

Computing Research in the FY 2001 Budget

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HIGHLIGHTS

- Information technology (IT) R&D continues to be a high priority for the Clinton Administration, which has proposed strong second-year funding for implementing the recommendations of the President's Information Technology Advisory Committee (PITAC).
- The FY 2001 budget request now consolidates all of the major interagency computing and communications research programs into a new crosscut, Information Technology R&D (IT R&D), the budget for which would grow from \$1.7 billion to \$2.3 billion, an increase of 34.5 percent (see Table I-10).
- The House has passed legislation to reauthorize the IT R&D programs, and a similar bill has been introduced in the Senate.

INTRODUCTION AND BACKGROUND

The mix of federally supported computing activities is dominated by several high-profile programs and coordinated multiagency efforts in which computing, computational, information, and networking research are interwoven. They are the present manifestation of a complex partnership among government, universities, and industry that has evolved over the past 50 years to advance the frontiers of information technology.

Within the context of this partnership, strategic federal investments in computing research drive precompetitive innovation and stimulate

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revolutionary advances in information technologies; improve the accessibility, robustness, reliability, and security of information infrastructure; and provide high-end computational and networking resources for government and university scientists working on problems of national importance.

It is often noted that federal research investments were responsible for the creation of the Internet. Today, the Internet economy alone generates \$300 billion in revenues, already rivaling century-old sectors like energy and automobiles. The information technology sector contributes a disproportionate share of the Gross Domestic Product and is disproportionately responsible for holding down the rate of inflation.

Most of the federal research agencies undertake some computing or information technology (IT) research. In general, however, only the National Science Foundation (NSF) and the Defense Advanced Research Projects Agency (DARPA) undertake *fundamental* research in a broad range of computing and communications areas. The contributions of mission-oriented agencies like the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA) tend toward research needed to produce computing, computational, and communications tools, applications, and infrastructure for the advancement of their missions.

CURRENT POLICY ENVIRONMENT

Information technology R&D policy is guided in large measure by the President's Information Technology Advisory Committee (PITAC), a congressionally chartered panel of IT experts and stakeholders. PITAC is concerned that federal support for IT R&D is inadequate and too focused on near-term problems. Based on PITAC's recommendations, the Administration initiated a long-term IT research program in FY 2000, known as Information Technology for the 21st Century (IT²). Five of the six agencies requesting funds to participate received full or nearly full appropriations to do so; the exception is DOE, which was denied any funding for participating in IT².

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In the FY 2001 budget request, the Administration has merged the IT² program, the High Performance Computing and Communications (HPCC) program, the Next Generation Internet (NGI) initiative, portions of DOE's Accelerated Strategic Computing Initiative (ASCI), and some core computing programs into a new interagency crosscut called Information Technology R&D (IT R&D). Given the new classification, it is also expected that the Administration will consolidate the various interagency coordination mechanisms for these programs.

In February, 2000, the House passed the Networking and Information Technology Research and Development Act (NITR&D, H.R. 2086), which would reauthorize HPCC and NGI, and establish new programs for long-term IT research and terascale computing. The measure is designed to respond to PITAC's recommendations and is consistent with the Administration's plans for IT R&D. A counterpart measure, the Next Generation Internet 2000 Act (S. 2046), has been introduced in the Senate and is pending in the Commerce Committee.

BUDGET REQUESTS AND PRIORITIES

Below is FY 2001 budget information on the IT R&D crosscut and selected agencies with significant computing research programs.

Information Technology R&D: The budget request for the IT R&D crosscut is \$2.3 billion, an increase of nearly \$600 million above the FY 2000 level and about \$1 billion more than similar spending in FY 1999. (See Table I-10 for a breakdown of IT R&D budgets by agency.)

Research priorities for IT R&D programs include: teams to exploit advances in computing; infrastructure for advanced computational modeling and simulation; more reliable software; storing, managing, and preserving data; intelligent machines and networks of robots; ubiquitous computing and wireless networks; managing and ensuring the security and privacy of information; future generations of computers; broadband optical networks; social, economic, and workforce implications of IT; and educating and training a new generation of researchers.

National Science Foundation (NSF): Overall, NSF would contribute \$740 million to the IT R&D crosscut. Much of this comes from the

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Computer and Information Science and Engineering (CISE) directorate, whose FY 2001 budget request is \$529 million, an increase of about \$141 million, or 36 percent, over estimated FY 2000 spending (see Table II-7). Most of the increase, \$100 million, would be for the Information Technology Research program; the remainder would be distributed among CISE's traditional divisions and activities.

CISE's Information Technology Research (ITR) activity supports broad thematic, large-scale, long-term, basic computer science research, including research that entails a higher risk than in established areas. Priority areas include: building "no-surprise," performance-engineered software and infrastructure systems; realizing broadband Internet access for tetherless devices; understanding, modeling, and predicting the behavior of networks; hardware/software co-design; multiplying individuals' physical and mental capabilities; meeting, working, and collaborating in cyberspace; building a ubiquitous content infrastructure for seamless retrieval of available information; and empowering computational discovery.

