

Statement of

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“Defining Federal Information Technology Research and Development:
Who? Where? What? Why? and How Much?”

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Chairman Putnam and Members of the Committee, thank you for this opportunity to testify today about the contributions of the National Institute of Standards and Technology (NIST) to Federal information technology research and development. I would like to address the questions you asked in your invitation to testify and tell you about some of the important activities currently underway at NIST.

The benefits that information technology has had on the United States and world economy are well known. NIST plays a critical role in building trust and confidence in information technologies and the continued development of secure, reliable, usable and interoperable IT with ground-breaking studies on technology performance, development of state-of-the art automated testing techniques, guidelines and standards for securing systems, and leadership of international standardization programs. NIST's programs help to ensure that U.S. industry maintains the competitive advantage vis-à-vis the rest of the world while ensuring that U.S. government information technology assets remain secure.

Our mission is to develop and promote measurement science, standards, and supporting programs in information technology in order to enhance productivity, facilitate trade, and improve the quality of life. We work in partnership with industry, academia, government—civilian and military, and consortia to develop and demonstrate tests, test methods, reference data sets, proof-of-concept implementations, and other information infrastructure technologies. Our goal is to enable the information technology industry in the United States to produce high quality reliable, interoperable, and secure products and services. Nowhere else in the world is there a laboratory dedicated to understanding the metrics of information technologies, and the development of tools and tests to enable industry and users to build better systems through the understanding of these metrics. Nowhere else in the federal government is there an organization dedicated to working with U.S. industry to improve the trust and confidence of IT, particularly scientific systems that are crucial to the continued competitive advantage of the United States in the international community.

A new age is dawning for scientific and engineering research, pushed by continuing progress in computing, information, and communication technology, and pulled by the expanding complexity, scope and scale of today's challenges. These information technology advancements provide the potential for the research community to build new types of scientific and engineering knowledge environments and organizations and to pursue research in new ways and with increased efficacy.¹ The acknowledged key to these breakthroughs is achieving the necessary functionality, interoperability, usability, confidence, and data protection within the IT systems that will lead the way.

NIST is at the forefront of this new age. The information technology research at NIST is focused on building the trust and confidence in today's and tomorrow's systems. Trust and confidence covers the range of IT systems: advances in modeling and simulation to complement the advances in the physical sciences; secure, robust, quality software; agile, resilient, robust networks that continue to operate under catastrophic conditions; and integrity, availability, interoperability and reliability of the systems, data and networks. We have a unique collection of scientists working collaboratively from computer scientists to chemists, electrical and

¹ *Revolutionizing Science and Engineering Through Cyberinfrastructure*, NSF, March 2003.

mechanical engineers and physicists striving to meet the challenge of trust and confidence in IT in the nanoscale revolution and beyond.

I would now like to mention some highlights from our major Information Technology program areas which will give you a flavor of the wide array of expertise and effort resident at NIST:

NIST ensures the security, confidentiality, integrity, and availability of information. NIST has a long-standing, highly successful role in working with Federal agencies and industry to ensure the protection of information technology and systems through standards and guidelines, testing methodologies, conformity assessment and complementary supporting research. These activities emanated from necessity and were formalized in legislation such as the Computer Security Act, the Federal Information Security Management Act, and the Cyber Security Research and Development Act. These efforts, often codified in Federal Information Processing Standards (FIPS), have led to increased protection of government information. NIST is also leading global efforts to develop secure smart card technologies and travel documents, and to achieve consensus on various electronic authentication strategies.

NIST mitigates the \$59.5 billion cost of inadequate software testing. NIST is the world leader in development of test methodologies for software assurance and conformity to IT standards. NIST maintains a robust program in software that is fundamental to the continued growth of the IT industry. We facilitate electronic commerce through development of XML tests, while also developing test methods and registries to improve the interoperability, quality, conformance, and correctness of healthcare information data transfer. Our expertise in software extends to the field of computer forensics; a program which enables the detection of computer crime and successful prosecution of terrorists and other criminals.

NIST develops test and measurement technology that keys the implementation, robust operation, and continuity of operations of the nation's core networking infrastructure. We have the premier capability in the world for modeling and simulating the performance of large networks under various failure and recovery scenarios, which enables more consistent service of the internet. Our broad ranging program also works with the public safety community and industry to develop modern, interoperable communication and networking standards for first responders.

NIST enables intuitive, efficient access, manipulation, and exchange of complex information. NIST continues to make strides in improving our customers' ability to use information technology and the underlying information. These efforts have brought advances to human language technology that enhances content extraction, question answering, and speech-to-text capabilities. Tremendous strides have also occurred in the usability and accessibility of information through the testing of NIST labs.

