Subcommittee on Research of the House Committee on Science

Testimony of Cita M. Furlani
Director, National Coordination Office for IT R&D

June 26, 2001

Good morning. My name is Cita Furlani. I am Director of the National Coordination Office (NCO) for Information Technology Research and Development. I want to thank Subcommittee Chair Smith, Ranking Member Johnson, and the members of the Subcommittee on Research for the opportunity to come before the Subcommittee today to describe the Federal government's multiagency Networking and Information Technology R&D (NITRD) effort.

Overview
I am pleased to provide an overview of the NITRD program because I believe it is an important part of the Federal research investment portfolio. The Government's networking and information technology research has a profound impact on critical Federal responsibilities such as national defense and national security, as well as on vital dimensions of the national interest such as economic growth and competitiveness, biomedical research, and weather forecasting. Federal information technology (IT) research also helps the Government support overarching public goals in education and training, energy management, health care, and other national priority areas.

Why is such an unadvertised effort so significant? Because, like the railway, highway, electrical, and telephone systems fostered by Federal investment in earlier eras, networking and computing technologies today constitute a critical new infrastructure for the Nation's overall development. This new infrastructure is arguably more powerful, complex, multidimensional, and far-reaching than any of its predecessors.

IT R&D provides necessary foundations for the infrastructure. Without this fundamental research, we would not have the revolutionary computing and communication technologies that are driving innovation and rapid change across all sectors of government and society. In fact, bipartisan Federal support for IT R&D helped launch the IT revolution some 50 years ago - long before the term "information technology" had even been coined - and pioneered many of the technologies that built U.S. leadership in advanced computing and networking.

In the national defense and national security arenas alone, for example, computing and networking technologies underpin virtually every advanced U.S. capability. IT uses in other sectors include:

- Immediate on-site medical care, in the home and at remote locations
- Reliable, failure-resistant systems for such mission-critical applications as air-traffic control, financial transactions, life support, and power supply

- Industrial process and product modeling, visualization, and analytical capabilities, such as in aircraft design and production, automotive efficiency and safety, and molecular synthesis of new drugs
- Expanded e-commerce with assured security and privacy of information
- On-demand universal access to education and knowledge resources
- Advanced computing capabilities that underpin the Nation's leadership in science and technology, including the biotechnology revolution, and the success of critical civilian and national security missions of the Federal government
- More accurate weather forecasting and improved environmental analysis and decision making
- High-performance networking and information systems for emergency and disaster management
- Access to information anytime, anywhere, with any device

Goals of the Federal investment
Federal IT research helped fuel the computing revolution and the unprecedented U.S. economic prosperity of recent years. And it continues to spur major technological innovations in computing and networking, such as the development of optical networking and experimentation with nano-scale and quantum computing and conducting materials. These are results of the Federal effort to accelerate development of the underlying technologies - called "enabling" technologies - on which all computing and networking devices and systems are based. By accelerating advances in these fundamental, underlying technologies, IT R&D enables Federal agencies to accelerate their development and deployment of state-of-the-art advanced systems and applications needed for critical government missions. Federal IT R&D also is devoted to readying laboratory advances for deployment and strengthening experimental technologies through prototyping, testbeds, and evaluations.

The multiagency program
I commend the Congress for its farsightedness in enacting the High Performance Computing (HPC) Act of 1991 (P.L. 102-194), which mandated a multiagency research effort to carry on the unique Federal role in long-range IT R&D. Not only is this program scientifically vital, but it offers a remarkably successful example of effective collaboration among Federal agencies and with the private sector. The bipartisan HPC legislation established a powerful framework for Federal IT research, combining ambitious research goals with specific requirements for interagency cooperation, coordination, and partnerships with academe and industry. That framework has evolved over a10-year period into a very productive research enterprise that involves all the major Federal science and research agencies and collaborations with virtually all major U.S. research universities and with many companies involved in developing new information technologies and applications. Technical and administrative support for the program is provided by the National Coordination Office for Information Technology Research and Development, which I direct.

