

NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT (NITRD)

Total Funding for NITRD

(Dollars in Millions)

	FY 2016 Actual	FY 2017 (TBD)	FY 2018 Request
Biological Sciences	\$99.00	-	\$69.00
Computer and Information Science and Engineering	933.76	-	838.92
Education and Human Resources	9.50	-	9.50
Engineering	29.50	-	23.25
Geosciences	24.00	-	22.00
Mathematical and Physical Sciences	94.75	-	76.50
Social, Behavioral, and Economic Sciences	28.14	-	22.71
Total, NITRD	\$1,218.65	-	\$1,061.88

NSF is a primary supporter of the Networking and Information Technology Research and Development (NITRD) program, and NSF's NITRD portfolio includes all research, infrastructure, and education investments in the Directorate for Computer and Information Science and Engineering (CISE), as well as contributions from all other directorates across the agency, enabling investments in every NITRD Program Component Area (PCA). The Assistant Director for CISE is co-chair of the NITRD Subcommittee of the National Science and Technology Council's Committee on Technology. In addition, numerous NSF staff work in close collaboration with other NITRD agencies and participate at the co-chair level in most of the NITRD Interagency Working Groups.

NSF's FY 2018 Budget Request continues strong support for NITRD at a level of \$1.06 billion. NITRD activities represent approximately 16 percent of NSF's FY 2018 Budget Request to Congress. CISE's support comprises 79 percent of NSF's NITRD activities.

The NITRD Subcommittee established a Fast-Track Action Committee (FTAC) in January 2016 to review the NITRD PCAs and their associated charges and definitions and to pursue and adopt changes as needed, beginning in FY 2018. The PCAs are the major subject areas under which the projects and activities coordinated through the NITRD program are grouped. These changes reflect the rapidly evolving IT R&D environment and the national priorities and focus areas on which the NITRD program's future direction is set.

Of the 10 PCAs in FY 2018, three are new: Computing-Enabled Human Interaction, Communication, and Augmentation (CHuman); Computing-Enabled Networked Physical Systems (CNPS); and Education and Workforce (EdW). Three of the PCAs were revised for FY 2018: High-Capability Computing Infrastructure and Applications (HCIA); Robotics and Intelligent Systems (RIS); and Software Design and Productivity (SDP). The remaining four are unchanged: Cyber Security and Information Assurance (CSIA); Enabling-R&D for High-Capability Computing Systems (EHCS); Large-Scale Data Management and Analysis (LSDMA); and Large-Scale Networking (LSN). Three of the 10 PCAs previously used to describe the NITRD portfolio were retired as part of this revision: Human-Computer Interaction and Information Management (HCI&IM); High-Confidence Software and Systems (HCSS); and Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW).

FY 2018 NSF Investments by Program Component Area (PCA)

The following information focuses on FY 2018 NSF investments, both new and continuing, by PCA.

CHuman (\$79.63 million): CHuman will include CISE investment in Cyberlearning and Future Learning Technologies (CFLT), which will aim to integrate advances in technology with advances in understanding how people learn. CLFT will emphasize the use of technologies to support adult retraining and continuing education. It will also include CISE investment in Smart and Connected Health (SCH), which will focus on improvements in safe, effective, efficient, and patient-centered proactive and predictive health and wellness technologies. Understanding the Brain (UtB) investment in CHuman will enable the research needed to integrate computational models across scales and develop innovative neurotechnologies to monitor brain function.

The Directorate for Social, Behavioral, and Economic Sciences (SBE) will invest in CHuman by focusing on the impacts of the nature and dynamics of information technology on technical and social systems. CHuman will also include SBE investment in cyberinfrastructure related to its three surveys (American National Election Studies, the Panel Study of Income Dynamics, and the General Social Survey), which will enable examination of societal concerns, such as competitiveness, security, economic development, and well-being.

CNPS (\$75.33 million): CNPS will include investments in advanced manufacturing, including cyber-manufacturing from CISE and the Directorate for Engineering (ENG). CISE investment in CNPS will also include Cyber-Physical Systems (CPS), enabling foundational interdisciplinary research and education in adaptive and pervasive smart systems supporting applications such as smart grid, intelligent transportation systems, and medical devices. Additionally, as part of CNPS, CISE investment in the NSF-wide Smart & Connected Communities (S&CC) will support interdisciplinary, integrative research and research capacity-building activities that improve understanding and design of intelligent infrastructure for communities, leading to enhanced quality of life for residents. Directorate for Biological Sciences (BIO) investment included in CNPS will expand and enhance access to the national resource of digital biological and paleontological data.

CSIA (\$98.48 million): CSIA will include investment in the NSF-wide Secure and Trustworthy Cyberspace (SaTC) program and other related cybersecurity research. CISE investment in SaTC—in partnership with the Directorate for Education and Human Resources (EHR), ENG, Directorate for Mathematical and Physical Sciences (MPS), and SBE—will support foundational research necessary to ensure society’s ubiquitous computing and communication systems are resistant to cyber-attacks and associated vulnerabilities, while enabling and preserving privacy and trust.

EdW (\$68.89 million): EdW will include CISE and EHR investments in (1) Computer Science for All (CSforAll), which seeks to enable rigorous and engaging computer science education in schools across the Nation; (2) Improving Undergraduate STEM Education (IUSE), with a focus on novel approaches for “CS+X,” enabling the diffusion of the fundamentals of computational thinking and computer science across a broad array of other disciplines at the undergraduate level; and (3) NSF Research Traineeships (NRT), which will support the development of bold, new, potentially transformative and scalable models for STEM graduate training focusing on research areas of national priority. It will also include CISE and EHR investments supporting workforce development in cybersecurity, enabling a growing pipeline of researchers, educators, and practitioners, as well as the development of a citizenry that understands the security and privacy of the digital systems on which society depends. Finally, EdW will include investment in NSF Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES), the NSF-wide effort to increase the preparation, participation,

advancement, and potential contributions of those who have been traditionally underserved or underrepresented in STEM fields.

