Networking and Information Technology Research and Development (NITRD) Program: Fiscal Year 2008 Budget Overview

The President's 2008 Budget requests $3.056 billion for the Networking and Information Technology Research and Development (NITRD) Program. The NITRD enterprise is an Administration interagency R&D budget priority for 2008.

About the NITRD Program

Now in its 16th year, the NITRD Program represents the coordinated efforts of Federal agencies – 14 member agencies plus informal participants – that support R&D in advanced computing, networking, cyber security, software, and other information technologies. These key technologies power Federal agency missions, help maintain U.S. leadership in science, technology, and engineering, and support the Nation's economic competitiveness. Notable NITRD Program highlights of the past year include the addition of the Department of Homeland Security (DHS) and the National Archives and Records Administration (NARA) as new member agencies. The NITRD Program operates under the aegis of the National Science and Technology Council's Committee on Technology and its NITRD Subcommittee.

Agencies coordinate their NITRD activities and plans in eight Program Component Areas (PCAs), each overseen by an Interagency Working Group (IWG) or a Coordinating Group (CG) of agency program managers who meet monthly to shape collaborative efforts. The President's 2008 NITRD budget (see table on page 6) shows request levels both by agency and by PCA.

2008 NITRD Budget Highlights by PCA [NOTE: A list of abbreviations and acronyms used appears on page 5.]

High End Computing Infrastructure and Applications (HEC I&A)

Members: NSF, OSD and DoD Service research organizations, NIH, DOE/SC, NASA, NIST, DOE/NNSA, NOAA, EPA.

2008 priorities: Procurement and evaluation of leadership-class systems, investment in production-quality capacity computing platforms to expand Federal computing resources, and development of advanced applications, particularly at the petascale level. Budget highlights include:

System acquisitions, upgrades:
- NSF: Pursue multiyear acquisition of petascale and mid-range systems.
- NASA: Initiate acquisition of Columbia follow-on.
- DOE/NNSA: Acquire multicore cell-processor-based system.
- OSD (HPCMP), DOE/SC, and NASA: Upgrade existing systems.

Applications:
- NSF: Modeling and simulation of complex systems across the sciences; computation, data integration in heterogeneous, dynamic environments; petascale applications.
- OSD (HPCMP): New multiyear CREATE program to develop highly scalable application codes.
- DOE/SC: Petascale applications; SciDAC2 awards, partnerships; continue INCITE Program opening up to 80% of leadership, 10% of production systems to broad academic, industrial, and Federal research communities.
- NASA: Open Columbia to external researchers from second round of NCLS proposals.
- NOAA: Test Earth System Modeling Framework with modeling capabilities agencywide.
- EPA: Algorithms, state-of-the-art air quality models and tools for distributed air-quality data modeling center.

High End Computing R&D (HEC R&D)

Members: NSF, OSD and DoD Service research organizations, DARPA, DOE/SC, NSA, NASA, NIST, DOE/NNSA, NOAA.

2008 priorities: Develop and prototype innovative next-generation systems; deepen understanding of petascale computing environments; explore novel approaches to solving technical problems such as thermal management and increasing the usability of large-scale multiprocessor systems; continue development of system productivity benchmarks; replenish the HEC R&D talent pool. Budget highlights include:

- HEC-URA: University-based R&D in file systems and I/O, system software and tools for complex systems – NSF, DARPA, DOE/NNSA, DOE/SC, NSA.
- Next-generation programming: R&D in parallel programming languages and programming environments – NSF, DARPA, NSA.
- High-Productivity Computing Systems (HPCS) Phase III: Full-scale prototypes by 2010 for new generation of petascale, economically viable systems – DARPA, DOE/SC, DOE/NNSA, NSA.
- System on a chip: Technology and self-monitoring of system processors' health and state; PCA technology for onboard, embedded processing capabilities – DARPA.
- Advanced computing systems: New research to improve power efficiency, chip-to-chip I/O, interconnects, productivity, resilience, and file system I/O – NSA.
- Quantum computing: Quantum information theory; architectures and algorithms; quantum memory modeling, quantum gates – DARPA, DOE/SC, NIST, NSA.
- Petascale systems and computational science: R&D in operating and runtime systems, programming models, file systems, performance modeling and optimization, software architectures; mathematics and computer science – DOE/SC, DOE/NNSA, NSF.
- Software environments: Common system software, tools – DOE/NNSA, DOE/SC, NSF, OSD.