Brief history of the program (see figure 1)
The10-year history of the Federal multiagency IT research effort is partly one of

changing nomenclature and partly one of burgeoning research programmatic interests in this explosively growing and increasingly critical scientific field. These interests expanded the program's focus from high performance computing and networking to applications that make advanced computing and networking capabilities more widely available and easier to use. Beneath the name changes and the programmatic evolution, however, the structure and budget process for the program have not changed. Most significant, the focus of the Federal effort has remained constant to the Congress's wise intent: To conduct the long-term, fundamental research that leads to technological breakthroughs advancing the science of information technology. That is the kind of work that made the U.S. the world leader in advanced computing and networking in the first place. And it is the kind of work required to sustain that preeminence over the long term.

From FY 1992 to FY 1996, this program was called the High Performance Computing and Communications (HPCC) Program. In FY 1997, it was renamed the Computing, Information, and Communications (CIC) programs. The programs' research groups, which had been called Components, were renamed Program Component Areas (PCAs) and were updated to reflect the growth of research needs beyond the HPCC Program's initial focus on high-end computing and advanced networking. In FY 1998, the Congress enacted a three-year Next Generation Internet (NGI) Initiative, which was included as part of the CIC budget crosscut. In FY 2000, the Administration sponsored an "Information Technology for the 21st Century (IT2) Initiative. In FY 2001, both the NGI and IT2 initiatives were incorporated into the renamed Information Technology R&D (IT R&D) Program. In the President's FY 2002 Budget, the program is referred to as the Networking and Information Technology Research and Development (NITRD) program.

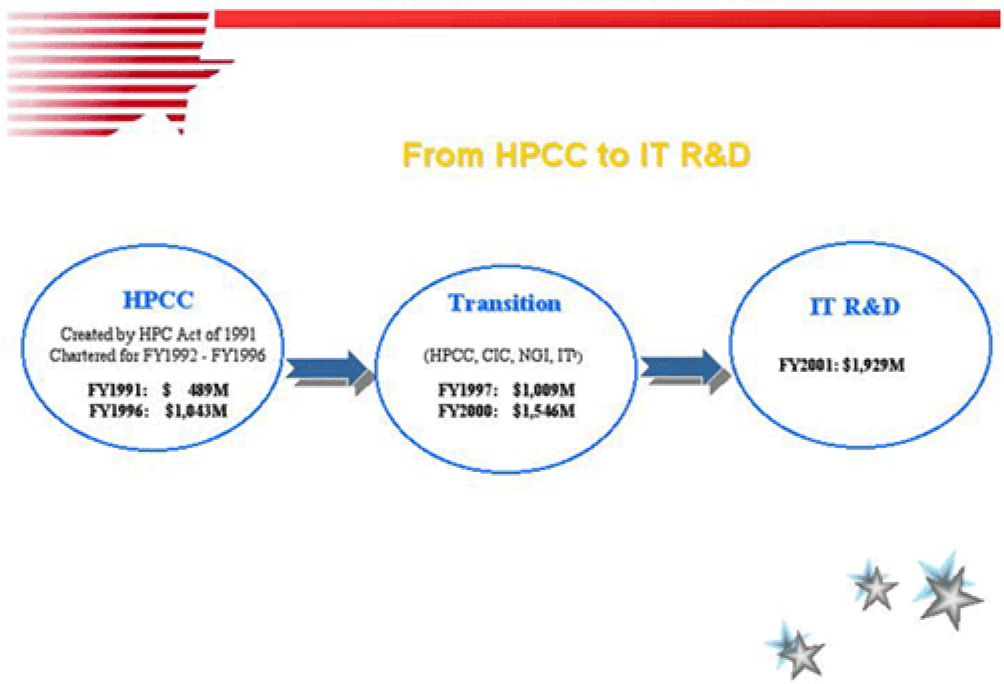
Participating agencies

The participating agencies are, in alphabetical order:

Agency for Healthcare Research and Quality (AHRQ)
of the Department of Health and Human Services
Defense Advanced Research Projects Agency (DARPA)
of the Department of Defense (DoD)
Department of Energy (DOE) National Nuclear Security
Administration (NNSA)
DOE Office of Science
Environmental Protection Agency (EPA)
National Aeronautics and Space Administration (NASA)
National Institutes of Health (NIH) of the Department
of Health and Human Services
National Institute of Standards and Technology (NIST)
of the Department of Commerce
National Oceanic and Atmospheric Administration (NOAA)
of DOC
National Security Agency (NSA) of DoD
National Science Foundation (NSF), and
Office of the Deputy Under Secretary of Defense

for Science and Technology (ODUSD [S&T]).

