

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

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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.

Current concerns are the role of the federal government in supporting IT R&D and the level of funding to allot to it. Proponents of federal support of information technology (IT) R&D assert that it 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. 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 President's FY2014 budget request for the NITRD Program was $3.968 billion, an increase over the FY2013 request of $3.808 billion. The final FY2014 funding levels and FY2013 actual expenditures have not yet been calculated. FY2012 NITRD actual expenditures totaled $3.810 billion.

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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 and software that would be capable of addressing the problems and issues the government needed to solve and study. One of the first such problems was calculating the trajectories of artillery and bombs; more recently, such problems include simulations of nuclear testing, cryptanalysis, and weather modeling. That interest continues today. These complex issues have led to calls for coordination to ensure the government's evolving needs (e.g., homeland security) will continue to be met in the most effective manner possible.

Structure

Established by the High-Performance Computing Act of 1991 (P.L. 102-194), the Networking and Information Technology Research and Development (NITRD) Program is the primary mechanism by which the federal government coordinates its unclassified networking and information technology (NIT) R&D investments. Eighteen federal agencies, including all of the large science and technology agencies, are formal members of the NITRD Program,[1] with many other federal entities participating in NITRD activities. The program aims to ensure that the nation effectively leverages its strengths, avoids duplication, and increases interoperability in such critical areas as supercomputing, high-speed networking, cybersecurity, software engineering, and information management. **Figure 1** illustrates the organizational structure of the NITRD Program.

The National Coordinating Office (NCO) coordinates the activities of the NITRD Program. The NCO was first established in September 1992 and was initially called the National Coordination Office for High Performance Computing and Communications (NCO/HPCC). Its name has changed several times over the years; as of July 2005, it is referred to as the National Coordination Office for Networking and Information Technology Research and Development (NCO/NITRD). The NCO/NITRD supports the planning, coordination, budget, and assessment activities of the Program. The NCO's role in the NITRD enterprise is recognized in the National Science and Technology Council (NSTC) charters, authorizing NITRD Program structures as well as in legislation and congressional hearings. The Director of the White House Office of Science Technology and Policy (OSTP) appoints a Director for the NCO. The Director of the NCO reports to the Director of the White House Office on Science and Technology Policy (OSTP). The NCO supports the National Science and Technology Council's Subcommittee on NITRD (also called the NITRD Subcommittee).[2] The NITRD Subcommittee provides policy,