BIO investment focusing on advancing the Nation's ability to incorporate and apply biological knowledge to economic development and other issues of societal importance will also be included in EdW.

EHCS (\$116.11 million): EHCS will include investment in the National Strategic Computing Initiative (NSCI), which will support advances in High-Performance Computing (HPC) systems, increasing the capacity, capability, and sustainability of an enduring national HPC ecosystem. CISE investment in NSCI will emphasize future HPC systems beyond the limits of current semiconductor technology, as well as emerging infrastructure, including quantum technologies, for all areas of science and engineering. MPS investment will advance computational algorithms and data analytics to address scientific and engineering challenges presented by the ever-expanding role of computational modeling and simulation combined with the explosion of data coming from digital and observational data sources. MPS also will invest in fundamental research on innovative materials integration and novel phenomena associated with quantum information science, optical computing, and neuro-computing.

HCIA (\$178.71 million): HCIA will include CISE investment on the development of software and algorithms for high-end computing systems as well as advanced computational infrastructure in alignment with NSCI. HCIA will also include CISE and MPS investments in new computational methods, algorithms, scientific databases, and other computational tools to support researchers in the mathematical and physical sciences as well as engineering through support for programs such as Computational and Data-Enabled Science and Engineering (CDS&E). The CISE investment in computational infrastructure as part of NSCI will be included in HCIA alongside GEO's support for EarthCube, a cyberinfrastructure investment for the geosciences. GEO's continued investment in the operations and maintenance of the National Center for Atmospheric Research's (NCAR) Wyoming Supercomputer facility and associated modeling efforts will also be included in HCIA. HCIA will include BIO investment on the application of HPC to a range of grand challenge problems in the biological sciences including, UtB, genotype to phenotype, and the environmental sciences.

LSDMA (\$198.82 million): LSDMA will include CISE investments in the Harnessing the Data Revolution (HDR) Big Idea, including big data analytics and visualization tools through the Critical Techniques, Technologies and Methodologies for Advancing Foundations and Applications of Big Data Sciences and Engineering (BIGDATA); the development of a comprehensive, scalable data infrastructure as part of Data Infrastructure Building Blocks (DIBBs); and, jointly with MPS, Transdisciplinary Research in Principles of Data Science (TRIPODS), which brings together the statistics, mathematics, and theoretical computer science communities to develop the theoretical foundations of data science through integrated research and training activities.

Additional MPS investment will include research efforts to develop and advance theories and techniques for analyzing and extracting information from large and disparate data sets. ENG investment in the cyberinfrastructure for the Natural Hazards Engineering Research Infrastructure (NHERI), which provides access to and the storage and analysis of massive amounts of data related to natural disasters, will be included. LSDMA will also include SBE investment in Resource Implementations for Data Intensive Research in the Social, Behavioral, and Economic Sciences (RIDIR) and BIO investment on integrative modeling of complex biological processes.

LSN (\$128.24 million): LSN will include CISE investment in next-generation software-defined infrastructure through Tomorrow's Internet Project Office (TIPOFF). LSN will also include CISE investment in a set of Platforms for Advanced Wireless Research (PAWR) that enable research on topics ranging from dynamic spectrum sharing to mobility and to measurement and monitoring, thus advancing

the next generation of high-performance, robust wireless networks. A portion of CISE investment in S&CC will be included in LSN.

RIS (\$41.32 million): RIS will include CISE and ENG investments in the National Robotics Initiative (NRI) and research related to the design, application, and use of robotics to augment human function, promote human-robot interaction, and increase robot autonomy. As part of the next generation of robotics, co-robot systems will be characterized by their flexibility and resourcefulness. They will use a variety of modeling or reasoning approaches, along with real-time, real-world data, demonstrating a level of intelligence and adaptability seen in humans and animals. As development of this next generation of robotics proceeds, complete confidence in the robotic systems that work beside, or cooperatively with, people in application domains such as advanced manufacturing, emergency response, and health care becomes increasingly important.

SDP (\$76.35 million): SDP will include CISE investment in Software Institutes for Sustained Innovation (SI2), a component of NSCI that catalyzes new thinking, paradigms, and practices in developing and using software that is robust, reliable, usable, and sustainable. SDP will also include BIO investment in the interagency and international Collaborative Research in Computational Neuroscience (CRCNS), which is joint with CISE and other NSF directorates and offices. Through CRCNS, BIO will fund research involving the development of software and other computational tools to advance biological knowledge and computational innovations. As part of SDP, SBE will continue to collaborate with CISE on exploring the emerging interface between computer and information science and engineering and the social, behavioral, and economic sciences.

NITRD Funding by Program Component Area

(Dollars in Millions)

	FY 2016 Actual	FY 2017 (TBD)	FY 2018 Request
Computing-Enabled Human Interaction, Communications, Augmentation	\$90.21	-	\$79.63
Computing-Enabled Networked Physical Systems	85.93	-	75.33
Cyber Security and Information Assurance	111.67	-	98.48
Education and Workforce	76.44	-	68.89
Enabling-R&D for High-Capability Computing Systems	133.00	-	116.11
High Capability Computing Infrastructure and Applications	197.93	-	178.71
Large-Scale Data Management and Analysis	248.87	-	198.82
Large Scale Networking	138.94	-	128.24
Robotics and Intelligent Systems	48.92	-	41.32
Software Design and Productivity	86.73	-	76.35
Total, NITRD	\$1,218.65	-	\$1,061.88