NIST is a world leader in analytical, statistical, and computational methods for solving scientific and engineering problems. We continue to provide technical leadership in state-of-the-art analytical and computational methods for the scientific and engineering world. The mathematics program develops, analyzes, and solves mathematical models of physical phenomena; develops highly efficient parallel computational models to enable scientific

advancement; develops and distributes mathematical software tools and tests; and continues development of the Digital Library of Mathematical Functions, a comprehensive, authoritative web-based interactive reference on the special functions of applied mathematics. NIST also continues to provide the statistical underpinnings that strengthen scientific research through formulation and development of statistical theory and methodology for metrology. The program develops new statistical methods for the design and analysis of Key Comparisons forming the basis of international trade; develops statistical methods to evaluate IT performance in networks, biometrics, and computer forensics; and characterizes complex instruments, systems, and processes in mathematical terms, including the analysis of the World Trade Center collapse. In cooperation with Sematech, NIST created the popular Web-based e-Handbook of Statistical Methods, which is a fundamental global reference.

NIST works to ensure the interoperability of technology specifications. Interoperability is essential to productivity and competitiveness of many industries because efficient design and manufacturing require the coordination of many different participants and processes that rely on a digital representation of the product. To mitigate the \$1 billion annual cost to members of the automotive supply chain, NIST has initiated the NIST Manufacturing B2B Interoperability Testbed to address the needs for demonstration and testing of B2B standards. The testbed is an on-going effort to mobilize software vendors, manufacturers, standards organizations, and other stake-holding parties to enhance the capability for on-demand demonstration and testing of interoperability of enterprise application in a B2B setting.

Through these efforts NIST has developed world-class competencies in security, software, networks, information access, mathematics, statistics, and interoperability. This bundle of competencies, combined with Nobel prize winning expertise in the physical sciences places NIST in a unique position to create an enormous impact on the economy and scientific research. It is precisely this unique capability that attracts funding from other agencies. We continually leverage our expertise and this funding to protect this Nation and position the US as a leader in the information technology and scientific arenas. I would like to again highlight some specific NIST efforts:

NIST assists government and industry in protection of the US border through the development of biometrics evaluation systems, biometrics standards, and biometrics research. Working with the biometric community, NIST has long been recognized as an expert in the use of biometric information. Two recent laws recognized this expertise and provided specific requirements for NIST, the USA PATRIOT Act and the Enhanced Border Security and Visa Entry Reform Act. Under these laws, NIST has refined programs in fingerprint testing, face testing, multimodal biometrics evaluation, multimodal system design, and standards.

NIST enhances trust and confidence in voting systems. The core of democracy is the voting system. The Help America Vote Act seeks to increase trust and confidence in the voting system, in part by providing NIST with mandates in the areas of security, hardware/software interoperability, and human factors issues. Under HAVA, NIST recently released a study titled: “Improving the Usability and Accessibility of Voting Systems and Products” which established a roadmap for voting constituencies, vendors and users to achieve increased trust and confidence that the voting system accurately reflects the will of the electorate.

NIST makes revolutionary advances in quantum communications and computing. Quantum communications offers the promise of perfectly protected messages while quantum computing offers the promise of dramatically increased computing power. NIST is developing the measurements and standards infrastructure to enable future development of information systems based on the principles of quantum physics. NIST's two Nobel Laureates are focused on this effort.

NIST utilizes information technology to find knowledge in large data sets. NIST has the most comprehensive array of chemical, physical, and engineering measurements data of any group worldwide working in science and technology. NIST cost-effectively manages this data by developing accessible IT resources, including web-based data dissemination and single-portal access to all these databases, while using statistical and mathematical methodology to make sense of the data.

NIST works with partners in other Federal agencies, academia, and industry to develop and promote openness and interoperability in information technology. It works with other agencies not only on a bilateral basis, where it furnishes expertise in its unique areas of research to the DoD, HHS, NIH, DOJ and others, but also through support and cooperation within the Interagency Working Group on Information Technology Research and Development. Examples of NIST IT cooperation with industry include electronic commerce and various aspects of U.S. manufacturing. One focus is on integrating information-based manufacturing systems. Another effort is aimed at developing the information-based measurement and standards infrastructure needed for the application of intelligent systems in manufacturing, defense, and homeland security. In a related effort, the NIST Combinatorial Methods Center develops methods that lead to innovations in materials science faster, cheaper, and better. Developing these methods requires a significant emphasis on IT research, as strategies for managing and analyzing the overwhelming amount of data generated are a critical problem for the Center and its industrial partners.

