

NETWORKING AND INFORMATION TECHNOLOGY R&D

The National Science Foundation is a primary federal agency supporting the Networking and Information Technology Research and Development (NITRD) program. Every NSF directorate is involved in NITRD activities and NSF participates in every NITRD Program Component Area (PCA).

Networking and Information Technology Research and Development Funding

(Dollars in Millions)

| | FY 2006 Actual | FY 2007 Request | FY 2008 Request | Change over FY 2007 | |
|--|-------------------|--------------------|--------------------|------------------------|--------------|
| | | | | Amount | Percent |
| Biological Sciences | \$77.00 | \$83.50 | \$83.50 | - | - |
| Computer and Information Science and Engineering | 496.35 | 526.69 | 574.00 | 47.31 | 9.0% |
| Engineering | 11.20 | 11.20 | 21.20 | 10.00 | 89.3% |
| Geosciences | 14.56 | 14.56 | 14.56 | - | - |
| Mathematical and Physical Sciences | 68.93 | 69.00 | 76.96 | 7.96 | 11.5% |
| Social, Behavioral and Economic Sciences | 12.47 | 12.47 | 14.47 | 2.00 | 16.0% |
| Office of Cyberinfrastructure | 127.14 | 182.42 | 200.00 | 17.58 | 9.6% |
| Subtotal, Research and Related Activities | 807.65 | 899.84 | 984.69 | 84.85 | 9.4% |
| Education and Human Resources | 3.88 | 3.90 | 9.00 | 5.10 | 130.8% |
| Total, NITRD Request | \$811.53 | \$903.74 | \$993.69 | \$89.95 | 10.0% |

NSF's FY 2008 Request continues strong support for the NITRD program, most notably through NSF's new investment in Cyber-enabled Discovery and Innovation (CDI). This initiative aims to explore radically new concepts, approaches, and tools at the intersection of computational and physical or biological worlds. CDI is comprised of five conceptual areas - knowledge extraction, interacting elements, computational experimentation, virtual environments, and education for computational discovery. This five-year initiative is led by the Directorate for Computer and Information Science and Engineering and is supported by several other NSF directorates and the Office of Cyberinfrastructure.

The NITRD Request of \$993.69 million supports fundamental research, development, and education in:

- High-end computing infrastructure and applications (HEC I&A) involving advanced computer systems, applications software, and related infrastructure, which are core necessities for cutting-edge discovery across all scientific and engineering fields;
- High-end computing research and development (HEC R&D) activities to optimize the performance of today's high-end computing systems and to develop future generations of systems to meet critical needs;
- Cyber security and information assurance (CSIA) focusing on improving the ability of information systems to prevent, resist, respond to, or recover from actions or events that compromise or threaten the availability, integrity, or confidentiality of data, of the information systems themselves, or of related services;
- Human-computer interaction and information management (HCI&IM) to increase the benefit of computer technologies to humans, particularly the science and engineering R&D community;
- Large-scale networking (LSN) for federal high-performance networking R&D in leading-edge networking technologies, services, and enhanced performance;
- High-confidence software and systems (HCSS) for systems and verification technologies to assure computer-based system safety, dependability, and correctness;

- Software design and productivity (SDP) leading to fundamental advances in concepts, methods, techniques, and tools for software design;
- Social, economic, and workforce aspects of IT and IT workforce development (SEW) focusing on the nature and dynamics of IT impacts on technical and social systems as well as interactions between people and IT devices and capabilities as well as workforce development needs.

NSF works in close collaboration with other NITRD agencies and participates at the co-chair level in seven of the eight PCA Coordinating Groups. NSF's Assistant Director for Computer and Information Science and Engineering is co-chair of the NITRD Subcommittee of the National Science and Technology Council's Committee on Technology.

NITRD Priorities in FY 2008

In addition to the Cyber-enabled Discovery and Innovation investment described previously, NSF is emphasizing investments in the following areas of NITRD in FY 2008:

Large Scale Networking (\$106.70 million): CISE will increase support for pre-construction planning activities for the Global Environment for Networking Innovations (GENI), including support for the GENI Project Office. GENI will provide computing researchers with world-class experimental opportunities that substantively transform research in networking and distributed systems.

Cybersecurity and Information Assurance (\$69.15 million): Support will continue for several centers, including one devoted to the scientific exploration of new technology that will radically transform the ability of organizations to design, build, and operate trustworthy information systems for critical infrastructure, and one investigating software architectures, tamper-resistant hardware, cryptographic protocols and verification systems as applied to electronic voting systems.

High-End Computing R&D (\$67.06 million): CISE will continue support of the High-End Computing University Research Activity to support innovative research activities aimed at building complex software and tools on top of the operating system for high-end architectures.

High-End Computing Infrastructure and Applications (\$303.09 million): Continuation of the acquisition of a high performance computing system in the Office of Cyberinfrastructure is included at an annual level of \$50 million. Several NSF directorates will increase their investments in this PCA to capitalize on the growing importance of cyberinfrastructure in furthering their research and education goals. For example, MPS and ENG will increase activity in modeling and simulation of complex systems; development of numerical algorithms and software implementations that push the boundaries of computing infrastructure; and use of the grid computing infrastructure.

MPS will strengthen support of research and education activities that contribute to and utilize the Virtual Astronomical Observatory, a federation of astronomical data bases. Support of other databases and digital libraries also will increase. MPS will support enhanced participation of remote access to instrumentation and increased connection of institutions that are distant from each other, such as a minority institution and its partner.