Figure 1 - History of Program



The Congress appropriates funding for the multiagency IT research program through agency appropriations, and this funding is reported in a budget crosscut. References in this testimony to "participating agencies" refer to agencies included in the budget crosscut. Other agencies, such as the Federal Aviation Administration and the General Services Administration, participate in NITRD discussions but are not part of the budget crosscut.

Program structure (see figure 2 on next page) The Congress's prescient requirement for collaboration in the HPC Act is particularly significant because information technology itself is an intensive interdisciplinary scientific endeavor in which collaboration across many science and engineering fields is a necessity. The alignment of scientific and programmatic imperatives for cooperative work in the Federal IT research effort has stimulated precisely the kind of ongoing exchange of ideas and cross-agency initiatives that the Congress envisioned.

Let me describe how this works logistically in the research effort that has evolved out of the High Performance Computing and Communications (HPCC) Program established by the Congress in 1991.

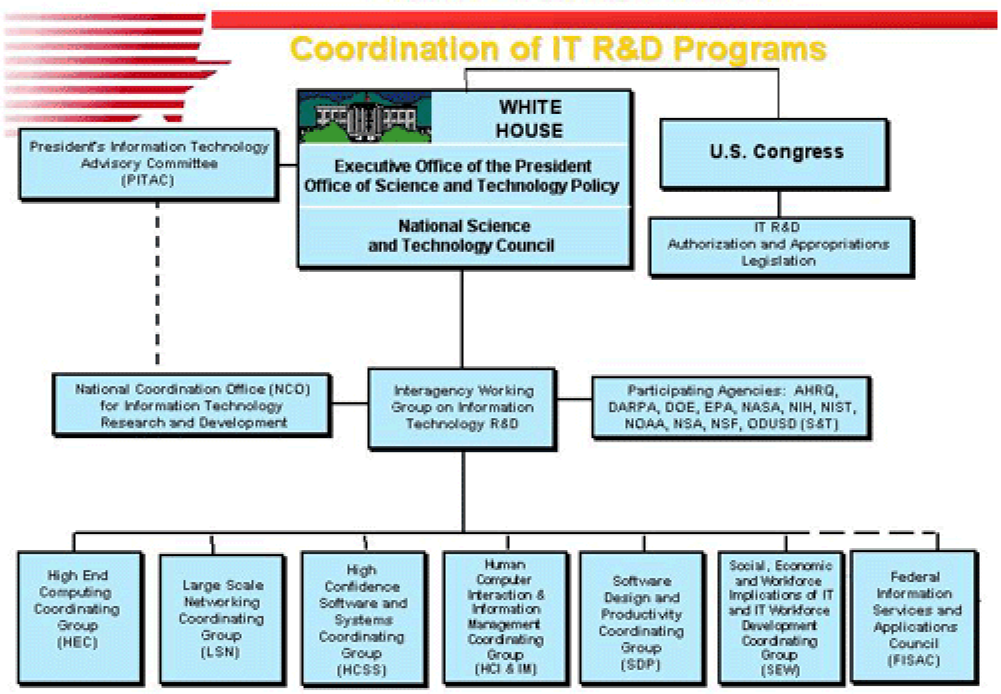
First, the White House sets broad policies and priorities for Federal networking and information technology R&D - from the President through the Office of Science and

Technology Policy (OSTP) and the National Science and Technology Council (NSTC). In addition, the President's Information Technology Advisory Committee (PITAC), the group of IT leaders in industry and academe that provides independent advice to the President on IT issues, periodically makes recommendations about Federal R&D that influence NITRD directions.

The hands-on coordination of interagency IT research activities is handled by the Interagency Working Group (IWG) on IT R&D. This group is made up of representatives from each of the participating agencies and from the Office of Management and Budget (OMB), OSTP, the National Economic Council (NEC), and my office, the National Coordination Office for IT R&D. The IWG is chaired by Dr. Ruzena Bajcsy, Assistant Director of the National Science Foundation and head of NSF's Directorate for Computer and Information Science and Engineering.