Providing security to supervisory control and data acquisition (SCADA) systems-- systems that monitor and control power flows in the electric power grid --involves significant IT research, as SCADA systems are increasingly IT-based. NIST is evaluating the performance of a number of promising security systems under development to ensure security while not compromising the performance of the power grid. In a similar way, cybernetic building systems involve information handling at many different levels of building services (e.g., fire detection, security and transport systems, energy management, and utilities). The NIST program which includes a full-scale demonstration of cybernetic building systems, involves a significant amount of IT research to develop a standards-based information infrastructure.

NIST is careful to utilize its unique attribute of being an unbiased, neutral third-party to best enhance the efforts of industry where it is needed most. The impact of NIST programs on the IT industry, the Federal government, the security of IT infrastructure, and security of the American people is broad and deep. The standards, tests and measures that NIST enables are also key to the continued competitive advantage of the United States. NIST's efforts in information technology

measurement, standards, and interoperability provide a unique contribution to the advancement of IT that would not otherwise be performed.

NIST received FY 2004 appropriated funding of \$48.6 million, which is supplemented by a number of other agencies by \$17 million. In addition, now before the Congress is the President's FY 2005 budget request that includes a proposed increase of \$7 million for NIST to address key national needs in cyber security and accelerate solutions to critical cyber security issues (\$6 million) and to address the biometric requirements of the USA Patriot Act by developing the standards for testing the accuracy of biometric technologies (\$1 million). This specifically includes working with the Department of Homeland Security through its Science and Technology Directorate, as well as the Information Analysis and Infrastructure Protection Directorate's National Cyber Security Division to enhance collaborative efforts begun in 2003. This proposed expansion of NIST's current program will allow for additional deliverables in FY 2005 and a critical start to long-term work in key areas including:

- Enhancing security, critical infrastructure application, and communication protocols;
- Expanding the NIST Cryptographic Toolkit to include limited power, small-sized computing environments;
- Improving broken wireless security standards by identifying, prioritizing, and accelerating approaches to securing wireless devices;
- Developing metrics to understand, express, and improve our ability to build secure networks and systems from individually understood components; and
- Developing advanced means to cost-effectively control access of individuals and automated services to information and other automated services.

In conclusion, NIST takes its roles in maintaining the vitality of the U.S. information technology industry seriously, in providing unique expertise to the rest of the government, and in sharing with industry, government and universities the basic science and technology that comes from its measurement and standards research. These brief examples of our work and accomplishments illustrate NIST's commitment to these roles. They also demonstrate the base upon which NIST continues to build.

This concludes my prepared remarks. I will be pleased to answer your questions.



Hratch Semerjian, Acting Director

Hratch G. Semerjian is serving as Acting Director of NIST while Arden Bement serves in a temporary capacity as the Acting Director of the National Science Foundation. Dr. Semerjian has served as the Deputy Director of NIST since July 2003. In this position, Dr. Semerjian is responsible for overall operation of the Institute, effectiveness of NIST's technical programs, and for interactions with international organizations. NIST has a total budget of about \$771 million, and a permanent staff of about 3,000, as well as about 1,600 guest researchers from industry, academia, and other national metrology institutes from more than 40 countries. Most of the NIST researchers are located in two major campuses in Gaithersburg, Md., and Boulder, Colo. NIST also has two joint research institutes; the oldest of these is JILA, a collaborative research program with the University of Colorado at Boulder, and the other is CARB (Center for Advanced Research in Biotechnology), a partnership with the University of Maryland Biotechnology Institute.

Dr. Semerjian received his M.Sc. (1968) and Ph.D. (1972) degrees in engineering from Brown University. He served as a lecturer and post doctoral research fellow in the Chemistry Department at the University of Toronto. He then joined the research staff of Pratt & Whitney Aircraft Division of United Technologies Corp. in East Hartford, Conn. In 1977, Dr. Semerjian joined the National Bureau of Standards (now NIST), where he served as Director of the Chemical Science and Technology Laboratory (CSTL) from April 1992 through July 2003. Awards he has received include the Fulbright Fellowship, C.B. Keen Fellowship at Brown, the U.S. Department of Commerce Meritorious Federal Service (Silver Medal) Award in 1984, and the U.S. Department of Commerce Distinguished Achievement in Federal Service (Gold Medal) Award in 1995. In 1996, he was elected a Fellow of the American Society of Mechanical Engineers. In 1997, he received the Brown Engineering Alumni Medal. Dr. Semerjian was elected to the National Academy of Engineering in 2000.