The Importance of Standards

Article I, Section 8: The Congress shall have the power to... fix the standard of weights and measures

- National Bureau of Standards established by Congress in 1901
- Eight different “authoritative” values for the gallon
- Electrical industry needed standards
- American instruments sent abroad for calibration
- Consumer products and construction materials uneven in quality and unreliable

Estimated that 80% of global merchandise trade is influenced by testing and other measurement-related requirements of regulations and standards
NIST Mission and Programs

“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.”

NIST Laboratories
- Create critical measurement solutions and promote equitable standards to stimulate innovation, foster industrial competitiveness, and improve the quality of life.

Hollings Manufacturing Extension Partnership
- Nationwide network of resources helping smaller manufacturers compete globally

Baldrige Performance Excellence Program
- Promoting and recognizing performance excellence via information and Presidential awards in manufacturing, service, small business, education, health care, and the nonprofit sector

Technology Innovation Program
- Supports development of cutting edge technologies by the private sector and universities to address critical national needs and key societal challenges

NIST is the nation’s innovation agency
President’s Innovation Strategy: Driving Towards Sustainable Growth and Quality Jobs

NI ST Programs Impact Every Level

Information Quality Impacts Every Level

Catalyze Breakthroughs for National Priorities
- Unleash a clean energy revolution
- Support advanced vehicle technology
- Drive breakthroughs in health IT
- Address the "grand challenges" of the 21st century

Promote Competitive Markets that Spur Productive Entrepreneurship
- Promote American exports
- Support open capital markets that allocate resources to the most promising ideas
- Encourage high-growth and innovation-based entrepreneurship
- Improve public sector innovation and support community innovation

Invest in the Building Blocks of American Innovation
- Restore American leadership in fundamental research
- Educate the next generation with 21st century knowledge and skills while creating a world-class workforce
- Build a leading physical infrastructure
- Develop an advanced information technology ecosystem

August 5, 2009
NIST has... ...two main campuses

Gaithersburg, MD

Boulder, CO

Courtesy HDR Architecture, Inc./Steve Hall © Hedrich Blessing

©Geoffrey Wheeler
NIST has... four joint institutes

**JILA**
NIST + University of Colorado

**University of Maryland Biotechnology Institute**

**Joint Quantum Institute**
NIST + University of Maryland + NSA

**Hollings Marine Laboratory**
NIST + NOAA + South Carolina + College of Charleston + Medical University of South Carolina
NIST Products and Services

**Measurement Research**
- ~ 2,200 publications per year

**Standard Reference Data**
- ~ 100 different types
- ~ 6,000 units sold per year
- ~ 226 million data downloads per year

**Standard Reference Materials**
- ~ 1,300 products available
- ~ 30,000 units sold per year

**Calibration Tests**
- ~ 18,000 tests per year

**Laboratory Accreditation**
- ~ 800 accreditations of testing and calibration laboratories
ITL Mission

To promote US innovation and industrial competitiveness by advancing

*measurement science, standards, and technology*

through research and development in

*information technology, mathematics, and statistics.*
Core Competencies

Technology Development

IT Measurement and Testing

Mathematical and Statistical Analyses for Measurement Science

Modeling and Simulation for Measurement Science

IT Standards Development and Deployment

Customers

Industry

Academia

Consortia

Govt
ITL Goals

• Accelerate the development and deployment of reliable, secure, usable, and interoperable information and communication systems.

• Catalyze the development of particular applications of national importance that have significant IT requirements.