Cyber Security and Information Assurance (CSIA)

Members: NSF, OSD and DoD Service research organizations, NIH, DARPA, NSA, NASA, NIST, DHS. Other participants: DOT, DTO, FAA, FBI, State, Treasury, TSWG.

2008 priorities: Functional cyber security and information assurance; infrastructure and domain-specific assurance; cyber security and information assurance assessment; and scientific foundations of security. Budget highlights include:

- Security management for critical infrastructures: R&D to harden automated systems and devices that control power grids, industrial processes, air-traffic-control systems, financial and wireless networks, and other critical infrastructures – NSF, NSA, DHS, NIST, TSWG.
- Software protection: Technologies for high-assurance software protection and secure software engineering – OSD, AFRL, ARO/ARL/CERDEC, ONR/NRL, NSA, NSF, TSWG.
- Trusting the edge: Technologies, techniques, and tools to provide distributed trust and assurance for the Global Information Grid (GIG) and mission-critical net-centric domains – OSD, AFRL, ARO/ARL/CERDEC, ONR/NRL, DARPA, NSA.
- Measurement science and technologies: Security metrics, testing, and validation – NSF, NSA, NIST, DHS, FBI.
- Situational awareness and response: Security event visualization, management; reconstitution of network services; automated protection response, behavior-based monitoring – NSF, OSD, AFRL, ARL/ARO/CERDEC, NSA, DHS.
- Assured information sharing: Virtual private network, secure collaboration; secure routing protocols, key and identity management; high-assurance, programmable guard; hardware enhancements; models and standards for protecting and sharing sensitive information and thwarting identity theft – NSF, OSD, AFRL, ONR/NRL, NSA, NIST, DHS.
- Testbeds: Cyber Defense Technology Experimental Research (DETER) cyber security testbed; security plan for GENI; infrastructure for R&D – NSF, DHS, NIST, ARL/ARO/CERDEC.

- Wireless: Advanced antennas for WLANs; insider threat detection, response; software-assisted (cognitive) radio technology; RF watermarking – NSF, OSD, AFRL, ARL/ARO/CERDEC, ONR/NRL, DARPA, NSA, NIST, DHS.

Human Computer Interaction and Information Management (HCI&IM)

Members: NSF, OSD and DoD Service research organizations, NIH, DARPA, NASA, NIST, AHRQ, NOAA, EPA, DHS, NARA. Other participants: DTO, GSA.

2008 priorities: Next-generation methods, technologies, and tools for integrating massive, distributed, heterogeneous forms of information to support complex human analysis and timely decision-making (key issues include information standards, decision-support tools, and long-term management and preservation of complex collections); multimodal interfaces and data; cognitive systems. Budget highlights include:

- Cyber-enabled Discovery and Innovation: New focus area on managing complex, ultra-scale, multidimensional data in high-performance scientific computing environments – NSF.
- Cognitive systems: Create systems to dramatically reduce workforce requirements, extend warfighter capabilities, provide decision-support systems/tools, and improve performance of automated and robotic systems – DARPA, ARL, NASA, NIST, ONR.
- Global Autonomous Language Exploitation (GALE): Software technologies to transcribe, translate, and distill speech and text in multiple languages to provide actionable information – DARPA, NIST, CENTCOM, DLI, other agencies.
- Multimodal language recognition and translation: Multilingual language technologies in speech-to-text transcription, two-way communications translation, text retrieval, automatic content extraction, speaker and language recognition, multimodal interfaces, usability – DARPA, NIST, NSF, DTO, NARA, other agencies. Biomedical informatics infrastructure: Infrastructure, tools, and data to facilitate biomedical discovery, enhance interdisciplinary communication, and improve health care – NIH.
- Information integration, accessibility, and management: Secure management; modeling, integration, analysis, and visualization techniques and tools; ontologies and metadata; data access and transmission; integration, exploitation of heterogeneous data; image understanding – NSF, ARL, ONR, NIH, NASA, NIST, AHRQ, NOAA, EPA, NARA.

