Information Technology Laboratory

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Letter from the Director

The Information Technology Laboratory (ITL), one of seven research laboratories within the National Institute of Standards and Technology (NIST), develops and deploys standards, tests, and metrics to make our information systems more secure, usable, interoperable, and reliable. As a world-class measurement and testing laboratory encompassing a wide range of areas of computer science, mathematics, statistics, and systems engineering, our research program supports NIST's mission to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and related technology through research and development in ways that enhance economic security and improve our quality of life.

ITL collaborates with other NIST laboratories, the Department of Commerce, other government agencies, the U.S. private sector, standards development organizations, and other national and international stakeholders in both the development and application of new information technologies to help meet national priorities. ITL is called upon to address national priorities due to our reputation as a globally recognized and trusted source of high-quality, independent, and unbiased research and data, and as a trusted third-party convener. The resulting measurement and standards infrastructure catalyzes innovation in IT and IT-related measurement science which drive progress across scientific, technology, and commercial applications.

ITL's strategy is to maximize the benefits of IT to society through a balanced IT measurement science and standards portfolio of three major activities: fundamental research in mathematics, statistics, and IT; applied IT research and development; and standards development and technology transfer. We invite you to learn more about how ITL is implementing this strategy and enabling the future of the nation's measurement and standards infrastructure for information technology. As always, we welcome your interest and comments.

Charles H. Romine

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ITL at A Glance

Our Mission

To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology through research and development in information technology, mathematics, and statistics.

Our Core Competencies

- IT measurement and testing
- Mathematical and statistical analysis for measurement science
- Modeling and simulation for measurement science
- IT standards development and deployment

Our Resources

- Highly qualified professional and support staff of 443 employees and 150 guest researchers
- Annual budget of about $147 million
- State-of-the-art research facilities in Gaithersburg, Maryland, and Boulder, Colorado

Our Products

- Standards and guidelines
- Reference data sets and evaluation software
- Advanced software quality assessment tools
- Tests and test methodologies
- Proof-of-concept implementations
- Specialized databases
- Validation programs for cryptographic standards
- Mathematical and statistical consulting

Our Customers and Stakeholders

- U.S. industry
- Federal, state, and local governments
- Academia
- Research laboratories
- IT users and providers
- IT standards developers
- Industry consortia
- NIST staff and collaborators

ITL Programs

Big Data

The ITL Big Data program aims to maximize the ability of users to extract knowledge from big data through the development of standards, measurements, and interoperability frameworks. The output of the program will enable foundational improvements in data access, data analytics, data security, data privacy, and data management across areas of high priority to industry, government, and academia. The program has three areas of focus: 1) big data standards and interoperability (including leading the NIST Big Data Public Working Group and chairing the ISO/IEC JTC 1 Working Group on Big Data); 2) data science measurement and benchmarking; and 3) data infrastructure for interoperability of Commerce and other agency data (including chairing the Interagency Technical Advisory Group on big data mashup).

Biometrics

Biometrics is the measurement of physiological characteristics such as fingerprint, iris patterns, or facial features. These features can be used to uniquely identify an individual from a group or verify the identity of an individual. ITL has been conducting research supporting testing and evaluation in the area of biometrics for over 50 years. Our goal is to help the biometric community develop and deploy better technology. Our emphasis is on the collection of good quality biometrics, the sharing of biometrics (e.g., between local and state law enforcement), and making sure biometric systems are accurate. Major products from this effort include the ANSI/NIST-ITL Standard for Biometric Data Interchange, the Fingerprint Vendor Technology Evaluation, and the Face in Video Evaluation.

Elham Tabassi and Mei Ngan conduct research to advance measurement science for fingerprint and tattoo recognition. NIST/Katherine Green

Cloud Computing

ITL plays a central role in defining and advancing standards, collaborating with other agencies, private sector experts, and international bodies to identify and reach consensus on cloud computing technology and standardization priorities. Through its strategic efforts with the public at large and in the role of a respected neutral party, ITL has published NIST Special Publication 500-293, *USG Cloud Computing Technology Roadmap*, to translate mission requirements into technical portability, interoperability, security, accessibility, and performance requirements. Focusing its efforts using these priorities, ITL is working with stakeholders to develop the standards, guidance, and technology which will enable the secure and effective deployment of the cloud computing model.

Cyber-Physical Systems

Cyber-Physical Systems (CPS) or "smart" systems are co-engineered interacting networks of physical and computational components. These systems will provide the foundation of our critical infrastructure (e.g., smart grid, transportation), form the basis of emerging and future smart services (e.g., smart city services), and improve our quality of life in many areas (e.g., healthcare). ITL's research helps to remove barriers to progress in CPS – by advancing measurement, standards, tools, and guidance in areas such as cybersecurity, privacy, networking, timing, and IT infrastructure. ITL works closely with industry, government, and academia to advance the technical underpinnings that are necessary to reap the benefits of CPS.