• Enable world-class measurement and testing through innovations in mathematics, statistics, and computer science.
NIST addressing critical national needs – Infrastructural Technologies

• Software Quality
• Usability
• Foundations of Measurement Science for Information Systems
• Math Knowledge Management
• Statistics for Uncertainty
• Digital Data Preservation
NIST addressing critical national needs – Software Quality

- Accelerate the development and adoption of correct, reliable, testable software, leading to increased trust and confidence in deployed software
  - Automated Combinatorial Testing for Software
  - Software Assurance Metrics
  - Static Analysis Tool Exposition
  - National Checklist Program
NIST addressing critical national needs – Usability

- User-centered research in human-system interaction by applying human factors scientific principles and methodologies to national priorities in the field of information technology
  - Usability Metrics & Measurements
  - Usability for Biometric Systems
  - Usability in Health IT
  - Usability and Accessibility of Voting Systems

Courtesy: Shutterstock/Brian A. Jackson
Develop metrics for assessing critical properties of information systems that can be used to both design more reliable and secure systems, as well as to enable effective real-time control of deployed systems.

- Macro-scale structure and dynamics of large-scale interconnected systems
- Identify and characterize fundamental measurable properties of complex information systems that are indicators of the systems' inherent level of security and reliability
- Complex Networks Data Sets
NIST addressing critical national needs – Math Knowledge Management

- Develop approaches, methods, algorithms, and prototype software tools for production of searchable math repositories with full semantics, and for upgrading existing math repositories to endow them with these same capabilities
  - Digital Library of Mathematical Functions
  - Math Metadata
  - Enhancing mathematical markup
  - Indexing of math content
  - Heuristic algorithms

=> Techniques and tools for online math documents

\[
\Gamma(z) = \int_0^\infty e^{-t} t^{z-1} dt,
\]

\[
\Gamma(z) = \lim_{k \to \infty} \frac{k! k^z}{z(z+1) \cdots (z+k)}
\]
NIST addressing critical national needs – Statistics for Uncertainty

- Develop metrics for assessing critical properties of information systems that can be used to both design more reliable and secure systems, as well as to enable effective real-time control of deployed systems.
  - Best practices for the characterization of measurement uncertainty
  - Uncertainty Quantification in Scientific Computing
  - NIST/SEMATECH e-Handbook of Statistical Methods
NIST addressing critical national needs – Digital Data Preservation

- Develop, and analyze the effectiveness of basic metrology and standards to improve the reliability, interoperability, and quality of diverse, complex, robust, and resilient current and future archival systems.
  - Digital Preservation Roadmap and Interoperability Framework
  - Foundational Digital Data Preservation Standards
  - Preservation of Electronic Health Records
NIST addressing critical national needs – Applications

- Healthcare
- Cyber Security
- Smart Grid
- Biomedical Imaging
- Voting Systems
- Computer Forensics
- Identity Management
Standards for National Priority Critical Infrastructures: Health Information Technology

- Support progress toward a nationwide healthcare information infrastructure by
  - Developing and harmonizing usable standards for health IT technologies
  - Creating a health IT technology testing infrastructure

Biomedical Measurements to Support Disease Diagnosis and Treatment

- Develop the measurement science and reference materials to improve the accuracy, reproducibility, and efficacy of measurements used in medical diagnostics and imaging
- Develop the measurement science and standards to support manufacturing and regulatory approval of biologic drugs
NIST addressing critical national needs – Cyber Security

• Scalable cybersecurity for emerging technologies and threats
  ▪ Improved cryptographic capabilities
  ▪ Stronger assurance of online user identities
  ▪ Easier-to-use security mechanisms
  ▪ Increased use of security automation technology
  ▪ Security measurement for large-scale systems
  ▪ Secure adoption of emerging virtual technologies
  ▪ Critical infrastructure testbed development
NIST addressing critical national needs – Smart Grid Interoperability

• Working collaboratively, develop a framework and measurement tools for interoperability of Smart Grid devices and systems.
  - Foundational Smart Grid Standards
  - Cyber Security for Smart Grid
  - Networking Standards for Smart Grid
  - Electric Power Metrology and the Smart Grid
NIST addressing critical national needs – BioImaging