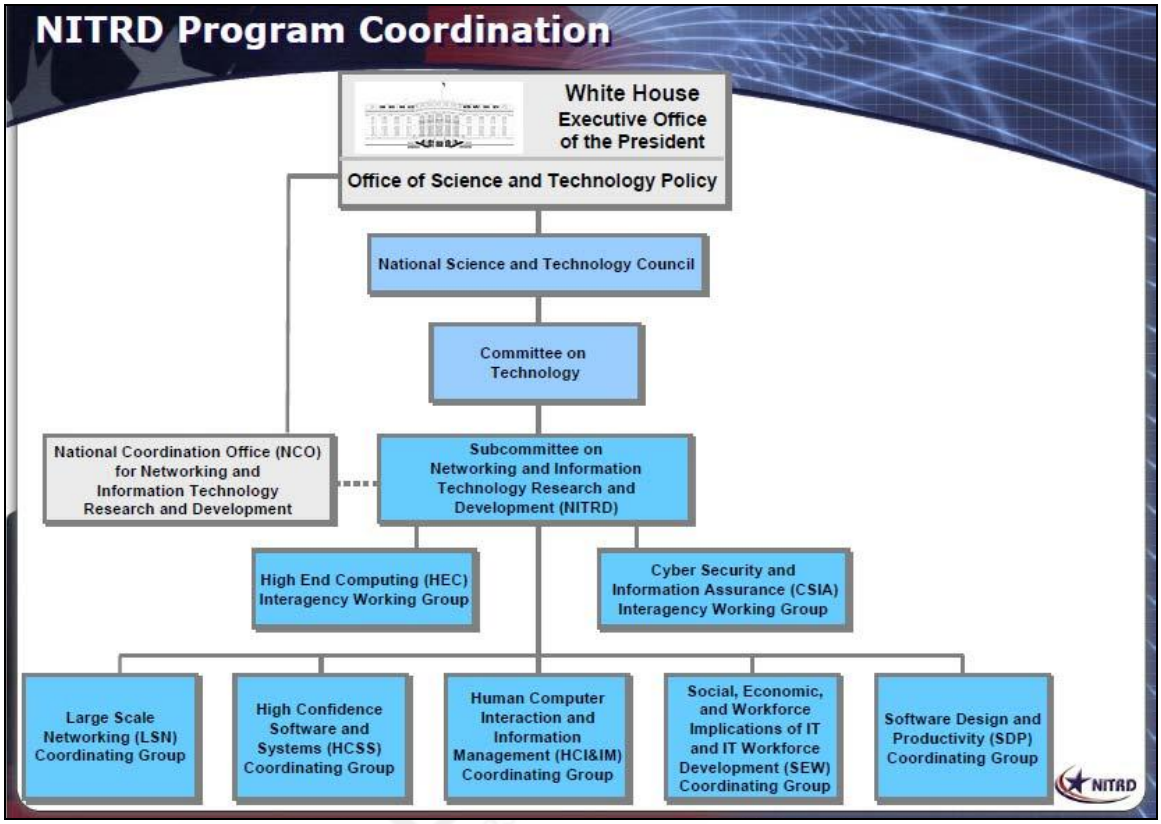
[1] Department of Commerce (DOC): National Institute of Standards and Technology (NIST), National Oceanic and Atmospheric Administration (NOAA); Department of Defense (DOD): Defense Advanced Research Projects Agency (DARPA), National Security Agency (NSA), Office of the Secretary of Defense (OSD) and Service Research Organizations (Air Force Office of Scientific Research (AFOSR), Air Force Research Laboratory (AFRL), Army Research Laboratory (ARL), Office of Naval Research (ONR); Department of Energy (DOE): National Nuclear Security Administration (DOE/NNSA), Office of Science (DOE/SC); Department of Homeland Security (DHS); Department of Health and Human Services (HHS): Agency for Healthcare Research and Quality (AHRQ), National Institutes of Health (NIH), Office of the National Coordinator for Health Information Technology (ONC); Environmental Protection Agency (EPA); National Aeronautics and Space Administration (NASA); National Archives and Records Administration (NARA); National Science Foundation (NSF).

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

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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.

Figure 1. Management Structure of the NITRD Program



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

NITRD Program activities are described under a set of eight Program Component Areas (PCAs),[3] four Senior Steering Groups (SSGs),[4] and a Community of Practice (CoP).[5] The PCAs are identified as an Interagency Working Group (IWG) or a Coordinating Group (CG) and report their R&D budgets as a crosscut of the NITRD agencies. They are charged with facilitating interagency program planning, developing and periodically updating interagency roadmaps, developing recommendations for establishing federal policies and priorities, summarizing annual activities for the NITRD program's Supplement to the President's Budget, and identifying potential opportunities for collaboration which has been identified by OMB and OSTP as priorities for federal coordination and collaboration. In addition to the PCAs, NITRD has

[3] Cyber Security and Information Assurance (CSIA); High-Confidence Software and Systems (HCSS); High-End Computing Infrastructure and Applications (HEC I&A); High-End Computing Research and Development (HEC R&D); Human-Computer Interaction and Information Management (HCI&IM); Large-Scale Networking (LSN); Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW); Software Design and Productivity (SDP).

[4] Big Data SSG; Cyber Security and Information Assurance R&D SSG; Health Information Technology R&D SSG; Wireless Spectrum R&D SSG.

[5] Faster Administration of Science and Technology Education and Research (FASTER) Community of Practice (CoP).

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established several Senior Steering Groups (SSGs). The SSGs allow a more flexible model for NITRD collaboration and are formed to focus on emerging issues as required by a mandate from OSTP. SSGs do not report an R&D budget under NITRD. The CoP's goal is to enhance collaboration and accelerate agencies' adoption of advanced IT capabilities developed by government-sponsored IT research. The NITRD Subcommittee convenes three times a year and the working groups meet approximately 12 times annually and provide input to the NITRD Supplement to the President's Budget.

Budget, Funding, and Spending

The NITRD budget is an aggregation of the IT R&D components of the individual budgets of NITRD-participating agencies and is reported in the annual release of *The Networking and Information Technology Research and Development Program Supplement to the President's Budget*. The NITRD budget is not a single, centralized source of funds that is allocated to individual agencies. In fact, the agency IT R&D budgets are developed internally as part of each agency's overall budget development process. These budgets are subjected to review, revision, and approval by the Office of Management and Budget and become part of the President's annual budget submission to Congress. The NITRD budget is then calculated by aggregating the IT R&D components of the appropriations provided by Congress to each federal agency.