With the proposed FY 2001 increment, CISE would expand ITR to include support for connectivity programs; IT applications in biology; research to determine the reasons for the lower participation of women and minorities in IT education and career paths; research in interactive education; and mathematical methods underlying software, high confidence systems, large-scale networking, and high-end computing.

CISE would also expand activities in support of another NSF-wide research initiative, Nanoscale Science and Engineering; \$5 million would be spent in FY 2001 in the following areas: quantum computing; self-assembly of biomolecular computer components; algorithms for extracting signals from noise in atomic force microscopy; nano-robotics; design automation tools; and nanoscale cellular automata.

Apart from the focused initiatives, CISE would also use \$21 million of its increment to expand support for disciplinary research. Priority areas would include: research in cognitive neuroscience to increase understanding of how the human brain performs computational types of actions such as recognizing faces or voices; research, demonstrations, and technical assistance on ways to make technology more accessible;

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research in methods for storage and access of scientific data to improve the use of existing resources; research on visualization and analysis for large, scientific data sets; research on new mechanisms for computing such as quantum devices and DNA or chemical based techniques; fundamental research on networking to address needs such as increased users, new types of services, increased complexity of protocols, and wireless networked devices; research in biological applications such as genome sequencing and database tools, biomolecular computing, computational biology, and hydrology and ecosystems modeling.

Outside of CISE, the NSF has also requested \$45 million in second-year funding for its Terascale Computing Systems program in the Major Research Equipment account, an increase of \$9 million over FY 2000.

Department of Defense (DOD): There are three components included in DOD's contribution to the IT R&D crosscut: a portion of support from the Defense Advanced Research Projects Agency for computing and communications R&D (see below); \$80 million for the National Security Agency's Advanced Research and Development Activity (ARDA), a joint effort of DOD and the intelligence community to support long-term research on problems and enabling technologies relevant to intelligence and information security; and \$10 million for fundamental IT research within the DOD-wide University Research Initiative.

Defense Advanced Research Projects Agency (DARPA): There are three DARPA line-items related to computing: Computing Systems and Communications Technology, with an FY 2001 budget of \$377 million, which would be 17 percent more than current funding; Next Generation Internet, whose budget would shrink from \$36 million to \$15 million in FY 2001, as the initiative begins to wind down; and Extensible Information Systems, a line-item created in FY 2000 to reflect DARPA's participation in IT². DARPA is requesting \$70 million for Extensible Information Systems, up from the FY 2000 appropriation of \$30 million.

Department of Energy (DOE): DOE's two computing programs—the Advanced Scientific Computing Research (ASCR) activity in the civilian Office of Science and the Accelerated Strategic Computing Initiative (ASCI), a component of the Nuclear Stockpile Stewardship program—would see healthy budget increases in FY 2001.

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The ASCR budget would grow from \$128 million to \$182 million, a 42 percent increase. Under the FY 2001 plan, ASCR would emphasize computer modeling and simulation R&D in several key areas of basic science including fusion, high energy physics, and genomics; development of scientific computing, networking, and collaboration tools needed by DOE researchers; and advanced scientific software to enable unique, data intensive laboratories of the future and to meet terascale software challenges. ASCI, funded at \$510 million in FY 2000, would grow to \$595 million in FY 2001. Portions of both ASCR and ASCI are included under the IT R&D crosscut, as are some applications research efforts in other disciplines supported by the Office of Science.

National Institutes of Health (NIH): One of NIH's FY 2001 budget themes is Fostering Interdisciplinary Research, and it includes a new Biomedical Information Science and Technology Initiative (BISTI). For several years now, NIH has been emphasizing that progress in biomedical research depends on expertise from many disciplines beyond the traditional ones of biology and medicine, including computing and computational expertise. BISTI is designed to address those needs and will include support for National Programs of Excellence in Biomedical Computing Support; development of new tools and technologies to handle the increasing amount of biomedical data; training of bioinformatics specialists to address emerging research needs; and Centers of Excellence in Genomic Science. A portion of BISTI funding, \$217 million in FY 2001, is counted as part of the IT R&D initiative.

National Institute of Standards and Technology (NIST): NIST laboratory funding for Computer Sciences and Applied Mathematics would grow by more than \$10 million, to a total of nearly \$56 million. Of the increment, \$5 million would be used to establish a team of computer security experts to help federal agencies protect their information systems in accordance with White House directives on critical infrastructure protection; another \$5 million would support research and development on new measurements, standards, test methods, and guidelines that identify and remedy vulnerabilities to natural and intentional disruptions of the IT elements of the Nation's critical infrastructures; and \$1 million would be used to provide a foundation of measurements and standards relating to advanced wireless communications technologies.