The major research emphases of the NITRD effort are reflected in the Program Component Areas (PCAs). The work of each PCA is guided by a Coordinating Group of program managers from participating agencies. These groups meet monthly to coordinate the objectives and activities of the multiagency projects in their specialized research areas. They report to the Interagency Working Group (IWG). The PCAs evolve in response to changing research needs.

Figure 2 - Program Structure



The PCAs are:

- High End Computing (HEC), which includes both HEC R&D and HEC Infrastructure & Applications (I&A Human Computer Interaction & Information Management (HCI&IM)
- Large Scale Networking (LSN)

  LSN also has three subordinate teams - High Performance Networking Applications Team (HPNAT), Joint Engineering Team (JET), and Networking Research Team (NRT) - that address specific technical issue areas. These teams include non-Federal members from academe and industry.

- Software Design and Productivity (SDP)
- High Confidence Software and Systems (HCSS)
- Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW)

In addition to the PCAs, the Federal Information Services and Applications Council (FISAC) is chartered to facilitate partnerships between the Federal IT R&D and non-R&D communities to promote early application of advanced computing, information, and communications technologies within the Federal government.

The technical and administrative support for the Interagency Working Group and the PCA Coordinating Groups is provided by the National Coordination Office (NCO). We provide similar support to the PITAC. The cost of operating the NCO is shared by the participating agencies in proportion to their IT R&D budgets. The functionality of the NCO is authorized in the 1991 HPC Act. NSF serves as the host agency for the NCO and has been extremely supportive in that role.

Program planning and assessment
NITRD planning and assessment are ongoing processes that are carried out in the program's year-round meetings and detailed in several kinds of formal documents produced by the Interagency Working Group and the Coordinating Groups:

- The annual Supplement to the President's Budget, known as the Blue Book, documents the current year's research accomplishments and proposed scope of work for the next fiscal year, with budget estimates for the current year and budget requests for the next fiscal year, by agency and by PCA.

- A more detailed mapping of PCA activities to agencies' internal programs and budgets is prepared in the annual Implementation Plan for the multiagency budget crosscut.

- Research planning papers periodically prepared by the Coordinating Groups provide a basis for discussion of research focuses and approaches within each PCA and across the NITRD portfolio. Often, these documents are developed from national research workshops sponsored by the Coordinating Groups, providing a forum for discussions with experts from academe and industry about key issues and future goals in IT R&D. Reports of these meetings also are published and become part of the ongoing assessment of research directions.

Program budgeting

Funding for NITRD activities is implemented through standard agency budgeting and appropriations processes that involve the participating agencies and departments, the Office of Management and Budget, the Office of Science and Technology Policy, and the Congress. Some activities are funded and managed by individual agencies. Others involve multiagency collaboration, with mutual planning and mutual defense of budgets.

The annual Supplement to the President's Budget and Implementation Plan together provide a roadmap from the annual Program Component Area budgets back to what each participating agency contributed, and in what agency program context. From year to year, this roadmap, if not wholly transparent, is clear to those who are familiar with the multiagency effort. With the Administration's help, we are trying now to streamline the Implementation Plan so that it will be a more useful document. I think in reality the funding and Coordinating Group structure is not complicated - you just have to roll your sleeves up and spend some time with it.

It is more difficult to track funding for this program back over time because of the many developmental changes in its scope described in this testimony. But I think what really is at issue here is the rapid development of this entire field in an incredibly short period of time. Did the program support digital libraries technologies 10 years ago, or for information assurance, microsensor software, wireless technologies, or workforce implications of IT even 5 years ago? No. But the program is supporting these areas today.

President's Information Technology Advisory Committee (PITAC)

A significant new form of guidance for the multiagency program has come from the President's Information Technology Advisory Committee (PITAC), established in 1997 by Executive Order and renewed for a two-year term on May 31, 2001, by Executive Order of President Bush. The PITAC's 1999 report, "Information Technology Research: Investing in Our Future," and the Committee's subsequent reviews of the Federal IT research effort have substantially influenced the thinking of agency managers about IT research topics and priorities.