Cybersecurity

ITL is responsible for developing standards, guidelines, tests, and metrics for the protection of non-national security federal information and communication infrastructure. While developed for federal agency use, these resources are frequently voluntarily used by nonfederal organizations, including industry and academia, because they provide highly adaptable, risk-based, and cost-effective approaches to securing systems. These standards and guidelines are developed in an open and transparent manner that engages diverse stakeholders and leverages the contributions of diverse technical experts from around the world. Our security automation project has made important strides towards standardizing and automating critical information security elements such as software vulnerabilities and secure configurations. The National Vulnerability Database, the National Checklist Program, and the technical standards that support them, are critical components in ensuring that security management is effective and efficient.

National Cybersecurity Center of Excellence

The National Cybersecurity Center of Excellence (NCCoE) is a collaborative engineering center dedicated to furthering innovation and increasing the rate of adoption of practical standards-based cybersecurity solutions. The NCCoE provides implementation guidance that is produced through collaboration with industry, academia, and government. The NCCOE established the nation's first Federally Funded Research and Development Center to provide NIST with the expertise and capabilities to quickly address a wide array of cybersecurity challenges.

National Initiative for Cybersecurity Education

ITL leads the National Initiative for Cybersecurity Education (NICE), a response to the President's declaration that the "cyber threat is one of the most serious economic and national security challenges we face as a nation." Our goal is to enhance the overall cybersecurity posture of the nation by accelerating the availability of educational resources designed to improve the cyber-behavior, skills, and knowledge of every segment of the population. NICE addresses this by raising national awareness about risks in cyberspace, broadening the pool of individuals prepared to enter the cybersecurity workforce, and cultivating a globally competitive cybersecurity workforce.

Joshua Franklin researches solutions for cellular security in the context of public safety. NIST/Katherine Green

National Strategy for Trusted Identities in Cyberspace

The National Program Office is tasked with implementing the National Strategy for Trusted Identities in Cyberspace (NSTIC), a White House initiative designed to work collaboratively with the private sector, academia, advocacy groups, public sector agencies, and other organizations by providing grants for pilots, partnerships, and federal adoption of solutions. The NSTIC vision is for individuals and organizations to utilize secure, efficient, easy-to-use, and interoperable identity solutions to access online services in a manner that promotes confidence, privacy, choice, and innovation.

Computer engineer Kamran Sayrafian uses NIST's Reconfigurable 3D Immersive Platform to study and model how radio frequency (RF) waves propagate through the human body. This research supports the development of standards from implantable and wearable wireless medical devices. *© Nicholas McIntosh*

Forensic Science

The methodologies of forensic science are used in solving crimes and presenting evidence in court. The kinds of evidence analyzed range from fingerprints and DNA found at crime scenes to call logs on cell phones to faces captured on surveillance video. It is imperative that the methods used in forensic science are reliable, accurate, and scientifically validated. The ITL Forensics program advances measurements and standards for forensic science through the application of computer science, mathematics, and statistics. We are working to better understand and improve the accuracy and reliability of forensic science; establish quantitative and statistical measures for forensic analyses; and provide test tools and data to help ensure that critical information that exists digitally can be found, analyzed and understood correctly.

Health Information Technology

Effective use of Health IT will result in considerable savings and better quality healthcare for our nation. To enable a robust health IT infrastructure, ITL researchers are collaborating with various stakeholders on standards, testing, certification, security and privacy, usability, and emerging technologies. Our conformance testing infrastructure supports electronic health record (EHR) meaningful use testing and certification. We leverage security specifications and apply them within the context of healthcare. We will enable interoperability throughout the health IT network by our advanced testing tools and techniques. Our safety-related usability research will protect patient safety and ensure effective use of health IT systems by care providers. Finally, we support emerging technologies such as smart healthcare, personalized and precision medicine, medical image quality, telemedicine, content-based access to EHRs, and body area networks.

Human Language Technology

The goal of the Human Language Technology program is to allow people to interact effortlessly with computers – asking the computer questions and getting back the information they need. The technical barriers to achieving this goal are enormous. ITL leads efforts in the measurement and evaluation of speech recognition and translation technology, natural language processing, information retrieval, and usability to enable advances in these crucial areas. The Text REtrieval Conference (TREC) has been a seminal event in information retrieval for over 20 years covering topics from spam filtering to video analysis to clinical decision support.

