United States House of Representatives
Committee on Science and Technology

Hearing on
Oversight of the Federal Networking and Information Technology Research and Development (NITRD) Program

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Good afternoon, Mr. Chairman and Members of the Committee. Thank you for granting me this opportunity to comment on the federal Networking and Information Technology Research and Development (NITRD) program. I am Daniel Reed, Chair of the Board of Directors for the Computing Research Association (CRA). I am also a researcher in high-performance computing; a member of the President's Council of Advisors on Science and Technology (PCAST); the former Head of the Department of Computer Science at the University of Illinois at Urbana Champaign; and currently Director of Scalable and Multicore Computing Strategy at Microsoft.

During our lifetime, information technology has transformed our society, our economy and our personal lives. Imagine a world without consumer electronics, personal computers, the Internet or predictive computational models. As Tennyson so eloquently expressed, we have "… dipped into the future, far as human eye could see; saw the vision of the world, and all the wonder that would be." **Despite our current wonder, the future of computing – the world that can be – is even more amazing, for we are poised on the brink of even greater revolutions**: deep understanding of biological and physical processes, personalized medicine and assistive living technology, autonomous vehicles that navigate in traffic and severe weather, strategic and tactical military and intelligence systems with true information superiority, information assistants that enhance our intellectual activities, distributed sensors and actuators that protect our environment, intelligent systems for advanced energy management, and a host of other innovations.

Making such visions a reality is the essence of information technology research and the core of the NITRD program. It is also why sustained and appropriate investments in information technology research and development are critical to our nation's future.

In response to your questions, I would like to make eight points today regarding the status and future of the NITRD program, beginning with a synopsis of the recent report of the President's Council of Advisors on Science and Technology (PCAST) assessment of the Networking, Information Technology Research and Development (NITRD) program.

1. PCAST: Information Technology Assessment

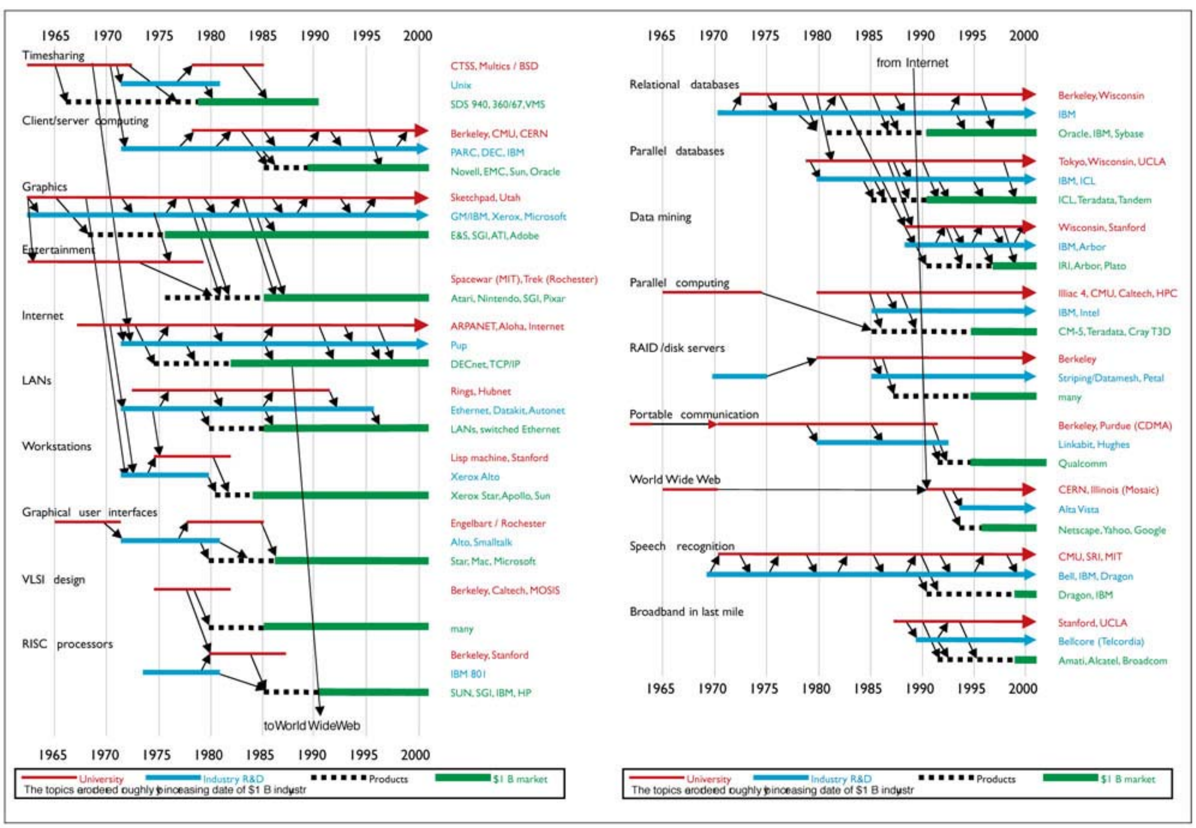
In 2007, I was privileged to co-chair PCAST's assessment of the NITRD program. The resulting report, *Leadership Under Challenge: Information Technology R&D in a Competitive World,*[1] was the first overall assessment of the NITRD program since that conducted in 1999 by the President's Information Technology Advisory Committee (PITAC). The 2007 PCAST report emphasized the following points.