The PITAC's 1999 recommendations called for "significant new research in computing and communications" focused on "long-term, high-risk investigations." The highest IT research priorities for this Federal effort, the PITAC said, were software, scalable information infrastructure (advanced networking), high-end computing, and socioeconomic impacts of IT such as on education and training. Directly as a result of these recommendations, the IT R&D effort was broadened to intensify research attention on issues in software development. Beginning in FY 2001, a new PCA was established - Software Development and Productivity (SDP) - and the charter of an existing PCA - High Confidence Systems - was expanded to include information assurance and safety, and that PCA's name was changed to High Confidence Software and Systems (HCSS). SDP is focused on the process of developing software, especially on reducing cost and improving quality. One special focus area is networked embedded systems of sensors that monitor physical surroundings and active physical devices. HCSS focuses on the software and systems technologies necessary to ensure that critical IT systems achieve extremely high levels of reliability, availability, protection, restorability, and security (protections against such problems as identity theft, for example). Integrating these attributes in software designs will help reduce the rate of significant software failures and reduce the skyrocketing costs of retrofitting systems with security services.

The Large Scale Networking PCA responded to the PITAC's concern about the lack of scalability in the Internet by expanding its research on that issue, including wireless and other technical strategies for expansion. As a result of the PITAC report's emphasis on the need for research on the educational and workforce development impacts of IT, the Education, Training, and Human Resources PCA evolved into the Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW) PCA. SEW became part of the budget crosscut in FY 2001, with an emphasis on education and training-related research.

Other changes in the program

Prior to the influence of the PITAC, the most significant changes to the original HPCC initiative came as a result of the rapid diffusion of information technology in society during the 1990s. The HPCC Program had focused on high performance computing and high-speed networking. The significance of applications research grew as researchers realized that simply advancing computing and networking speeds, while vital, did not address the question of how to harness those capabilities to broad uses. But trying to create widely useful applications of advanced digital technologies also raised its own novel questions about how humans can most effectively use and interact with computing devices. That led to the evolution of a PCA on Human-Computer Systems. With the growth of issues in managing and utilizing the explosion of electronic information in the last few years, pointed to by the PITAC report, that PCA added information management to its research agenda, becoming the Human-Computer Interaction and Information Management (HCI & IM) PCA beginning in FY 2001.

In FY 2000, the High End Computing PCA subdivided its activities into two areas: High End Computing Research and Development, which pursues advances in architectures and computational speeds, and High End Computing Infrastructure and Applications, which focuses on expanding access to high-performance platforms for researchers and on developing advanced applications. This change reflected the distinction between research aiming to improve the technical capabilities and performance of high-end systems, and research focused on developing advanced applications for those systems, including distributed shared applications.

Goal setting in the multiagency IT research enterprise also has changed since 1991. The original HPCC Program had one set of five-year goals. Since the beginning of the PCA structure in 1996, the PCAs have set their own timelines, reflecting the varying characteristics of their individual research areas.

Why the Federal IT research investment is so successful
I have been asked to comment on how well the Federal program is working. I believe the program works, and works very well. The secret of its success is that its purposes and structure are exactly the right ones in the context of both government missions and the broader U.S. economy.

The right purposes

- Federal IT R&D occupies a unique R&D niche. It is the Nation's primary source of long-term, fundamental research on IT issues that must be addressed to advance the capabilities of computers, networks, and information systems generally. Industry and venture capitalists typically focus on short-term product development offering the likelihood of rapid returns on investment. Private-sector investment strategies therefore tend to bypass key technology areas that may be the most critical to Federal government missions and that help support the continuing superiority of the U.S. IT industry. These areas include high-end computing, mass storage, optical networking, interoperable systems and applications, security, privacy, new generations of embedded and large scale systems, improved processes for developing new software, and effective human uses of IT. In fundamental IT R&D, the research time horizons are much longer and there is no guarantee of the success of any one research path. IT industry leaders have been for many years among the most ardent champions of Federal investment in long-term, fundamental IT research - precisely because the U.S. government is a primary source of support for that kind of risky, pre-competitive exploration. It is not necessarily the case that the private sector should not have a strong role in the support of fundamental research, but the difficulty to the company in appropriating the returns makes commercial support of this research more difficult.

- Federal IT R&D supports critical agency missions and national needs, including national defense and national security, critical infrastructure protection, energy systems, aerospace engineering, weather and climate forecasting, and advanced biomedical and other scientific research. National defense and national security needs alone require advanced IT research efforts on a continuing basis to equip the military with cutting-edge weapons technologies and secure communications systems and to accurately model and design these advanced systems.