Large Scale Networking (LSN)

Members: NSF, OSD and DoD Service research organizations, NIH, DARPA, DOE/SC, NSA, NASA, NIST, AHRQ, DOE/NNSA, NOAA. Other participants: USGS.

2008 priorities: Enable near-real-time petabyte-per-second and above data transfers to support advanced scientific research; develop future Internet architectures that are flexible, trustworthy, and able to support pervasive computing using wireless access and optical light paths, networked sensors, and innovative applications; implement standard measurement instrumentation and protocols, and cross-domain cooperation enabling end-to-end application performance tuning. Budget highlights include:

- Optical network testbeds (ONTs): Evaluate lessons learned from NSF's CHEETAH and DRAGON networks, DOE/SC's UltraScience Net, and coordination with OMNInet, OptiPuter, Internet2, National LambdaRail, and regional ONTs; develop second-generation GMPLS, QoS, agile circuit-switching, and interdomain control plane protocols, tools, services, and management – NSF, DARPA, DOE/SC, NASA.
- Innovative network architectures: GENI support of R&D for a large-scale experimental facility for new scalable, flexible, trustworthy, usable Internet architectures including high-impact emerging technologies, such as quantum cryptography – NSF, with DARPA, DOE/SC, NASA, NIST, NSA.
- Network security research: For R&D networks, applications, and infrastructure – NSF, OSD, DARPA, DOE/SC, NIST.
- End-to-end agile networking, QoS, GMPLS: Develop robust technologies for on-demand networking and assured bandwidth for applications – NSF, DARPA, DOE/SC, NASA, other agencies.
- IPv6 and cyber security implementation: Roll out IPv6 onto research networks and establish DNSSEC prototyping in research networks in response to OMB requirements – All.
- International coordination: Leverage investments in federated security regimes, optical networking transparency with international partners – NSF, DOE/SC.

High Confidence Software and Systems (HCSS)

Members: NSF, OSD and DoD Service research organizations, NIH, NSA, NASA, NIST. Other participants: DOE [OE], FAA, FDA.

2008 priorities: Scientific foundations (innovative theories, methods, and tools, including new architectural principles and frameworks, for building systematic specialization, integration, and assurance into systems from the ground up); composable, configurable, high-confidence real-time embedded systems technology substrate to reduce dependence on aging and increasingly obsolete technology base); next-generation critical IT-centric societal infrastructures – adaptive avionics, intelligent transportation and industrial process control systems, high-assurance medical devices, defense and emergency-response systems. Budget highlights include:

- Cyber-enabled Discovery and Innovation: New effort to improve design, control, and decision-making about large-scale interacting complex systems – NSF.
- Cyber-physical systems: New effort to develop a next-generation real-time technology base for architectures and virtualization, system complexity; high-confidence system service composition – NSF, OSD, AFRL, NSA, NASA, NIST, FAA, FDA. High-confidence RTOS: Research to develop next-generation technology base – NSF, OSD, AFRL, ONR, NSA, NASA, with DOE, NIST, FAA, FDA.
- Foundations of assured computing: Methods and tools for modeling, measuring, analyzing, evaluating, and predicting performance, correctness, efficiency, and dependability of complex, real-time, and distributed systems – NSF, OSD, AFRL, NSA, NASA, NIST, FDA.
- Information assurance requirements: Intelligent, secure, flexible, self-protecting global infrastructure; safe computing platforms – NSA.
- Flight-Critical Systems Software Initiative: New start on mixed criticality architecture requirements for embedded systems platform and integrated tool chain – AFRL, NSF, with NASA, FAA.
- Illustrative domain research for high-confidence, real-time technologies: Medical device, aviation, and critical infrastructures (e.g., power) that rely on SCADA systems – HCSS agencies.

Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW)

Members: NSF, NIH, DOE/SC, DOE/NNSA. Other participants: GSA.

