

Findings of the PCAST NITRD Working Group

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Background

This is a periodic review of the Federal Networking and Information Research and Development Program. Both the coordinating effort and the research portfolio were originally given shape by Congress in the High-Performance Computing Act of 1991. Today this program represents the Nation's entire unclassified research and development investment in networking and information technology. Our Statement of Work asked us to consider both the coordinating effort, and the research portfolio itself.

Process

Let me say just a word about process of the study.

Our 14-member Working Group has worked tirelessly since last spring on the project.

In carrying out the assessment, the Working Group consulted with more than 50 experts from industry, government, and academia, who are listed in Appendix B of the report. We also consulted with roughly half a dozen members of PITAC.

Once our report was nearly complete in draft form, it was reviewed by PITAC and by the PCAST co-chairs. Throughout this process we received many suggestions, and we have attempted to diligently respond to them; that is reflected in the draft version that you have before you today.

Principal findings

Let me now discuss the principal findings in several areas.

The role of Networking and Information Technology

The first concerns the role of networking and information technology.

Our first and most important finding is that America's NIT R&D efforts have been hugely successful. This is amply evident, and authoritatively documented, with impacts ranging from accelerating the pace of discovery in nearly all other fields, to driving our economic competitiveness. Earlier this morning Chuck Vest, in responding to a question from Craig Mundie regarding the *Gathering Storm* report, provided an excellent overview of the technological and societal and economic impacts of networking and information technology research and development. I do want to indicate that economic studies conclude that two thirds of the Nation's labor productivity growth since 1995 are

due to the advancement and utilization of networking and information technology. Our Nation's competitiveness depends upon this field. The impacts of networking and information technology research and development are described in Section 2 of the report.

Secondly, this impact arises from a deep tradition of research, in which the Federal government plays an essential role. It's a complex ecosystem involving Federally-supported research largely at universities and Federal laboratories, industry research, and industry development, working together to make America the world leader in information technology. It's important to understand the role of basic research and not to over-emphasize the role of technology development. The Federal investment is essential; we discuss this in fairly technical terms in Section 12 of the report. It's one of the best investments that our Nation has ever made.

Third, recent technological and societal trends place the further advancement and application of NIT squarely at the center of our Nation's ability to achieve many of our most important priorities, in areas such as improved health care, improved energy efficiency, improved transportation systems, national security, education, and open government. We describe these technological and societal trends in Section 3 of the report. We describe the role of advances in NIT in achieving our national priorities in Sections 4 and 5.

I want to note, in this context, Al Shaffer's presentation earlier today regarding the Quadrennial Defense Review. He listed eight "critical capabilities" for the Department of Defense going forward. The first four of those eight capabilities were squarely networking and information technology: they were decision support, autonomous systems, trusted systems and trusted cyber-physical systems, and immersive training. Those are *his* examples of the role that NIT plays in our nation's strategic capabilities. He then spoke on his next slide about the need to move "from data to decisions" in the military context; "data discovery" is an important theme of our report.

Finally, among this group of findings, in contrast to the Department of Defense, many Federal agencies don't fully grasp the impact of advances in networking and information technology in fulfilling their missions. They may have a narrow view of the role of NIT advances – they may not appreciate the full breadth – or they may believe that they can get by with application of existing NIT rather than with true advances in NIT. But in areas such as privacy, security, the automated analysis of large volumes of data, software productivity, and scalable systems, advances are required pervasively by Government agencies, as well as by business, in achieving their goals. Research frontiers such as these are the subject of Sections 6 and 7 of our report.

High performance computing

I want to speak briefly about our findings regarding high performance computing, since the Chinese supercomputer effort has been discussed several times this morning.

Clearly, high performance computing – supercomputing – plays an essential role in national security and in scientific discovery.

What we want to emphasize – and, again, Mr. Shaffer touched on this – is that HPC is only one of many aspects of networking and information technology that are critical to our national competitiveness. And furthermore, within HPC, there has been an excessive emphasis on winning international benchmarks of numerical performance. This is not unimportant, but it is a one-dimensional measure of our competitiveness. This focus takes attention away from other important forms of high performance computing (such as large-scale data analysis, which is critical to scientific discovery and to national security), from realizing the greatest impact from current-generation leading-edge systems (that is, from getting science done with the systems we have today), and from carrying out research with the potential for breakthroughs 5, 10, 15 years down the road.

Our international competitiveness needs to be measured in ways in addition to numerical performance. A challenge for our field is to be able to better quantify our competitiveness in those other dimensions of information technology.

NITRD coordination, leadership, and investment

Let me say a word about NITRD Program coordination, leadership, and investment.

The NITRD inter-agency coordination mechanism is widely – and we think correctly – viewed as successful and valuable.

However, NITRD is chartered and staffed to coordinate multi-agency programs, not to provide strategic vision and leadership. We believe that strategic vision and leadership is essential in a field that is this important to the nation, and that a mechanism to provide strategic vision and leadership in NIT is necessary.

An important finding of our report is that the NITRD crosscut budget significantly overstates the Federal investment in networking and information technology research and development, which may contribute to a systematic tendency to under-invest in such activities. The NITRD budget mixes investment in NIT R&D with investment in NIT infrastructure for R&D in other fields. For example, we asked the Science and Technology Policy Institute to review the top 100 awards (by award size) in NIH's NITRD portfolio – totaling nearly \$600 million, roughly half of NIH's NITRD crosscut total – and STPI concluded that only between 2% and 11% (by dollar value) should be considered NIT R&D. The rest represents extremely important applications of NIT systems to advance biomedical research.

I want to emphasize that there is no firm division between NIT R&D and applications. Much of the best work in computer science arises because of trying to meet the demands of new applications. At the other extreme, though, there is procurement of networking and information technology – today's technology to meet today's needs. That is critically important, but does not advance the forefront of networking and information technology.

It's a continuum. I want to make it clear that there is no attempt on our part to diminish the critical role that *advanced* applications play in moving this field forward. That's why we're in this business – it's why we do what we do. But it's distinct from procurement and routine application.

Today, we are investing far less in advancing this critical field than we think – and far less than we need.

NITRD workforce

Finally, let me say a word about workforce.

Networking and information technology is *the dominant factor* in America's science and technology (S&T) employment. The Bureau of Labor Statistics estimates that over the next 10 years, more than 60% of *all* new jobs in *all* fields of science, engineering, and the social sciences will be for computer specialists. The gap between the demand for NIT talent and the supply of that talent is considerable and will unfortunately, for the foreseeable future, continue to be so.

We believe that in addition to visa issues, which have been well discussed in the past, PCAST was precisely on track in advocating for significant improvements in K-12 science, technology, engineering and mathematics education, and in advocating for the inclusion of computer science as a STEM field and as part of that education.

This is critical to helping America's kids participate in this new economy, and keeping our nation competitive.