filled by any other agency.

The DDR&E study group began meeting with members of the computing community during summer 2006. Indications are that DDR&E hopes to release the report sometime during 2007, but exactly when is not yet clear.

The third study is an effort by the National Research Council tentatively titled *Assessing the Impact of Changes in the Information Technology Research and Development Ecosystem*. The focus of this particular effort is to understand how changes in immigration policy, student interest, changes in research funding, and foreign approaches to intellectual property are impacting the IT R&D ecosystem. The NRC hopes to complete the study by early 2008.

The need to review current federal efforts in funding IT R&D also factors in the one significant policy proposal for IT R&D likely on Congress’ agenda for 2007. In March 2007, the House passed the High-Performance Computing R&D Act (H.R. 1068), a bill that would amend the High Performance Computing and Communications Act of 1991 (the same Act that established what would become the NITRD program) to provide sustained, transparent access for the research community to federal HPC assets, assure a balanced research portfolio and strengthen interagency planning efforts. The bill is very similar to efforts that failed to pass in the 106th-109th Congresses for a variety of reasons, very few

⁴ For a variety of reasons, support for university research in computer science at DARPA—once the key agency for developments in computing—dropped by half from 2001 to 2004.

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having to do with the actual content of the bills. Two key provisions in the bill would change the status quo. The first is a requirement that the Director of the Office of Science and Technology Policy (OSTP) “develop and maintain a research, development, and deployment roadmap for the provision of federal high-performance computing systems.” This “roadmapping” requirement is an attempt to bolster the interagency planning process—to get the agencies to work better together so that there is technology transfer across the various R&D programs and a strategy for advancing next-generational technologies.

The second noteworthy provision of the HPC R&D Act is an explicit requirement that the Presidential advisory committee for IT (currently PCAST) review the goals and funding levels of the NITRD program every two years and report the results of that review to Congress. This requirement is, in part, a response to some frustration from the community over the lack of timely, independent reviews of the NITRD program, and the hope that an explicit requirement to review the funding will allow the community to assess whether the current federal investment is adequate.

The Senate is likely to consider its own version of the HPC R&D Act in the coming months. There appears to be bipartisan support for action, so the computing community is cautiously optimistic that both provisions will find their way into law before the expiration of the 110th Congress.

BUDGET REQUEST

Eight agencies included requests for FY 2008 funding as part of the NITRD activity. For FY 2008, the President has requested \$3.1 billion for the NITRD initiative, an increase of 0.4 percent over the FY 2007 requested level (see Table I-9). The growth of the NITRD program in FY 2008 would slow compared with the increases in his FY 2007 request, when agencies that were the focus of the President’s American Competitiveness Initiative—NSF, NIST and DOE—requested double-digit percentage increases for NITRD-related research. In FY 2008, of the ACI agencies, only NSF enjoys that kind of priority with a requested 10 percent increase over its FY 2007 request. In contrast, NIST is held flat compared to its FY 2007 request and DOE would receive a modest 3.9 percent increase. The Department of Health and Human Services (HHS) would see its two NITRD agencies—NIH and AHRQ—endure cuts in FY 2008 under the President’s plan.

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National Science Foundation (NSF): NSF 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 \$994 million on NITRD-related research in FY 2008, an increase of \$90 million or 10 percent over its FY 2007 level.

The locus of NSF’s NITRD activity is the foundation’s Computing and Information Science and Engineering (CISE) directorate, which would account for \$574 million of NSF’s NITRD-related in FY 2008, an increase of \$47 million (or 9 percent) over the FY 2007 enacted level. The directorate is undergoing a leadership change in 2007. Dr. Peter Freeman, who served as the directorate’s head since January 2002, ended his term in January 2007. Dr. Jeannette Wing, currently head of the Computer Science Department at Carnegie Mellon University, will become the directorate’s new director beginning July 1, 2007. As the new CISE AD, Wing will also serve as the head of the NITRD Interagency Working Group.

The requested increase for CISE—along with funds freed up as the directorate’s Information Technology Research initiative (launched in 2001) ends—would allow the directorate to launch two new initiatives. The first is a \$50 million effort focused on “High-risk, High-return Research: Seeking Big Ideas in support of Grand Vision.” Programs in this area would focus on fundamental questions in computing, larger projects, and try to exploit the potential of emerging technologies.