2008 priorities: Human-centered computing (study design, use, and implications of new technologies in economic, social, and legal systems, with emphasis on information privacy, human-robot interaction); public policy (applying SEW research to foster informed decision-making by policymakers); government IT practitioner communities (build communities of practice to improve services); IT education and training (support innovative educational approaches to broadening participation in IT careers, and doctoral and post-graduate programs to expand the IT workforce). Budget highlights include:

- Cyber-enabled Discovery and Innovation: New focus area on distributed knowledge environments for discovery, learning, and innovation across boundaries; design, implementation, and sustenance of large-scale socio-technical systems that integrate humans and cyberinfrastructure; integration of computational discovery techniques in the education of scientists – NSF.
- Creativity and IT: New program emphases on understanding the ecology of IT, creativity, and innovation; broadening participation in IT activities by underserved communities; transforming IT education in U.S. universities and colleges; developing a globally aware workforce – NSF.
- Computational Science Graduate Fellowship Program: Support for advanced computational science training activity at national laboratories – DOE/NNSA, DOE/SC.
- Bioinformatics fellowships and training: Graduate and post-doctoral programs to expand the ranks of professionals trained in both IT and applications of IT in biomedical sciences – NIH.
- Collaborative Expedition Workshops: Sixth year of monthly workshops exploring cost-effective emerging technologies for the delivery of services at all levels of government, establishing "communities of practice" among IT implementers across government and the private sector, and developing reference standards for interoperable Federal information sharing – CIO Council, GSA, SEW agencies.

Software Design and Productivity (SDP)

Members: NSF, OSD and DoD Service research organizations, NIH, NASA, NIST, NOAA.

2008 priorities: Software design for the 21st century – generate creative scientific advances in design of software artifacts and software-intensive systems through innovative, interdisciplinary research in scientific foundations for managing complexity, quality, cost, and human intellectual control of software systems design and development; new approaches that impact design research and education. Budget highlights include:

- Design for software-intensive systems: Interdisciplinary team projects to adapt and apply design science to the understanding, development, and evaluation of software-intensive systems – NSF.
- Computing processes and artifacts: Increased emphasis on cyberinfrastructure and computational science to address software engineering challenges for the "e-science" community; foundations of software design and engineering methods – NSF, NASA.
- System information integration and informatics: Increased emphasis on the use of digital forms of information and knowledge in the state of software-intensive systems – NSF.
- Standards validation and testing: Methods and tools, with focus on shortening the development, validation, implementation, and testing cycle – NIST.
- Biomedical modeling tools: Software for advanced multiscale modeling of biological, biomedical, and behavioral systems – NSF, NIH.

Abbreviations

AFRL - DoD's Air Force Research Laboratory
AHRQ - HHS's Agency for Healthcare Research and Quality
ARL - DoD's Army Research Laboratory
ARO - DoD's Army Research Office
CERDEC - U.S. Army's Communications-Electronics Research, Development, and Engineering Center
CIO - Chief information officer
CREATE - OSD's Computational Research and Engineering Acquisition Tools and Environments program
DARPA - DoD's Defense Advanced Research Projects Agency
DHS - Department of Homeland Security
DNSSEC - Domain Name System security extensions
DOC - Department of Commerce
DoD - Department of Defense
DOE - Department of Energy
DOE/NNSA - DOE/National Nuclear Security Administration
DOE (OE) - DOE's Office of Electricity Delivery and Energy Reliability
DOE/SC - DOE's Office of Science
DOT - Department of Transportation
DTO - Disruptive Technology Office (formerly ARDA)
EPA - Environmental Protection Agency
FAA - DOT's Federal Aviation Administration
FBI - Federal Bureau of Investigation
FDA - HHS's Food and Drug Administration
GENI - NSF's Global Environment for Network Investigations program
GMPLS - Generalized MultiProtocol Label Switching