- **NIT and global competitiveness.** Today, the United States is the global leader in networking and information technology (NIT) and that leadership is essential to U.S. economic prosperity, security, and quality of life. However, other countries and regions have also recognized the value of NIT leadership and are mounting challenges.
- **NITRD ecosystem.** The NITRD program is a key mechanism through which the federal government contributes to NIT research and development leadership, and the NITRD program has by and large been effective at meeting agency and national needs.

[1] *Leadership Under Challenge: Information Technology R&D in a Competitive World*, President's Council of Advisors on Science and Technology (PCAST), August 2007, http://www.ostp.gov/pdf/nitrd_review.pdf

- **Research horizons and risks.** The federal NIT research and development portfolio is currently imbalanced in favor of low-risk projects; too many are small scale and short-term efforts. The number of large-scale, multidisciplinary activities with long time horizons is limited and visionary projects are few.
- **Workforce availability and skills.** The number of people completing NIT education programs and the usefulness of that education fall short of current and projected needs. Current curricula must be re-evaluated, graduate fellowships increased and visa processes simplified to address these challenges.
- **Research priority areas.** The top priorities for new funding are NIT systems connected to the physical world, software, networking and digital data, with continuing emphasis on high-end computing, cybersecurity and information assurance, human-computer interaction and NIT and the social sciences.
- **Strategic plans and roadmaps.** We must develop, maintain, and implement a strategic plan for the NITRD program, along with public R&D plans or roadmaps and progress metrics for key technical areas that require long-term interagency coordination and engagement.
- **Interagency coordination.** The current nature and scale of NITRD program coordination processes are inadequate to meet anticipated national needs and to maintain U.S. leadership in an era of global NIT competitiveness.

With this backdrop, the remainder of my testimony expands and explains the rationale for these PCAST findings along with personal observations on possible actions. However, the opinions expressed herein are my own, not necessarily those of PCAST or the Office of Science and Technology Policy (OSTP). I would also like to acknowledge the contributions of Peter Harsha, from the Computing Research Association (CRA), to these remarks.



Source: From [6], reprinted with permission from the National Academy of Sciences, courtesy of the National Academies Press, Washington D.C. © 2003.

Figure 1 IT Research Transition and Impacts

2. The Importance of Information Technology

The importance of information technology (IT) in enabling innovation and powering the new economy is well documented. Advances in computing and communications have led to significant improvements in product design, development and distribution for American industry, provided instant communications for people worldwide, and enabled new scientific disciplines like bioinformatics and nanotechnology that show great promise in improving a whole range of health, security, and communications technologies. **Several studies have suggested information technology has been responsible for 25 percent of more of U.S. economic growth in recent years, despite being a much smaller fraction of the gross domestic product (GDP).[2] Moreover, information technology leadership has proven essential to the nation's security, from our national infrastructure and signals intelligence to our military.**

Information technology has also changed the conduct of research. Innovations in computing and networking technologies are enabling discovery across every scientific and engineering discipline – from mapping the human brain to modeling climatic change and enhancing energy production. Faced with problems that are ever more complex and interdisciplinary in nature, researchers are using IT to collaborate across the globe, visualize large and complex datasets, and collect and manage massive amounts of real-time sensor-derived data.