An interactive history of NITRD Program funding, dating to 1991, is available online at http://www.nitrd.gov/open/index.aspx. Additional information is available at http://www.nitrd.gov/pubs/2009supplement/nitrd_history/NITRD-crosscut.pdf.

FY2014 Budget

The President's FY2014 budget request for the NITRD Program was $3.968 billion,[6] an increase over the FY2013 request of $3.808 billion. The final FY2014 estimated funding levels and FY2013 actual expenditures have not yet been calculated.[7] FY2012 NITRD actual expenditures totaled $3.810 billion.

FY2012 and FY2013 Budgets

FY2013 appropriations bills from the Senate and the House were not passed before the end of the 112th Congress. H.J.Res. 117, passed by the House on September 13, 2012, provides a framework for a six-month Continuing Resolution that began on October 1, 2013. On March 26, 2013, the President signed the Consolidated and Further Continuing Appropriations Act of 2013 (P.L. 113-6), which funded the majority of the federal government at close to FY2012 levels for the remainder of FY2013.

[6] NITRD Supplement to the President's Budget, FY2014, http://www.nitrd.gov/Publications/PublicationDetail.aspx?pubid=48.

[7] Differences between the President's Budget request for a given year and estimated/actual spending for that year reflect revisions to program budgets due to evolving priorities, as well as congressional actions and appropriations. In addition, the NITRD agencies have continued to work collectively on improving the PCA definitions, as reflected by changes in the definitions outlined in OMB Circular A-11, and individually on improving the classification of investments within the PCAs, resulting in changes in the NITRD Program budget figures.

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Reports, 2010-2012[8]

As explained earlier, the NCO provides technical and administrative support to the NITRD Program and the NITRD Subcommittee. This includes supporting meetings and workshops and preparing reports. The NCO interacts with OSTP and Office of Management and Budget (OMB) on NITRD Program matters. Additionally, in accordance with a presidential executive order and law, the NITRD Program is reviewed biannually.

NITRD Program 2012 Strategic Plan

In July 2012, the NTSC and NCO released the five-year strategic plan for the NITRD Program. This plan responds to the August 2007 assessment of the NITRD Program by the PCAST, *Leadership Under Challenge: Information Technology R&D in a Competitive World*.[9] In this report, the PCAST recommended that NITRD "develop, maintain, and implement a cohesive strategic plan" that includes "a comprehensive technology vision and strategy that identify the next generation and future generations of important networking and information technology challenges and describe how to meet those challenges."

This plan presents the NCO's overarching vision for the digital world in the 21st century—a world in which high-speed networks, systems, software, devices, data, and applications are fully secure, safe, reliable, multimodal, and easy to use. In the envisioned future, next-generation IT infrastructure and capabilities will enable continued U.S. leadership in economic innovation, scientific discovery, national security, education, and quality of life. To realize this vision, the plan calls for advancing U.S. capabilities in three broad areas identified as the essential "foundations" for sustained leadership in a digital world:

- WeCompute—Expanded human-computer partnerships, including more capable, available, and affordable systems; more powerful digital tools for people; and new forms of collaboration between the two.
- Trust and Confidence—The ability to design and build systems with levels of security, safety, privacy, reliability, predictability, and dependability that "you can bet your life on."
- Cyber Capable—Transformed education and training to ensure that current generations benefit fully from cyber capabilities and to inspire a diverse, prepared, and highly productive next-generation workforce of cyber innovators.

The strategic plan discusses the topical elements of each foundation and summarizes the principal research and education challenges that need to be addressed, providing a comprehensive research and education strategy for the future. The plan concludes that the NITRD Program should pursue expanded multiagency collaboration; cultivate new forms of partnership with academia and industry; and continue to lead by example in multidisciplinary activities and identification of critical-path research needs.

[8] All NITRD reports are available online at http://www.nitrd.gov/Publications/index.aspx.

[9] This report is available online at http://www.nsf.gov/geo/geo-data-policies/pcast-nit-final.pdf.

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Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program

In December 2011, the NSTC released, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*.[10] The report defines a set of interrelated priorities for the agencies of the U.S. government that conduct or sponsor R&D in cybersecurity. The priorities are organized into four thrusts: Inducing Change, Developing Scientific Foundations, Maximizing Research Impact, and Accelerating Transition to Practice.