GSA - General Services Administration
HEC-URA - HEC University Research Activity, jointly funded by multiple NITRD agencies
HHS - Department of Health and Human Services
HPCMP - OSD's High Performance Computing Modernization Program
INCITE - DOE/SC's Innovative and Novel Computational Impact on Theory and Experiment program
I/O - Input/output
NARA - National Archives and Records Administration
NASA - National Aeronautics and Space Administration
NCLS – NASA's National Leadership Computing System program
NIH - HHS's National Institutes of Health
NIST - National Institute of Standards and Technology
NOAA - National Oceanic and Atmospheric Administration
NRL - DoD's Naval Research Laboratory
NRT - LSN's Networking Research Team
NSA - National Security Agency
NSF - National Science Foundation
ONR - DoD's Office of Naval Research
OSD - Office of the Secretary of Defense
PCA - Polymorphous computer architecture
QoS - Quality of service
RF - Radio frequency
RTOS - Real-time operating system
SCADA - Supervisory control and data acquisition
SciDAC - DOE/SC's Scientific Discovery through Advanced Computing program
WLAN - Wireless local area network

Agency NITRD Budgets by Program Component Area [1]

FY 2007 Budget Requests [2, 3]

and

FY 2008 Budget Requests

(Dollars in Millions)

Agency		High End Computing Infrastructure & Applications (HEC I&A)	High End Computing Research & Development (HEC R&D)	Cyber Security & Information Assurance[1] (CSIA)	Human-Computer Interaction & Information Management (HCI &IM)	Large Scale Networking (LSN)	High Confidence Software & Systems (HCSS)	Social, Economic, & Workforce Implications of IT (SEW)	Software Design & Productivity (SDP)	Total
NSF	2007 Request	272.4	64.1	67.6	220.9	84.0	51.3	92.9	50.7	903.7
	2008 Request	**303.1**	**67.1**	**69.2**	**225.6**	**106.7**	**57.4**	**109.3**	**55.3**	**993.7**
OSD and DoD Service Research Orgs.[3]		260.4	6.2	23.9	95.2	133.0	43.0		6.7	568.2
		234.1	**2.0**	**23.3**	**78.7**	**137.8**	**31.5**		**4.3**	**511.8**
NIH		194.7			183.2	74.6	8.3	12.2	17.7	490.7
		131.7	**1.8**	**1.2**	**194.5**	**65.4**	**8.2**	**11.9**	**2.9**	**417.6**
DARPA[3]			89.6	93.4	198.6	38.2				419.9
			68.9	**96.9**	**204.3**	**42.4**				**412.5**
DOE/SC		135.3	160.4			45.0		4.0		344.7
		250.5	**67.0**			**47.3**		**5.0**		**369.8**
NSA[3]			36.4	15.8		1.1	22.1			75.4
			60.3	**15.8**		**1.4**	**25.2**			**102.6**
NASA		63.9		1.3	2.0	6.0	7.0		1.8	82.0
		69.2		**0.3**	**8.0**	**3.1**	**2.0**		**2.0**	**84.6**
NIST		2.4	1.3	11.1	7.8	5.3	17.5		5.0	50.4
		2.4	**1.3**	**11.1**	**7.8**	**5.3**	**17.5**		**5.0**	**50.4**
AHRQ					44.9	5.0				49.9
					39.8	**5.0**				**44.8**
DOE/NNSA		9.5	23.4			1.6		4.6	4.7	43.8
		9.8	**17.8**			**1.5**		**4.7**		**33.8**
NOAA		16.4	1.9		0.5	2.9			1.6	23.3
		16.4	**1.9**		**0.5**	**2.9**			**1.6**	**23.3**
EPA		3.3			3.0					6.3
		3.3			**3.0**					**6.3**
NARA					3.5					3.5
					4.5					**4.5**
TOTAL (2007 Request)[3]		958.2	383.4	213.0	759.5	396.7	149.1	113.7	88.2	3,062
TOTAL (2008 Request)		**1,020.5**	**288.0**	**217.7**	**766.7**	**418.8**	**141.9**	**130.9**	**71.2**	**3,056**

[1] NITRD budgets for DHS were not finalized as of publication of this interim budget document.

[2] Some 2007 agency requests shown in this table differ from (and supersede) those reported in the *2007 NITRD Supplement to the President's Budget* and/or the President's 2008 Budget. Discrepancies are due to rounding and late shifts in estimates.

[3] Because Congress enacted the 2007 appropriation for DoD, the 2007 figures shown for this agency are estimates of appropriations.