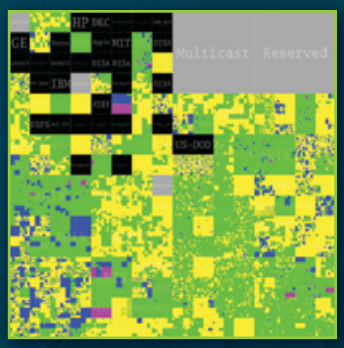
Shanee Dawkins investigates the usability of voting applications and other human-computer interaction projects. *NIST/Katherine Green*

Internet Infrastructure Protection

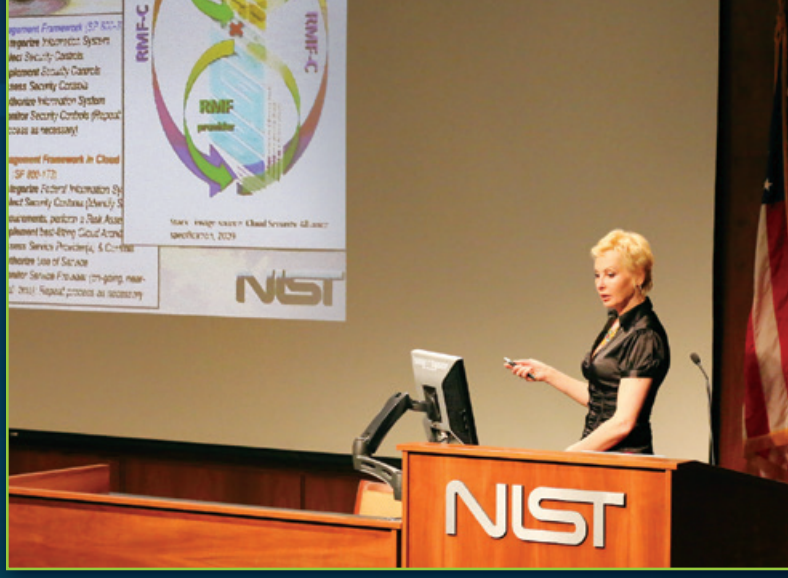
ITL's Internet Infrastructure Protection (IIP) program works with industry to develop the measurement science and new standards necessary to ensure the robustness, scalability, and security of the global Internet. Our research focuses on the measurement and modeling techniques necessary to understand, predict, and control the behavior of Internet-scale networked information systems. ITL staff use these insights to guide the design, analysis, and standardization of new technologies aimed at improving the robustness of the Internet's core infrastructure. Recent efforts have focused on enhancing the security of the Internet's Domain Name System (DNS) and Border Gateway Protocol (BGP), and fostering deployment of Internet Protocol version 6 (IPv6). In addition, the IIP program conducts research to evaluate emerging technologies such as Software Defined Networks (SDNs) and Information Centric Networks (ICNs) that have the potential to significantly impact future Internet architectures.

Metrology for Scientific Computing

Scientific computing has become an indispensable tool for science and engineering. Steady advancement in hardware and software has resulted in powerful tools for simulating systems of interest in commerce and in formulating policy. Yet, as the consequences of decisions based on computations increase, so too do the needs to assess confidence in their outputs. Unfortunately, most computational scientists today are ill equipped to address such important questions with the same



Visualization of the emerging global structure of the Resource Public Key Infrastructure (RPKI). The RPKI has been designed to provide the trust infrastructure upon which Internet routing security technologies can be based.
Source: http://rpki-monitor.antd.nist.gov/.



Michaela Iorga, ITL's Senior Security Technical Lead for Cloud Computing, is addressing Requirement 2 of NIST SP 500-293 by discussing with industry, academia, and other government stakeholders how to apply NIST's Risk Management Framework to cloud-based federal information systems.
NIST/Katherine Green

scientific rigor that has come to be expected in more traditional experimental science. In response, ITL has initiated a program to introduce metrology constructs — reference computations, uncertainty quantification, and traceability — into scientific computing. This infrastructure will result in predictive computing with quantified reliability, enabling improved decision making based on computer simulations.

Quantum Information

An emerging discipline at the intersection of physics and computer science, quantum information is likely to revolutionize science and technology just as lasers, electronics, and computers did in the 20th century. By encoding information into quantum states of matter, one can, in theory, enable phenomenal increases in information processing capability, as well as communication channels with provably high levels of security. Although many of the necessary physical manipulations of quantum states have been demonstrated experimentally, scaling these up to enable fully capable quantum computers remains a grand challenge. In ITL, we perform theoretical studies to understand the true power of quantum computing, as well as efforts to characterize and benchmark physical implementations of quantum information processing technologies and systems.

About NIST

Founded in 1901, NIST is a non-regulatory federal agency within the U.S. Department of Commerce. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. With total Fiscal Year 2015 resources of $863.9 million in direct appropriations, an estimated $50.9 million in service fees, and $100.8 million from other agencies, NIST employs about 3,000 scientists, engineers, technicians, and support and administrative personnel at its headquarters in Gaithersburg, Maryland, and its laboratories in Boulder, Colorado. The agency also hosts about 2,700 associates from academia, industry, and other government agencies, who collaborate with NIST staff and access user facilities. See *http://www.nist.gov*.

NIST/Katherine Green

We invite you to visit our Information Technology Laboratory website at *http://www.nist.gov/itl*.

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