The thrusts provide a framework for prioritizing cybersecurity R&D in a way that concentrates research efforts on limiting current cyberspace deficiencies, precluding future problems, and expediting the infusion of research accomplishments into the marketplace. The principal objectives of the thrusts include achieving greater cyberspace resiliency, improving attack prevention, developing new defenses, and enhancing U.S. capabilities to design software that is resistant to attacks.

The Inducing Change thrust includes a new priority theme named Designed-in Security, together with the existing themes of Tailored Trustworthy Spaces, Moving Target, and Cyber Economic Incentives. The Designed-in Security theme focuses on developing capabilities to design and evolve high-assurance systems resistant to cyberattacks, whose assurance properties can be verified. Such development capabilities offer the path to dramatic increases in the security and safety of software systems.

Explicit in the execution of this plan is the coordination process across government agencies through the NITRD Program and the leadership function of the NITRD Cyber Security and Information Assurance Interagency Working Group (CSIA IWG), the federal government's principal group for coordinating cybersecurity R&D activities. In conjunction with OSTP, the NITRD Senior Steering Group for Cybersecurity R&D, and the Special Cyber Operations Research and Engineering SCORE Interagency Working Group, the CSIA IWG assures that the execution of this plan by individual federal research agencies is coordinated, cohesive, and complementary.

Designing a Digital Future: Federally Funded Research and Development in Networking Information and Technology

In December 2010, the President's Council of Advisors on Science and Technology (PCAST)[11] released, *Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology*.[12] This report fulfilled PCAST's responsibility to report on the status of the NITRD Program under Executive Order 13539 and the High-Performance Computing Act of 1991 (P.L. 102-194).[13] PCAST appointed an expert 14-member Working Group, which consulted with more than 50 individuals, including government officials, industry

[10] This report is available online at http://www.whitehouse.gov/sites/default/files/microsites/ostp/fed_cybersecurity_rd_strategic_plan_2011.pdf.

[11] The PCAST was acting in its role as the President's Innovation and Technology Advisory Council (PITAC).

[12] This report is available online at http://www.nitrd.gov/pcast-2010/report/nitrd-program/pcast-nitrd-report-2010.pdf.

[13] As amended by the Next Generation Internet Research Act of 1998 (P.L. 105-305) and by the America COMPETES Act of 2007 (P.L. 110-69).

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representatives, and experts from academia, to develop a comprehensive review of the program. PCAST found that NITRD is well coordinated and that the U.S. computing research community, coupled with a vibrant NIT industry, has made seminal discoveries and advanced new technologies that are helping to meet many societal challenges. Importantly, however, PCAST also found that

> a substantial fraction of the NITRD multi-agency spending summary represents spending that supports R&D in other fields, rather than spending on R&D in the field of NIT itself. As a result, the United States is actually investing far less in NIT R&D than the $4 billion-plus indicated in the Federal budget. To achieve America's priorities and advance key research frontiers to support economic competitiveness in NIT, this report calls for a more accurate accounting of this national investment and recommended additional investments in NIT R&D, including research in networking and information technology for health, energy and transportation, and cyber-infrastructure.[14]

The PCAST stated its belief that NIT has yielded enormous benefits for the nation's economic competitiveness, national security, and quality of life. It stressed the importance of maintaining the country's leadership in NIT in an ever more competitive global environment, encouraging the federal government to be bold in its investments, including funding of high risk/high reward research with the potential to move NIT in unanticipated directions.

Federal Technology Funding: Background and Context

In the early 1990s, Congress recognized that several federal agencies had ongoing high-performance computing programs,[15] 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

[14] Designing a Digital Future: Federally Funded Research and Development in Networking and Information Technology, p. v.

[15] "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.

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- 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 of federal funding of IT R&D contend that it 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."[16] The CSTB's observation 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."[17] 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.[18]

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 typically diverge from a common standard if it sees a potential competitive or financial advantage; this happened, for example, with standards for instant messaging.[19]

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.

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

[17] Ibid., p. 4.

[18] Ibid., p. 4.

[19] Ibid., p. 18.

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Critics have asserted that the government, through its funding mechanisms, may set itself up to pick "winners and losers" in technological development, a role more properly residing with the private sector.[20] For example, the size of the NITRD Program could encourage industry to follow the government's lead on research directions rather than selecting those directions itself.