- The research portfolio is diversified and balanced. Federal research responds to a basic reality of the interdisciplinary IT field: What can be accomplished using IT is determined by the weakest or the slowest technology, not by the strongest or the fastest. For that reason, Federal IT R&D pursues a balanced, diversified portfolio of research interests, seeking advances across the wide range of enabling technologies required for agency missions.

- Federal IT R&D produces broadly useful technologies and tools that spur innovation across the U.S. economy. It is an effective engine of technology transfer. The coordination of Federal IT R&D investments across many agencies and private-sector partnerships leverages mission-related research, producing general-purpose, broadly useful, and interoperable technologies, tools, and applications. Federal IT R&D has thus been a powerful engine of technology transfer, the direct result of its focus on widely applicable solutions to basic IT problems and its mechanisms of funding R&D. The large number of Federally funded breakthroughs subsequently commercialized in the private sector - often by graduates of U.S. research universities whose education was funded through the IT R&D programs - leverage the Federal investments even further.

- The Federal IT R&D program maintains the talent pipeline the Nation needs to continue making technological advances. More than half of the NITRD budget is expended for university-based research. This work is peer-reviewed, which helps assure it is of the highest quality, and the research dollars help support the graduate training of new generations of highly skilled scientists, engineers, and technicians needed to work on national research challenges.

The right program structure
The structure of the Federal research effort works well to support the NITRD goals for the following reasons:

- The multiagency approach aligns well with the multidisciplinary nature of IT research issues.

- The NITRD effort involves the right Federal agencies. The program also draws in a variety of other interested agencies to participate in its meetings, research workshops, and other activities. Such agencies include the Bureau of Labor Statistics, the Department of Defense High Performance Computing Modernization Office, the Federal Aviation Administration, and the General Services Administration.

- Through interactions in this program, the NITRD agencies have developed active, trusting, and efficient relationships for communication and cooperation. For example, agencies now participate in each other's proposal review processes.

- The missions of the participating agencies span all major IT R&D areas, ranging from fundamental research in broadly useful enabling technologies to applying those technologies to a wide variety of applications. NSF invests in fundamental research itself; some agencies invest in fundamental research in order to accomplish their agency's unique goals; and others use the technologies developed by these agencies to conduct R&D on their own agency's mission-driven applications. Individually, the agencies could not have accomplished all that the multiagency effort has made possible. A special by-product of this collaboration is that NITRD technologies are able to interoperate, which benefits both Federal operations and U.S. economic competitiveness. So, for example, today each agency does not have its own stand-alone network. Rather, the Federal government and the country have the Internet, a network of networks that is still evolving. Agencies are focusing on complementary efforts, making the coordinated program substantially greater than the sum of its agency parts.

- The Program Component Area system of organizing NITRD research emphases provides the program with the flexibility to evolve quickly in response to changing R&D needs. For example, even the PITAC's compelling 1999 recommendations for IT research made no mention of one key area - microsensors and embedded devices -that is now of paramount importance for national defense. The PITAC report made only passing reference to a second area - assurance and security in software - that is now viewed as a prerequisite for development of any mission-critical software. The PCAs are able to evolve their interests, as noted above, in a timely way to encompass such emerging research focuses.

- The multiagency coordination process has facilitated innovative collaborative research efforts that individual agencies would not otherwise have been able to tackle. A notable example is the Large Scale Networking program, in which NSF, DARPA, NASA, NIH, DOE National Nuclear Security Administration, DOE Office of Science, NIST, NOAA, AHRQ, and ODUSD (S&T) collaborate in networking research and development. Since1998, LSN research has boosted the end-to-end performance of shared end-user applications over networks from 1.5 megabits per second to 1 gigabit per second today. That is nearly a thousand-fold improvement in the end-to-end performance of networks for the Nation's scientific research community.