But equally important to the role IT plays in enabling innovations in industry and in the other scientific and engineering disciplines is the role of the research and development (R&D) ecosystem in enabling IT innovations. The 1995 National Research Council (NRC) report, *Evolving the High Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure*,[3] included a compelling graphic illustrating this spectacular return. The graphic was updated in 2002 and is reproduced in Figure 1.

The graphic in Figure 1 shows the development of technologies from their origins in industrial and federally-supported research, to the introduction of the first commercial products, through the creation of billion-dollar industries and markets. The original 1995 NRC report identified 9 of these multibillion-dollar IT industries (the categories on the left side of the graphic). Seven years later, the number of examples had grown to 19 – multibillion-dollar industries that are transforming our lives and driving our economy.

The graphic also illustrates the complex interplay among industrial R&D efforts and the interdependent ecosystem of NITRD agencies that supports academic research. Each federal agency plays a distinct, but important role in the current and future success of the U.S. information technology ecosystem.

3. The NITRD Ecosystem: Fostering Innovation via Diversity

The NITRD program is a collaborative confederation of thirteen federal agencies, each with differing missions that depend – to varying degrees – on advances in information technology. This ecosystem of agencies is complex and interdependent, with some small and others large, some supporting outcome-directed research and others supporting innovation-driven research, some supporting small projects and others funding large initiatives, some focused on federal research laboratories and others engaging academia.

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[2] Dale W. Jorgenson and Charles Wessner, editors. 2007. *Enhancing Productivity Growth in the Information Age: Measuring and Sustaining the New Economy.* Washington, D.C.: National Academies Press. Also see Dale W. Jorgenson, Mun S. Ho, and Kevin J. Stiroh. 2005. *Productivity Volume 3: Information Technology and the American Growth Resurgence.* Cambridge, Mass.: MIT Press.

[3] U.S. National Research Council. *Evolving the High Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure.* National Academies Press, Washington, D.C. 1995.

Historically, this NITRD diversity has been a major strength of the U.S. approach to information technology research, as it has fostered diverse approaches to complex computing problems, with differing research horizons and communities. Together, a strong IT industry, powerful commercialization system, and high-quality education and research institutions have been critical to America's leadership in IT. The aforementioned 1995 report by the National Research Council emphasized the "extraordinarily productive interplay of federally funded university research, federally and privately funded industrial research, and entrepreneurial companies founded and staffed by people who moved back and forth between universities and industry."

To further illustrate this point, consider some specific, compelling examples of agency leadership, cross-agency collaboration and industrial engagement. The Defense Advanced Research Projects Agency (DARPA) has historically supported large-scale projects with revolutionary intent – high-speed networks for resilient communication, artificial intelligence and autonomous navigation, massively parallel supercomputing for detailed modeling, real-time and embedded systems for situational awareness – to ensure the technological superiority of U.S. military forces. **Today's Internet began in the 1960s as an ambitious DARPA (then ARPA) research project in resilient, packet-based communications for national defense.**

Reflecting its long-term focus, DARPA supported the Arpanet for well over a decade. **This later enabled the National Science Foundation (NSF) to build on a rich research and technology base to create a high-speed national network connecting supercomputing centers and their NSF-funded students and faculty researchers. From this fertile ground, the Mosaic web browser was born at the University of Illinois, spawning the commercial web revolution and today's Internet via commercial investments.**

The Department of Energy's Office of Science (DOE SC) and its National Nuclear Security Administration (DOE NNSA) have long supported algorithms and software research, network and distributed systems studies and advanced computer architecture designs in both DOE laboratories and academia. **DOE SC's Scientific Discovery through Advanced Computing (SciDAC) program supports multidisciplinary teams to develop the enabling technologies for next-generation computing systems and their application to models of climate change, efficient energy sources and biological processes.** In turn, the DOE NNSA has advanced computer systems, software and algorithms in support of nuclear stockpile stewardship and certification.