Overall, CSTB stated 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.[21]

Legislation in the 113th Congress

Seven bills have been introduced that would affect the NITRD Program and one hearing has been held that addressed the activities of the NITRD Program member agencies.

H.R. 756—Cybersecurity Enhancement Act of 2013

H.R. 756 was introduced by Representative Michael McCaul on February 15, 2013. The bill was reported (amended) on April 11, 2013 (H.Rept. 113-33). It was passed by the House and referred to the Senate Committee on Commerce, Science, and Transportation on April 17, 2013.

This bill would—

- Require NITRD member agencies to provide to Congress a cybersecurity strategic research and development plan and triennial updates, and develop and annually update an implementation roadmap for such plan.
- Expand permitted National Science Foundation (NSF) grants for basic research on innovative approaches to the structure of computer and network hardware and software that are aimed at enhancing computer security to include research into identity management, crimes against children, and organized crime.
- Require applications for the establishment of Computer and Network Security Research Centers to include a description of how such Centers will partner with government laboratories, for-profit entities, other institutions of higher education, or nonprofit research institutions.
- Repeal the Cyber Security Faculty Development Traineeship Program.
- Require the NSF Director to continue carrying out a Scholarship for Service program under the Cyber Security Research and Development Act.
- Direct the President to transmit a report to Congress addressing the cybersecurity workforce needs of the federal government.

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

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

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- Require the Office of Science and Technology Policy (OSTP) Director to convene a cybersecurity university-industry task force to explore mechanisms for carrying out collaborative R&D activities.
- Revise provisions concerning the development and dissemination by the National Institute of Standards and Technology (NIST) of security risk checklists associated with computer systems that are, or are likely to become, widely used within the federal government.
- Require conducting intramural security research activities under NIST's computing standards program.
- Require the NIST Director to (1) ensure coordination of U.S. government representation in the international development of technical standards related to cybersecurity; (2) maintain a cybersecurity awareness and education program through the Hollings Manufacturing Extension Partnership program; and (3) continue a program to support development of technical standards, metrology, testbeds, and conformance criteria with regard to identity management research and development.

H.R. 967—Advancing America's Networking and Information Technology Research and Development Act of 2013[22]

H.R. 967 was introduced by Representative Cynthia Lummis on March 5, 2013. The bill was reported (H.Rept. 113-34)[23] by the House Committee on Science, Space, and Technology on April 11, 2013, and referred to the Senate Committee on Commerce, Science, and Transportation on April 17, 2013. This bill would:

- Amend the High-Performance Computing Act of 1991 to rename the National High-Performance Computing Program as the NITRD Program.
- Direct the federal agencies participating in the Program to

  (1) periodically assess the contents and funding levels of program component areas and restructure the Program when warranted; and

  (2) ensure that the Program includes large-scale, long-term, interdisciplinary R&D activities.
- Require the participating federal agencies to develop, and update every three years, a five-year strategic plan to guide activities provided for under the Program.
- Require the Director of the OSTP to encourage and monitor the efforts of participating agencies to allocate the resources and management attention necessary to ensure that the strategic plan is executed effectively and that Program objectives are met.

[22] H.R. 1468, the SECURE IT Act of 2013, is a related bill to H.R. 3834. Section 407 of the bill contains conforming and technical amendments to the High-Performance Computing Act of 1991. However, it does not change the functions of the program or its management structure.

[23] This document is available online at http://www.gpo.gov/fdsys/pkg/CRPT-113hrpt34/pdf/CRPT-113hrpt34.pdf.

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- Require the Program, in addition to its current requirements, to provide for

  (1) increased understanding of the scientific principles of cyber-physical systems and improve the methods available for the design, development, and operation of such systems; and

  (2) research and development on human-computer interactions, visualization, and big data.

- Require continuation of an NCO and require the Director of the Office to

  (1) convene a task force to explore mechanisms for carrying out collaborative R&D activities on cyber-physical systems; and

  (2) examine issues around funding mechanisms and policies for the use of cloud computing services for federally funded science and engineering research, through the NTSC, an interagency working group.