- Collaborative efforts include industry partnerships. Critical networking integration activities in the LSN effort, for example, involve such corporations as AT&T, Cisco, MCI Worldcom, Nortel, Qwest, and Sprint. Representatives of Internet2 participate in the LSN specialized teams. Intel, Sun, and others are developing an automatically tuned application/network interface; Ciena and others are developing key optical networking components. NSF partnered with Compaq in the research to develop the terascale computing platform at the Pittsburgh Supercomputing Center. The terascale machine is the newest and most powerful addition to NSF's Partnerships for Advanced Computational Infrastructure (PACI) program. DOE/NNSA is collaborating with more than 20 organizations representing academia, industry, and government to develop a next-generation storage system based on commercially available products. Types of industry involvement include: CRADAs, collaboration, IPAs, consortia, start-ups, tech transfer, procurement, standards development, and advisory committees.

- The NITRD program is responsive to constituent research communities in universities and in industry. Its focused workshops, for example, draw the attention and participation of academic and industry researchers nationally and help shape or revise the research agenda in specific areas. Recent workshops on future directions in networking and on long-range issues in software design and productivity were well attended and enthusiastically endorsed by leading academic and industry experts in these fields.

- <u>The Federal IT research investment has consistently received bipartisan congressional support and the support of the Executive Branch.</u>

It seems to me that this program structure has been quite effective in evolving to respond to important new research areas as they emerge. The PITAC's powerful overview of the needs in the U.S. IT research enterprise has been very influential in shaping important new research emphases - one example is software, where the issues are multiple and further research is important. The NITRD emphases going forward must continue to be focused fundamental research in enabling technologies. This research must be peer reviewed, well designed, and tightly coordinated within the multiagency framework. The research priorities laid out in the PITAC report are sound and are serving us well in the near term.

Program funding

The estimated FY 2001 Federal investment in the NITRD effort totaled $1,929 million. The Department of Defense's FY 2002 levels are subject to change as a result of the FY 2002 Defense Budget Amendment. Until DoD can match up its FY 2002 Budget Amendment with the interagency IT definitions, we are using the placeholder projections that were shown in the Budget in April. This leads to an estimate of the NITRD program's total FY 2002 request, currently $1,969 million. With this request, information technology research increases by $40 million and includes the largest-ever contribution from the Department of Health and Human Services ($266 million). For your information, I have included synopses of some of the exciting NITRD projects that NIH is currently supporting at the end of my testimony. These projects include research on applications that could promote lower cost health improvement, which will be desirable especially in light of increasing health care costs. There have been healthy increases in IT research spending, including FY 2002.

Authorization of the program

Coordination of NITRD activities is now a standard part of the way participating agencies conduct their routine business. Over the first decade of this program's development, each of the agencies has become committed to information technology research and the process that coordinates the effort across agencies.

The current program structure provides important flexibility to agencies and Program Component Areas to respond to changes in the networking and advanced computing fields. My view is that the NITRD effort does not suffer from structural weaknesses. However, strong coordination is vital to the program, and it would be very beneficial for the collaborative enterprise as a whole if agencies gave more attention to the fact that the individual programs are part of a larger research portfolio. So raising awareness of the great significance of this effort to the Nation's well being is always a good thing. We will be happy to work with the Congress on specific issues associated with the underlying legislation.

State and local government involvement
Many state universities are participants in the Federal IT research effort. More than 50 percent of all NITRD funding is expended on research conducted on the campuses of research institutions nationwide.

What are some of the challenges ahead for the program?
The following are challenges that receive discussion within the multiagency program. This is not a complete list, and it is not in order of priority.

- Undertaking the R&D necessary to tackle IT problems at scale. For example, we have never built a network that is the size and complexity of the Internet. We do not know how to do that today. But when we think we do know how, we will need to experiment, test, and evaluate the model in order to make it work and work well. We will need large-scale R&D testbeds for this research.

- Providing infrastructure for research on high-end applications for the sciences and engineering (for example, growing the NSF Partnerships for Advanced Computing Infrastructure [PACI]). Access to high-performance computing platforms and high-speed networks remains very limited today, constraining the ability of researchers to build and test the most advanced scientific applications. Access to computing cycles at the NSF supercomputing centers has declined as the demand for computing time increases.

- Working with other Federal agencies on their IT problems. Some agencies do not have a research mission, but the IT transformation that they are undergoing requires that they take on new tasks, or tackle old tasks in new ways. This requires research, and the implementation of research-based innovations. The NITRD agencies are willing to work with other agencies on these issues.