- Lead the development and rigorous evaluation of new computational approaches supporting multidisciplinary research, particularly at the convergence of bio- and information technologies.
  - Cell Segmentation
  - Live Cell Tracking
  - Subcellular Feature Extraction
  - Medical Imaging
NIST addressing critical national needs - Voting Systems

- Develop approaches, methods, algorithms, and prototype software tools for production of searchable math repositories with full semantics, and for upgrading existing math repositories to endow them with these same capabilities
  - Standards and Conformance Testing of Voting Systems
  - Usability and Accessibility of Voting Systems
  - Voting System Security
NIST addressing critical national needs – Computer Forensics

• Provide infrastructure necessary for automated processing in computer forensic investigations with scientific rigor necessary to support introduction of evidence
  ▪ National Software Reference Library
  ▪ Computer Forensics Tool Testing
  ▪ Computer Forensics Tool Testing for Mobile Devices
  ▪ Computer Forensics Reference Data Sets
NIST addressing critical national needs – Identity Management

• Advance Identity Management Systems technologies to ensure security, cost effectiveness and interoperability
  ▪ Face & Iris Testing
  ▪ Fingerprint Technology Testing for Identity Management
  ▪ Identity Credential Interoperability
  ▪ IDMS Research & Development
  ▪ IDMS Standards Activities
  ▪ Multimodal Biometrics
  ▪ Research for Next Generation Biometric Measurements & Standards (NGBMS) for Identity Management
  ▪ Usability of Biometric Systems
Interagency Working Group on Digital Data

• 22+ active participating agencies

• CHARGE: To *develop* and *promote* the implementation of a strategic plan for the Federal government to cultivate an *open interoperable framework* to ensure *reliable preservation* and *effective access* to digital data for research, development, and education in science, technology, and engineering.
IWGDD Report (January 2009)
http://www.nitrd.gov/About/Harnessing_Power.aspx
www.itl.nist.gov
Background material
Specific Mandates

• Biometrics
  - USA PATRIOT Act
  - Enhanced Border Security and Visa Entry Reform Act
  - 10-Print Transition: mandated by Homeland Security Council Deputies Committee

• Cloud Computing
  - Federal CIO direction to NIST on cloud security and standards

• Cyber Security
  - Section 5131 of the Information Technology Management Reform Act of 1996 (Public Law 104-106) [supersedes Computer Security Act of 1987 (Public Law 100-235)]
  - Computer Security Research and Development Act of 2002
  - OMB M04-04 E-Authentication Guidance for Federal Agencies
  - Information Technology Management Reform Act of 1996, Public Law 104-106
  - OMB Circular A-130 and OMB Directive 05-24
Specific Mandates, continued

- **DNSSEC**
  - OMB mandate M-08-23

- **Emergency Alert for wireless mobile devices**
  - Warning, Alert, and Response Network Act

- **Healthcare**

- **Identity Management**
  - National Strategy for Trusted Identities in Cyberspace

- **Internet Protocol version 6 (IPv6)**
  - OMB memo
  - OMB memo M-05-22 on Transition Planning for IPv6 (August 2, 2005)

- **Smart Grid**
  - Energy Independence Security Act (EISA) of 2007

- **Statistical methods for evaluating and expressing the uncertainty of NIST measurement results**
  - NIST Administrative Manual Subchapter 4.09, Appendix E, 3b

- **Voluntary Voting System Standards**
  - Help America Vote Act
Program Portfolio

• National Priorities
  - Biometrics
  - Cloud Computing
  - Cyber Security
  - Domain Name System Security (DNSSEC)
  - Health Information Technology
  - Identity Management
  - Internet Protocol Version 6 (IPv6)
  - Smartgrid
  - Statistics for Uncertainty (e.g., Gulf Oil Spill Response)
  - Voting Systems

• Emerging Technologies
  - Complex Systems
  - Pervasive Information Technology
  - Quantum Information
  - Virtual Measurement Systems

• Enabling Scientific Discovery
  - Digital Library of Mathematical Functions