H.R. 1468—Strengthening and Enhancing Cybersecurity by Using Research, Education, Information, and Technology Act of 2013 (SECURE IT) Act of 2013

H.R. 1468 was introduced by Representative Marsha Blackburn on April 10, 2013. The bill was referred to the Committee on Science, Space, and Technology, and in addition to the Committees on Oversight and Government Reform, the Judiciary, Armed Services, Intelligence (Permanent Select), and Energy and Commerce, in each case for consideration of provisions that fall within the jurisdiction of the committee concerned, on April 10, 2013. On April 30, 2013, the bill was referred to the Committee on the Judiciary's Subcommittee on Crime, Terrorism, Homeland Security, and Investigations. In addition to other purposes, this bill contains NITRD-related provisions similar to those in H.R. 967.

H.R. 2413—Weather Forecasting Improvement Act of 2013

H.R. 2413 was introduced by Representative Jim Bridenstine on June 18, 2013. The bill was referred to the Committee on Science, Space, and Technology's Subcommittee on Environment on July 8, 2013, and a consideration and mark-up session was held the following day. On December 5, 2013, a committee mark-up was held and the bill was ordered to be reported in the nature of a substitute. The final bill removed the provision in the original bill that would have required the National Oceanic and Atmospheric "to issue a specified plan for high performance computing support of its advanced research and operational weather prediction models."

H.R. 2495—American Super Computing Leadership Act of 2013

H.R. 2495 was introduced by Representative Randy Hultgren on June 25, 2013. The bill was referred to the Committee on Science, Space, and Technology's Subcommittee on Energy on September 24, 2013. This bill would:

- Amend the Department of Energy High-End Computing Revitalization Act of 2004 with respect to

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(1) exascale computing (computing system performance at or near 10 to the 18th power floating point operations per second); and

(2) a high-end computing sytem with performance substantially exceeding that of systems commonly available for advanced scientific and engineering applications.

- Direct the Secretary of Energy (DOE) to

  (1) coordinate the development of high-end computing systems across DOE;

  (2) partner with universities, National Laboratories, and industry to ensure the broadest possible application of the technology developed in the program to other challenges in science, engineering, medicine, and industry; and

  (3) include among the multiple architectures researched, at DOE discretion, any computer technologies that show promise of substantial reductions in power requirements and substantial gains in parallelism of multicore processors, concurrency, memory and storage, bandwidth, and reliability.

- Repeal authority for establishment of at least one High-End Software Development Center.
- Direct the Secretary to conduct a coordinated research program to develop exascale computing systems to advance DOE missions, requiring establishment through competitive merit review of two or more DOE National Laboratory-industry-university partnerships to conduct integrated research, development, and engineering of multiple exascale architectures.
- Require the Secretary to conduct mission-related co-design activities in developing such exascale platforms. Defines "co-design" as the joint development of application algorithms, models, and codes with computer technology architectures and operating systems to maximize effective use of high-end computing systems.
- Direct the Secretary to develop any advancements in hardware and software technology required to realize fully the potential of an exascale production system in addressing DOE target applications and solving scientific problems involving predictive modeling and simulation and large-scale data analytics and management. Requires DOE also to explore the use of exascale computing technologies to advance a broad range of science and engineering.
- Direct the Secretary to submit to Congress an integrated strategy and program management plan.
- Require the Secretary, before initiating construction or installation of an exascale-class computing facility, to transmit to Congress a separate plan detailing

  (1) the proposed facility's cost projections and capabilities to significantly accelerate the development of new energy technologies;

  (2) technical risks and challenges that must be overcome to achieve successful completion and operation of the facility; and

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(3) an independent assessment of the scientific and technological advances expected from such a facility relative to those expected from a comparable investment in expanded research and applications at terascale-class and petascale-class computing facilities, including an evaluation of where investments should be made in the system software and algorithms to enable these advances.

S. 733—Exascale Computing for Science, Competitiveness, Advanced Manufacturing, Leadership, and the Economy Act of 2013

S. 733 was introduced by Senator Lamar Alexander on April 16, 2013. The bill was referred to the Committee on Energy and Natural Resources the same day. This bill would:

- Direct the Secretary of Energy (DOE) to

  (1) conduct a research program to develop exascale computing machines to promote DOE missions;

  (2) establish national laboratory-industry partnerships for the research and development of exascale computing machines across all applicable DOE agencies;

  (3) implement the program through an integration of application, computer science, and computer hardware architecture using public-private partnerships to ensure that exascale computing machines are capable of solving DOE target applications and scientific problems; and

  (4) use existing funds to carry out the program.