- Helping the Congress and the U.S. public better understand how IT advances are contributing to advances in not just the sciences but also the humanities. Many benefits could flow from greater public understanding of IT, ranging from increased student interest in science, mathematics, and research, to broader awareness of the impacts of information technology on all of us.

Conclusion
I believe that information technology is our future. The Federal investments we make in computing and networking research will help shape our long-term ability to succeed as a Nation. These investments, which unleash the brilliant skills of academia and industry, are the keys to the future for our children and grandchildren. I look forward to working with the Congress to fulfill that enormous promise.

Thank you.

Examples of NIH Advanced Networking Applications Projects

Biomedical Tele-Immersion
By combining teleconferencing, telepresence, and virtual reality, Tele-Immersion enables teachers and students to interact with three-dimensional models, point, gesture, converse, and see each other.

Contact: Jonathan C. Silverstein, MD
University of Illinois at Chicago
School of Biomedical and Health Information Services
1919 W. Taylor
Chicago, IL 60612-7249
Phone 312-996-5112; Fax: 312-996-8342

Connectivity, Security, and Performance of an NGI Testbed for Medical Imaging Applications
This project implements an NGI testbed in Northern California's San Francisco Bay Area for medical imaging applications. The clinical applications include: impact of telemammography consultation service in a regional environment compared with a local level; and how real-time interactive teaching in breast imaging would improve the confidence level of general practice radiologists.

Contact: H.K. Huang, D.Sc.
University of California, San Francisco
Department of Radiology
530 Parnassus Avenue, Rm. CL-158
San Francisco, CA 94143-0628
Phone: 415-476-6044; Fax: 415-502-321

Indianapolis Testbed Network for NGI Applications to Telemedicine
The Indianapolis Network for Patient Care (INPC) provides a testbed of NGI technologies including IP security (IPsec), Quality of Service (QoS) in televideo applications at a nursing home, and IP roaming capabilities with a portable wireless workstation.

Clement J. MacDonald, M.D.

A Multicenter Clinical Trial Using NGI Technology
This project provides the infrastructure of a multicenter clinical trial of new therapies for adrenoleukodystrophy (ALD), a fatal neurologic genetic disorder. It enables the formation of a worldwide imaging network of clinical institutions to evaluate ALD therapies. Three centers collaborate on this project. The Imaging Science and Information Systems (ISIS) Center at Georgetown University Medical Center, the Kennedy Krieger Institute and the Department of Radiology at Johns Hopkins University. NGI technology will be used to speed the transmission and evaluation of high quality MRI images. The project provides procedures to ensure medical data privacy and security.

Contact: Hugo W. Moser, M.D.

Kennedy Krieger Research Institute, Inc.
707 North Broadway
Baltimore, MD 21205
Phone: 410-502-9405; Fax: 410-502-9839

Human Embryology Digital Library and Collaboratory Support Tools
This application enables collaboration between multiple, distributed researchers and advances clinical and educational goals. It integrates existing data capture and analysis procedures at the National Museum of Health and Medicine (NMHM) into a high performance testbed network that includes a petabyte archive and analysis capability.

Contact: J. Mark Pullen, Ph.D.
George Mason University
Computer Science MS 4A5
4400 University Drive
Fairfax, VA 22030
Phone: 703-993-1538; Fax: 703-993-1710

Medical Nomadic Computing Applications for Patient Transport
This project provides real-time transmission of multimedia patient data from an incident scene and during transport to a receiving center enabling diagnostic and treatment opportunities prior to arrival. It includes acute ischemic stroke and trauma scene response - to define a range of Quality of Service (QoS) requirements for multiple critical care applications

Contact:David M. Gagliano
TRW, Inc.
One Federal Systems Park Drive
Fairfax, VA 22033
Phone: 703-345-7497; Fax:

Next Generation Internet (NGI) Implementation to Serve Visible Human Datasets
This project develops a production system to serve visible human datasets. These include a comprehensive set of interactive 2-D and 3-D browsers with arbitrary 2D cutting and 3-D visualizations. An interactive Web navigation engine is deployed to create and visualize anatomic fly-through, under haptic control of the user.

Contact: Brian D. Athey, Ph.D.
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Phone: 734-763-6150; Fax: 734-763-1166