ENG will increase support of virtual organizations to leverage distributed physical experimentation, data collection, modeling and analysis capabilities using high-end computing and large scale networking infrastructures. ENG will also increase activity in modeling and simulation of complex systems; development of numerical algorithms and software implementations that push the boundaries of computing infrastructure; and use of the grid computing infrastructure.

BIO will invest in activities to broaden access to and usability of high performance computing resources in the biological sciences. While biology applications claim a substantial amount of HPC computing resources, those applications cover a narrow slice of all of biology. With increasing availability of large amounts of data, from genome data to ecosystems modeling, more areas of biology will need to have access to HPC resources.

GEO will continue support of the Climate Simulation Laboratory (CSL) at the National Center for Atmospheric Research. CSL provides state of the art computing systems and data management services, helping to keep the U.S. at the forefront of 21st century climate science.

High Confidence Software and Systems (\$57.44 million): CISE will increase support for research on computing processes and artifacts and computer systems research for high-confidence embedded systems, hybrid control, and distributed systems.

ENG will increase support of research on novel processor architectures, high density memory and storage devices, and resilient networking tools to enable high confidence systems.

Human Computer Interaction and Information Management (\$225.62 million): NSF will focus increased attention on the issues of federation, preservation, curation, and access to large, heterogeneous collections of scientific data and information. High capacity data management and high capacity computing are increasing challenges for a growing number of research communities. Funding in this area is increased to address the limitations of current tools. BIO's investments in this area will facilitate discovery through tools that integrate the published literature with the expanding universe of digital data collections, expand capacity for understanding through virtual environments that provide an intuitive display of the complex networks of interactions among organisms and their environments, and make it practical for scientists to search vast collections of biological images simply and quickly.

Software Design and Productivity (\$55.31 million): CISE will increase its investments in software design and productivity. With software development reaching the limits of technologies developed over the last 50 years, innovative theories, methods, and tools will be developed. Computational models for software are now just emerging and will be incubated with focused funding and supportive demonstration environments. While much of the research focus during the first 50 years of computing was on correct syntax-directed computation of details for computer execution, the focus of the next 50 years will shift to semantics-directed computation of correct abstractions for human understanding and manipulation.

BIO, through its Biological Databases and Informatics program, will promote new ways of enabling science through the use of cyberinfrastructure, including new visual programming environments and integrated information systems that allow an entire community of experts to contribute simultaneously to understanding genome dynamics.

Social, Economic and Workforce (\$109.32 million): CISE will continue to support the Broadening Participation in Computing program aimed at significantly increasing the number of students who are U.S. citizens and permanent residents receiving post secondary degrees in the computing disciplines. In addition, through a new internationally-focused program, CISE will contribute to the development of a competitive, *globally aware* workforce. This program will increase the computing research community's engagement in key nation states and regions.

In collaboration with partners across the Foundation, OCI will support creative explorations and demonstrations of the use of cyberinfrastructure to integrate research with education, the development of innovative technologies that will facilitate the integration of research and education, and research on how

educators and students interact with cyberinfrastructure along with exploring novel uses of cyberinfrastructure.

BIO will strengthen IT capabilities in all biological sub-disciplines through support for postdoctoral fellowships in bioinformatics; integrative graduate programs that combine training in biology and computer sciences (via the NSF-wide IGERT program); undergraduate summer institutes in bioinformatics through the interagency Bioengineering and Bioinformatics Summer Institutes program (BBSI); and other mechanisms.

EHR will continue to study the impact of IT on educational practice, new approaches to using technology in education, application and adaptation of technologies to promote learning in a variety of fields and settings, and the effects of technology on learning. EHR's support for the new NSF-wide Cyber-enabled Discovery and Innovation investment will include funding of proposals that study the impact of information technology on educational practice, new approaches to using technology in education, application and adaptation of technologies to promote learning, the effects of technology on learning, and up to four new CREST centers that target nanotechnology and/or cyberinfrastructure.

NITRD by Program Component Area
(Dollars in Millions)

| | FY 2006 Actual | FY 2007 Request | FY 2008 Request | Change over FY 2007 | |
|--|-------------------|--------------------|--------------------|------------------------|--------------|
| | | | | Amount | Percent |
| Large Scale Networking | \$87.50 | \$84.00 | \$106.70 | \$22.70 | 27.0% |
| Cybersecurity and Information Assurance | 54.78 | 67.57 | 69.15 | 1.58 | 2.3% |
| High End Computing R&D | 64.16 | 64.13 | 67.06 | 2.93 | 4.6% |
| High End Computing Infrastructure and Applications | 221.12 | 272.35 | 303.09 | 30.74 | 11.3% |
| High Confidence Software and Systems | 42.11 | 51.25 | 57.44 | 6.19 | 12.1% |
| Human-Computer Interaction and Info Management | 198.06 | 220.85 | 225.62 | 4.77 | 2.2% |
| Software Design and Productivity | 50.56 | 50.69 | 55.31 | 4.62 | 9.1% |
| Social/Economic/Workforce | 93.25 | 92.90 | 109.32 | 16.42 | 17.7% |
| Total, NITRD Request | \$811.53 | \$903.74 | \$993.69 | \$89.95 | 10.0% |

Totals may not add due to rounding.