- Rename the Department of Energy High-End Computing Revitalization Act of 2004 as the Exascale Computing for Science, Competitiveness, Advanced Manufacturing, Leadership, and the Economy Act of 2013.
- Define "exascale computing" as computing through the use of a computing machine that performs near or above 10 to the 18^{th} power floating point operations per second.
- Authorize appropriations for FY2014-FY2016.

S. 884—Deter Cyber Theft Act of 2013

S. 884 was introduced by Senator Carl Levin on May 7, 2013. The bill was referred to the Committee on Finance the same day. This bill would:

- Require the Director of National Intelligence (DNI) to annually report to specified congressional committees on foreign countries that engage in economic and industrial espionage in cyberspace with respect to U.S. trade secrets or proprietary information and require each report to identify countries that engage in such espionage as well as countries that engage in the most egregious forms of such espionage.
- Direct the President to exclude from entry into the United States any article produced or exported by an entity identified within any such report, as long as the President determines that such exclusion is warranted for the enforcement of

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intellectual property rights or to protect the integrity of the Department of Defense (DOD) supply chain.

S. 1353—Cybersecurity Act of 2013

S. 1353 was introduced by Senator John Rockefeller on July 24, 2013. The bill was referred to the Committee on Commerce, Science, and Transportation and ordered to be reported with an amendment in the nature of a substitute favorably, on July 30, 2013. In addition to other purposes, this bill would direct specified agencies under the High-Performance Computing Act of 1991 to support research leading to a scientific foundation for the field of cybersecurity.

Hearings in the 113th Congress

One hearing has been held related to the NITRD Program.

Applications for Information Technology Research & Development

"Applications for Information Technology Research & Development," was held by the House Committee on Science and Technology's Subcommittee on Research and Technology, on February 14, 2013.[24] Witnesses at the hearing were: Dr. Kelly Gaither, Director, Visualization Lab, Texas Advanced Computing Center, University of Texas, Austin; Dr. Kathryn McKinley, Principal Researcher, Microsoft; and Dr. Ed Lazowska, Bill and Melinda Gates Chair in Computer Science and Engineering, University of Washington. The purpose of the hearing was to examine how to protect essential systems and networks that support fundamental sectors of the U.S. economy, such as emergency communications, power grids, air-traffic control networks, and national defense systems.

Activity in the 112th Congress

Three bills were introduced that would have affected the NITRD Program and two hearings were held that addressed the activities of the NITRD Program member agencies.

Legislation

Three pieces of legislation were introduced in the 112th Congress that would have had an effect on the NITRD member agencies: H.R. 3834, the Advancing America's Networking and Information Technology Research and Development Act of 2012; H.R. 2096, the Cybersecurity Enhancement Act of 2011; and S. 1152, also called the Cybersecurity Enhancement Act of 2011. H.R. 2096 and S. 1152 are identical.

[24] The hearing main page can be found at http://science.house.gov/hearing/subcommittee-research-applications-information-technology-research-devlopment.

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H.R. 3834—Advancing America's Networking and Information Technology Research and Development Act of 2012[25]

H.R. 3834 was introduced by Representative Ralph Hall on January 27, 2012. The bill was reported (H.Rept. 112-420)[26] by the Committee on Science, Space, and Technology on March 22, 2012, and passed April 27, 2012. It was referred to the Senate Committee on Commerce, Science, and Transportation on May 7, 2012. This bill was substantially similar to a bill introduced in the 113th Congress, H.R. 967—Advancing America's Networking and Information Technology Research and Development Act of 2013.

H.R. 2096 and S. 1152—Cybersecurity Enhancement Act of 2011

H.R. 2096 was introduced by Representative Michael McCaul on June 2, 2011. The bill was reported (amended) on October 31, 2011 (H.Rept. 112-264). It was passed by the House and referred to the Senate Committee on Commerce, Science, and Transportation on May 7, 2012.

S. 1152 was introduced by Senator Robert Menendez on June 7, 2011. The bill was referred to the Senate Committee on Commerce, Science, and Transportation, and no further action has been taken.

These bills were substantially similar to the bill of the same name introduced in the 113th Congress, H.R. 756—Cybersecurity Enhancement Act of 2013.

Hearings

Two hearings were held related to the NITRD Program.