The Human Genome Project, funded by the National Institutes of Health (NIH), was enabled by high-throughput sequencing systems, based on advanced semiconductor technology and efficient algorithms for DNA subsequence reassembly executing atop high-performance computing systems. Simply put, the Human Genome Project was a collaborative triumph of biomedicine and information technology; the commercial semiconductor designs and computer architecture and academic algorithms that enabled this breakthrough were previously funded by DARPA, NSF and DOE. The tantalizing promise of low-cost, personalized medicine, with treatments and drugs tailored to individual needs, will be realized only via continued advances in computing technology, themselves derived from information technology research.

As all these examples illustrate, the success of the NITRD program has accrued from the health, diversity and vigorous interactions among its component agencies, universities and industrial partnerships. Historically, DARPA funded large-scale, high-risk projects involving academic and industry teams. In turn, DOE supported national laboratory and academic researchers around large-scale scientific instruments, and NSF supported innovation-driven research, predominantly by individual faculty members and their students, with a mix of larger projects and centers. NIH has partnered on selected

NITRD programs and NASA, NIST and the other NITRD agencies have supported mission-specific research and development programs.[4]

The rich ecosystem of computing research approaches, collaborative agencies and funding models has long made the U.S. the undisputed leader in information technology, with concomitant benefits to our national security, economic competitiveness and lifestyle.

4. Research Horizons and Risks: The Funding Monoculture

In a biological ecosystem, environmental changes or the death of a species can change the ecosystem's set point or even lead to its death; the NITRD ecosystem is no different. T**oday, the health of the NITRD ecosystem is threatened, and the future of our national competitiveness is at grave risk, due largely to an over-dependence on a single research funding source, a single funding approach and inadequate research funding overall.** Through the 1990s, academic computing research funding was dominated by two NITRD sources, DARPA and NSF, with each filling complementary ecosystem niches based on different project selection models, funding scales and assessment approaches.

From its inception, DARPA supported larger-scale, outcome-driven initiatives and projects based on targeted solicitations. DARPA program managers had broad latitude to assemble academic and industrial consortia that built computing technology prototypes and transferred promising prototypes into industry for commercialization. In a complementary role, NSF funded exploratory, innovation-driven computing research, funding peer-reviewed research proposals submitted by the academic community. Although project funding levels were typically lower than at DARPA, researchers were free to explore novel ideas of their own choosing. NSF researchers not only filled niches not occupied by DARPA, their most promising results often stimulated new DARPA technology prototyping and transfer initiatives.

As an example, research flourished in computer architecture, system software, programming models, algorithms and applications in the 1990s. Computer vendors launched new initiatives, parallel computing startup companies were born, and planning began for petascale systems, based on integrated hardware, architecture, software and algorithms research. This renaissance in parallel and high-performance computing research was a direct consequence of the High-Performance Computing and Communications (HPCC) program and interdependent agency initiatives, notably DARPA and NSF. DARPA funded large-scale hardware prototypes and software initiatives, while NSF supported exploratory research by single investigators.

When DARPA shifted its funding and evaluation model to shorter-term, "go/no-go" assessments and approaches, the ecosystem of funding agencies and researchers reacted and adapted. Large-scale computing research contracted, and those academic institutions and faculty who has historically benefited from DARPA's largess turned to NSF for research funding**. This retreat of DARPA from funding fundamental computing research at U.S. universities has left a hole in the overall federal IT research ecosystem that other participating agencies have been unable to fill.** The types and scale of research changed and the number of research proposals submitted to NSF rose precipitously, with a concomitant decline in proposal success rates.

The National Science Foundation is now the predominate funder of all academic computing research. Indeed, recent analyses show that NSF provides 86 percent of all funding for academic computing research.[5] The result is that NSF is now viewed by most academic researchers as the *only*

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[4] Each of the NITRD agencies supports diverse programs at multiple scales. This description captures the dominant mode of each agency.

[5] National Science Foundation, Division of Science Resources Statistics. 2008. *Federal Funds for Research and Development: Fiscal Years 2005–07*. Forthcoming. Arlington, VA.

viable source of research funding. The notable exceptions are the DOE SciDAC program and those faculty members who have strong ties to the national laboratories.

The consequences of this ecosystem shift are both deep and profound, with several deleterious effects. First, fierce competition for funding has made researchers risk averse. **Today, those proposals recommended for funding are far more likely to emphasize short-term, incremental research that builds on well-understood approaches. Such proposals are less controversial and more likely to win consensus approval than those embodying high risk, groundbreaking ideas. This is especially worrisome given the timeline of Figure 1, which shows the long incubation period for these technologies between the time they were conceived and first researched to the time they arrived in the market as commercial products.** In nearly every case, that lag time is measured in decades.