The second is actually a foundation-wide initiative called “Cyber-enabled Discovery for Innovation” (CDI). This would be a \$52 million initiative in FY 2008 (of which CISE would receive \$20 million) that aims to “broaden the Nation’s capability for innovation by developing a new generation of computationally based discovery concepts and tools to deal with complex, data-rich and interacting systems.” NSF envisions the initiative growing at a rapid pace each year, ultimately reaching \$250 million (with CISE likely controlling a proportional share) in 2012.

Also noteworthy is CISE’s request to spend \$20 million on pre-construction planning for the Global Environment for Networking Innovations (GENI), a large-scale networking test bed that the computing community hopes will enable the research community to invent and

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demonstrate a global communications network and related services that will be qualitatively better than today's Internet.

NSF's Office of Cyberinfrastructure (OCI) would also see a significant increase in the President's budget for FY 2008 of 9.6 percent to \$200 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 suits and programming environments, to scalable interactive visualization tools, productivity software libraries and tools, and large scale data repositories and information management systems. In FY 2008, the office plans to boost its support for software and services for complex science engineering, and petascale application software development. In addition, OCI would spend an additional \$20 million on sustaining the operations of university supercomputing centers and to bridge them to the TeraGrid or Extensible Terascale Facility.

Department of Defense: Despite big cuts to DOD's requested computing research budget for FY 2007, computing research at DOD still managed to grow slightly in the FY 2007 appropriations process. Though congressional appropriators cut the requested budgets for DARPA's Integrated Cognitive Systems and Information and Communications Technology accounts, Congress still provided more money for each program in FY 2007 than they received in FY 2006.

Unlike last year's request, however, the President's request for FY 2008 would make cuts to computing research across the agency, including cuts to current funding for both ICT and Cognitive Computing. DOD's overall computing R&D budget would decline \$37 million to \$1.0 billion in FY 2008, a decline of 3.4 percent. DARPA's Cognitive Computing Systems account would shrink slightly to \$180 million in FY 2008, down \$0.3 million. DARPA's Information and Communications Technology account would also shrink to \$230 million, a reduction of \$4.3 million. Overall, DARPA's total IT R&D budget would drop \$7.4 million to \$413 million in FY 2008, a decline of 1.8 percent.

The DOD Service Labs and programs run under the Office of the Secretary of Defense would also see their computing research funding decline in FY 2008. The combined budgets would decline \$56 million to \$512 million in FY 2008, a drop of 9.9 percent from FY 2007.

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Only the NSA would see an increase in FY 2008, up \$27 million to \$103 million in FY 2008, a growth of 36.1 percent, as it ramps up its participation in the High-Productivity Computing Systems Phase III, along with research in advanced computing systems, quantum computing, information assurance requirements, and university-based R&D in file systems, system software and tools for complex systems.

Health and Human Services (HHS): NIH constitutes the bulk of funding in IT R&D at HHS. For FY 2008, the President's plan includes \$462 million in IT R&D funding at HHS, a decrease of 14.5 percent.

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. 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.

Department of Energy: IT R&D activities in DOE's Office of Science and NNSA 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 \$404 million for FY 2008, an increase of 3.9 percent, or \$15 million, from the FY 2007 level.

The Office of Science's Advanced Scientific Computing Research (ASCR) program makes up the bulk of the department's participation in NITRD. For FY 2008, ASCR would grow to \$340 million. ASCR's mission is to underpin and enable the efforts of programs within DOE Science, as well as "to provide the high-performance computational and networking resources that are required for world leadership in science." In FY 2008, the agency estimates that 47 percent of ASCR's budget would support facility operations, 40 percent would support research in the national labs, and 8 percent would fund university researchers. NNSA's NITRD-related funding would drop to \$33.8 million.

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National Aeronautics and Space Administration: Under the President's plan, NASA would see a 3.2 percent increase, or \$2.6 million over its FY 2007 requested level for its NITRD programs. The President's request includes \$85 million for NASA IT R&D in FY 2008. Within its NITRD-related efforts, NASA has reduced funding for 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 \$50 million for NIST in FY 2008, the same amount the agency requested in the FY 2007 budget.

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 million for NOAA in FY 2008, also the same amount the agency received in the FY 2007 budget.

Environmental Protection Agency: The EPA would receive \$6 million in FY 2008 under the President's plan, the same as requested in FY 2007. 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 2008, the agency requests \$5 million, \$1 million more than it requested in FY 2007.