Protecting Information in the Digital Age: Federal Cybersecurity Research and Development Efforts

"Protecting Information in the Digital Age: Federal Cybersecurity Research and Development Efforts," was held by the House Committee on Science and Technology Subcommittees on Technology and Innovation and Research and Science Education, on May 25, 2011, on issues relating specifically to cybersecurity R&D.[27]

[25] H.R. 4263, the SECURE IT Act of 2012, is a related bill to H.R. 3834. Section 407 of the bill contains conforming and technical amendments to the High-Performance Computing Act of 1991. However, it does not change the functions of the program or its management structure. That bill was introduced by Representative Mary Bono on March 27, 2012, and referred to the House Committees on Science, Space, and Technology; Oversight and Government Reform; Judiciary; Armed Services; and Intelligence (Permanent Select). It was referred to the House Subcommittee on Crime, Terrorism, and Homeland Security on April 9, 2012.

[26] This document is available online at http://www.gpo.gov/fdsys/pkg/CRPT-112hrpt420/pdf/CRPT-112hrpt420.pdf.

[27] The hearing main page can be found at http://science.house.gov/hearing/subcommittee-research-and-science-education-subcommittee-technology-and-innovation-%E2%80%93-joint. Information includes the hearing charter, the opening statements, and the witness testimony.

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Oversight of the Networking and Information Technology Research and Development Program and Priorities for the Future

"Oversight of the Networking and Information Technology Research and Development Program and Priorities for the Future," was held by the House Committee on Science and Technology Subcommittee Research and Science Education, on September 21, 2011, on issues relating to future research directions.[28]

Potential Issues for Congress

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

Issues related to U.S. competitiveness in high-performance computing and the direction the IT R&D community has been taking have remained salient over the last 5 to 10 years and include

- the United States' status as the global leader in high-performance computing research;
- the apparent ongoing 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.

[28] The hearing main page can be found at http://science.house.gov/hearing/research-and-science-education-subcommittee-hearing-oversight-networking-information-tech.

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Appendix. 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,[29] 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,[30] amended the original law to expand the mission of the NITRD Program to cover Internet-related research, among other goals.

High-Performance Computing Act of 1991

The High-Performance Computing Act of 1991 (P.L. 102-194) 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.[31]

Next Generation Internet Research Act of 1998

The Next Generation Internet Research Act of 1998 (P.L. 105-305) amended the High-Performance Computing Act of 1991. The act had two overarching purposes. The first was to

[29] 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.

[30] 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.

[31] 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.

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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.

America COMPETES Act of 2007

Section 7024 of the America COMPETES Act of 2007 (P.L. 110-69) revised the program requirements for the National High-Performance Computing Program. Among other requirements, the bill amended the original enabling legislation to—

- require the Director of the Office of Science and Technology Policy to: (1) establish the goals and priorities for federal high-performance computing research, development, networking, and other activities; (2) establish Program Component Areas that implement such goals and identify the Grand Challenges (i.e., fundamental problems in science or engineering, with broad economic and scientific impact, whose solutions will require the application of high-performance computing resources and, as amended by this section, multidisciplinary teams of researchers) that the Program should address; and (3) develop and maintain a research, development, and deployment road map covering all states and regions for the provision of high-performance computing and networking systems.
- revise requirements for annual reports by requiring that such reports: (1) describe Program Component Areas, including any changes in the definition of or activities under such Areas and the reasons for such changes, and describe Grand Challenges supported under the Program; (2) describe the levels of federal funding and the levels proposed for each Program Component Area; (3) describe the levels of federal funding for each agency and department participating in the Program for each such Area; and (4) include an analysis of the extent to which the Program incorporates the recommendations of the advisory committee on high-performance computing. Eliminates the requirement for inclusion of reports on Department of Energy activities taken to carry out the National High-Performance Computing Program.
- require the advisory committee on high-performance computing to conduct periodic evaluations of the funding, management, coordination, implementation, and activities of the Program, and to report at least once every two fiscal years to specified congressional committees. Prohibits applying provisions for the termination, renewal, and continuation of federal advisory committees under the Federal Advisory Committee Act to such advisory committee.
- instruct the NSF to support basic research related to advanced information and communications technologies that will contribute to enhancing or facilitating the availability and affordability of advanced communications services for all people of the United States. Requires the NSF Director to award multiyear grants to institutions of higher education, nonprofit research institutions affiliated with such institutions, or their consortia to establish multidisciplinary Centers for Communications Research. Increases funding for the basic research activities

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described in this section, including support for such Centers. Requires the NSF Director to transmit to Congress, as part of the President's annual budget submission, reports on the amounts allocated for support of research under this section.

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