Incremental advancement itself is not bad; it is the lifeblood of the scientific process. However, just as a balanced retirement portfolio includes an evolving mix of low risk, modest return investments and higher risk, higher return investments, the long-term success of our computing research ecosystem depends on a balance of modest risk, moderate payoff research and higher risk, but high payoff, revolutionary research. **We must rebalance our research portfolio to encourage greater innovation and risk taking.**

Second, current academic structures necessitate research funding as an external validation of quality and to sustain internal research processes. Hence, faculty members face enormous institutional pressure to seek external research funding for promotion, tenure and national visibility. **Because only a modest fraction of submitted proposals is funded in many programs, faculty members now spend an inordinate fraction of their time preparing, submitting and reviewing proposals.** It is not uncommon for an assistant professor to write five or even ten proposals in a single year, hoping one or two will be funded. **Hence, we must address the funding shortfall that currently limits research innovation.**

5. Research Priority Areas: Identifying Innovation Foci

The seminal 1999 PITAC report, *Information Technology Research: Investing in Our Future*,[6] highlighted the importance of software noting, "Software is the new physical infrastructure of the information age. It is fundamental to economic success, scientific and technical research, and national security." The report also noted that the diversity and sophistication of our software systems was growing rapidly at a time we lacked the technologies to build reliable and secure software systems and that even more perniciously, we were under-investing in the research needed to develop those technologies. In addition to the critical importance of software, the 1999 PITAC report emphasized the importance of adequate research investment in scalable information infrastructure and high-performance computing.

In 2007, PCAST revisited the 1999 PITAC technical priority areas, concluding that the broad areas remained deeply relevant, albeit with slight changes. Information technology systems that interact with the physical world emerged as the new top priority – cyber-physical systems where computing systems, sensors and actuators are deeply embedded in engineered objects. Such systems are now both diverse and ubiquitous and include our critical national infrastructure such as the electric power grid, mobile and human-centered sensors (e.g., mobile biomedical devices), environmental monitors and military systems. Such systems can be difficult and costly to design, build, test, and maintain and the consequences of failure can be catastrophic. However, the benefits are enormous, including more efficient transportation systems, more efficient energy generation and management and a reduced carbon footprint for a diverse set of human activities.

[6] President's Information Technology Advisory Committee, *Information Technology Research: Investing in Our Future,* http://www.nitrd.gov/pitac/report, 1999

One should rightly view systems that interact with the physical world as a special case of the broader software priority identified by PITAC. In this spirit, software remains the second broad priority identified by PCAST, along with networking and digital data. The latter two areas reflect the popularization of the Internet, with concomitant challenges in security, scalability, resilience and management, and the explosive growth of digital data, itself enabled by inexpensive sensors and large-scale storage devices. Advances in these areas are also essential to national security and to combating cybercrime. **PCAST also recognized the need for continuing emphasis on high-end computing, cybersecurity and information assurance, human-computer interaction, and information technology and the social sciences.**

6. Workforce: Ensuring Quality and Quantity

In a knowledge economy, continued innovation and international competitiveness depend on an adequate and continually renewed supply of qualified and motivated workers. In the U.S., the IT workforce is composed of those educated here – U.S. citizens, permanent residents and international students – and the best and brightest from around the world who choose to live and work here. **We face both quantity challenges, ensuring an adequate supply of IT workers, and quality issues, creating curricula that match emerging technical trends and that attract and excite sufficiently diverse cross-section of the population.** As the 2007 PCAST report noted,

> *Although the overall supply of networking and information technology specialists is expected to grow in response to the growth in total demand, at current rates of enrollment and graduation, shortfalls in the numbers of highly qualified computer scientists and engineers graduated at the undergraduate and doctoral levels are likely. Women and other underrepresented groups will constitute a declining proportion of the new graduates.*

The stereotype of a geek who writes code in a small cubicle and who eschews human interaction is neither reflective of the diversity of modern computing and nor of computing's role in all aspects of society, from the arts and humanities through business practice to science and engineering. Many academic, federal and private groups are working assiduously to dispel this stereotype and raise the image of computing among potential students. The *Image of Computing Task Force*[7] was created by a consortium of companies and computing professional societies to "expose a realistic view of opportunities in computing" and to "educate the public and those with the aptitude and interest to pursue computing careers, on the increasing vital role computing plays in every major field." In addition, the CRA *Committee on the Status of Women (CRA-W),*[8] the *National Center for Women and Information Technology (NCWIT)*[9] and the *Coalition to Diversity Computing (CDC)*[10] are all highlighting the importance of diversity in computing and the opportunities for creative and engaging careers.

In addition to increasing awareness of information technology as a vibrant, attractive and relevant problem-solving skill in the 21st century knowledge economy, computing professional societies and universities are working to revamp curricula that have changed relatively little since the 1970s. The changes include increasing multidisciplinary computing education (i.e., computing and its applications to another discipline), multi-track curricula that allow students to create degree programs that better match their interests and emphasizing the power of computing as a general-purpose problem solving tool. As a complement to image education and curricula reform, PCAST also recommended increasing the number of multiyear graduate fellowships offered to U.S. students.

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[7] *Image of Computing*, http://www.imageofcomputing.com
[8] *CRA Committee on the Status of Women*, http://www.cra.org/Activities/craw
[9] *National Center for Women and Information Technology*, http://www.ncwit.org
[10] *Coalition to Diversity Computing*, http://www.cdc-computing.org

These image, curricula and fellowship reforms potentially address the shortfall of domestic students. However, the U.S. information technology ecosystem has long been a magnet for talented students, researchers and workers from around the world. Such individuals increasingly find attractive educational, research and professional opportunities in their home countries. **It is in the best interests of the U.S. to retain the best and brightest international students who obtain graduate degrees in this country, often supported by research grants and contracts. Hence, PCAST also recommended streamlining the process for obtaining visas for non-U.S. students admitted to accredited graduate degree programs and to make it routine for foreign nationals who have obtained advanced degrees in NIT subjects at accredited U.S. universities to be permitted to work and gain citizenship by easing visa and permanent resident processes for them.**

7. NITRD Coordination: Strategic Planning and Execution

Without doubt, the NITRD program has been effective in fostering informal communication and coordination across agencies, both collectively and via the National Coordination Office (NCO). The NCO annually solicits and reports agency spending on NITRD Program Component Areas (PCAs). **Though each federal agency is represented within a NITRD Interagency Working Group (IWG) on IT research and development, the IWG has no budget authority over any of the participating agencies or the PCAs, nor does the NCO.** Each agency controls its own budget and sets its own goals exclusively on the perceived appropriateness of that funding to the agency's mission.

In practical terms, this means the IWG function in NITRD is largely one of information sharing among agency representatives on what the agencies plan to do and have done. Although the resulting NCO data is useful, it is a retrospective view of agency decisions and priorities, rather than an assessment of program priorities and progress against those plans. The process also tends to bias the process toward incremental, agency-specific agendas, making the NITRD program less effective in managing larger-scale, coordinated projects than span multiple agencies.

In a globally competitive world, we must plan more strategically and increase agency accountability for execution against those strategic plans. This will require greater interagency coordination and collaboration across PCAs to facilitate research and development transition within and across agencies, both to support fundamental research and to enable larger, multiagency projects.

8. Remaining Competitive: A Call to Action

To maintain the health and vibrancy of the U.S. information technology ecosystem, we must fully fund the agencies and programs included in the America COMPETES Act. I commend you and your colleagues, Mr. Chairman, for working so hard for its passage last year. It sent a powerful signal about the importance of the federal role in supporting fundamental research in the physical sciences, including information technology. I also appreciate your efforts to see the promise of the COMPETES Act realized in appropriations. **The funding authorized in the Act would help drive the core of the IT innovation engine – the fundamental information technology research in U.S. universities and national laboratories supported by the National Science Foundation, the Department of Energy's Office of Science, and the National Institute of Standards and Technology.**

The focus within the COMPETES Act on programs that aim to increase the number of students who enter science, technology, engineering and mathematics (STEM) fields is also crucial to the future of information technology research. As I noted earlier, the projected demand for IT professionals over the next 10 years -- positions that require at least a Bachelor's degree in computer science or computer engineering – exceeds all other science and engineering disciplines combined. Encouraging U.S. students to enter the science and engineering education pipeline, as is the focus of many of the programs included in the COMPETES Act, will help ensure that those projected workforce needs are addressed. **The many provisions in the Act that seek to increase the participation of women and minorities in science and**

engineering fields -- two populations that are woefully underrepresented in computing – are especially important.

Adequate funding is critically important, but it is not sufficient; this funding must be invested wisely in our information technology ecosystem. **The unilateral decision by any agency to change the direction, scope and mechanisms for its research investments has consequences across the entire NITRD ecosystem – federal agencies, universities and industry.** Such changes must not be undertaken without due consultation and consideration of broad consequences. **We must rebalance agency participation in the NITRD program so that the crucial responsibility of supporting fundamental research in computing is not borne solely by one agency.**

We must also create an interagency IT research and development strategic plan, complemented by a roadmap and a set of associated metrics that define interagency expectations and accountabilities. An evolving, strategic vision of information technology, together with an appropriate balance of short-range, low risk and long-range, high risk projects is essential if we are to remain global leaders. **The 1999 PITAC report recommended creation of large-scale Expeditions to the 21st Century, revolutionary expeditions whose mission**

> … *will be to report back to the Nation what could be accomplished by using technologies that are quantitatively and qualitatively more powerful than those available today. In essence, these centers will create "time machines" to enable the early exploration of technologies that would otherwise be beyond reach for many years.*

We would do well to embrace this vision and recommendation, ensuring that we fund a mix of projects, large and small, low and high risk, and both short and long term.

Finally, we must also have appropriate oversight and review of our research investment and accountability against strategic plans. The President's Information Technology Advisory Committee (PITAC) was authorized by Congress as a federal advisory committee under the High-Performance Computing Act of 1991 and the Next Generation Internet Act of 1998, with responsibility to assess advanced information technology and review the NITRD program. PITAC functioned as a separate Presidential advisory committee until its roles and responsibilities were assigned by Executive Order in 2005 to the President's Council of Advisors on Science and Technology (PCAST).

PCAST has a broad scope that spans all of science and technology, a challenging and important portfolio. **Given the importance of IT research and technology to our nation's economy, national security, military readiness and research enterprise, an independent PITAC is needed that can devote the time, energy and diligence to ongoing assessment of successes, challenges, needs and opportunities in information technology.** I base this opinion on my own experience as a previous member of PITAC and a current member of PCAST. Simply put, the NITRD program is best served by a standalone PITAC composed of computing experts from academia and industry.

In summary, information technology is a universal intellectual amplifier, advancing all of science and engineering, powering the knowledge economy, enhancing the quality of our health care, and transforming how we work, play and communicate. With vision, strategic investment and coordination, the U.S. NITRD program can and will continue to be the world's leader.

Mr. Chairman, thank you and this committee for your interest in the future of the NITRD program and its importance to U.S. competitiveness. Thank you very much for your time and attention. At the appropriate time, I would be pleased to answer any questions you might have.

Biographical Sketch

Daniel A. Reed is Director of Scalable and Multicore Computing Strategy at Microsoft. Previously, he was the Chancellor's Eminent Professor at the University of North Carolina at Chapel Hill, as well as the Director of the Renaissance Computing Institute (RENCI), which explored the interactions of computing technology with the sciences, arts and humanities. He formerly held the Edward William and Jane Marr Gutgsell Professorship at the University of Illinois at Urbana-Champaign, where he was Professor and Head of the Department of Computer Science and Director of the National Center for Supercomputing Applications (NCSA). At Illinois, he also led National Computational Science Alliance, a consortium of roughly fifty academic institutions and national laboratories to develop next-generation software infrastructure of scientific computing. He was also one of the principal investigators and chief architect for the NSF TeraGrid.

Dr. Reed is a member of President Bush's Council of Advisors on Science and Technology (PCAST) and a former member of the President's Information Technology Advisory Committee (PITAC). He recently chaired a review of the federal networking and IT research (NITRD) portfolio, and he is chair of the board of directors of the Computing Research Association (CRA), which represents the research interests of universities, government laboratories and industry. He received his PhD in computer science in 1983 from Purdue University.