

Testimony of

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Prioritized Approach for Homeland Security
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Chairmen Bilirakis and Lungren, Ranking Members Richardson and Clarke, Members of the Subcommittees, I am Mary Saunders, Director, Standards Coordination Office of the National Institute of Standards and Technology (NIST). I want to thank you for this opportunity to discuss standards development and NIST's role in standards as it relates to equipment for and in support of our first responders.

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. Our efforts to drive innovation through advances in measurement science enable industry to bring technological advances to the commercial market sooner, thereby helping U.S. manufacturers stay globally competitive. The focus on innovation is critical if we are to, as the President and Secretary of Commerce John Bryson have noted, "make it here and sell it everywhere."

Today's hearing is focused on innovation as it relates to the development of standards for equipment used by or in support of the first responder community. My testimony will discuss the standards ecosystem in which NIST works, address the issue of standards as a help or hindrance to innovation in this space, highlight some examples of our work related to first responders, and the touch upon the technical challenges ahead.

The Standards Ecosystem

Mr. Chairman, the U.S. voluntary, consensus standards system is bottom-up, industry-driven, and sector-focused. The government participates as an equal and interested partner. Federal, state, local and Tribal government representatives participate when the activity is relevant to their needs, and consistent with their respective missions and functions. In contrast to the government-directed, prescriptive standards that characterize the systems in place in a number of other countries, the Federal government does not control or direct the standards system in the United States.

The modern day engagement of the U.S. government in the formal U.S. standards system can be traced back to the founding of the organization that has evolved into the American National Standards Institute (ANSI). In 1916, the Department of Commerce was one of the founding members of the American Engineering Standards Committee, formed to be an "impartial national body to coordinate standards development, approve national consensus standards, and halt user confusion on acceptability"¹.

Since the founding of the American Engineering Standards Committee, U.S. government agencies have been extensively involved in the development and use of standards to meet agency missions and priorities. This engagement was catalyzed in 1995 by the passage of the National Technology Transfer and Advancement Act (P.L. 104-113), which directed Federal agencies to "use technical standards that are developed or adopted by voluntary consensus standards bodies,

¹http://www.ansi.org/about_ansi/introduction/history.aspx?menuid=1

using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments”,² except where inconsistent with applicable law or impractical.

The strength and agility of the U.S. standards system stems from its sector-specific focus. Individual industry and technology sectors are served by standards developing organizations that are sensitive to and responsive to that sector’s needs, and understand the dynamics of that technology and industry. While there is no formal count of the number of standards developers in the United States, it is estimated that there are about 600 standards setting organizations based in the United States.

The Federal Government’s Role

Federal government agencies engage in standardization in a wide range of mission-specific roles, including contributing to development of standards in the private sector and using standards for procurement or regulatory actions. In FY 2010, more than 2800 Federal agency staff from across the Federal enterprise participated in more than 500 private-sector standards organizations. This participation is spurred in large part by the National Technology Transfer and Advancement Act (NTTAA) of 1995 (P.L. 104-113), and the associated OMB Circular A-119. The NTTAA directs agencies to consider the use of voluntary consensus standards, in lieu of government unique standards, and OMB A-119 reflects this direction and also strongly encourages agencies to participate in standards development activities to ensure that the resulting standards are better suited to meet agency needs.

NIST’s Role in the US Standards System

NIST plays a critical role in the context of Federal engagement in the standards process. As the nation’s measurement laboratory, NIST has multiple roles relating to standards in the Federal enterprise. NIST’s coordination function, defined by statute, has been borne out by a track record of technical excellence and objectivity, embraced by NIST’s world-class scientists and engineers, ever since the Institute was chartered by Congress in 1901. NIST’s strong ties to industry and the standards development community, backed by technical excellence, have enabled NIST to take on critical standards-related challenges and deliver timely and effective solutions.

NIST also plays a leadership role on the National Science and Technology Council’s Subcommittee on Standards (SOS), which brings together senior officials across the federal government to engage on standards-related issues. In October 2011, the Subcommittee issued a report, “*Federal Engagement in Standards Activities to Address National Priorities: Background and Proposed Policy Recommendations*,” that provided an overview of the current legal and policy frameworks for government engagement in private-sector standardization and conformity-assessment activities; described how the government engages in those activities; summarized stakeholder observations in response to a request for information about government engagement in standardization; and outlined policy recommendations to supplement existing guidance to

² P.L.104-113 National Technology Transfer and Advancement Act of 1995, Section 12 (d)(1).(available at: http://standards.gov/standards_gov/nttaa.cfm)

agencies. As a follow-up to this report, the Administration released a memo in January 2012 highlighting the need for continued work in the standards area.³

NIST views standards and standardization as an important tool to enable U.S. innovation and competitiveness. NIST engagement in the private sector led standards system enables the effective and efficient transfer of technology from the NIST laboratories to the marketplace. This is further made possible by the participation of nearly 400 NIST technical staff in over 100 standards organizations, and more than 1000 different standards activities, in support of domestic and international priorities. It is noteworthy that this number represents more than a quarter of the NIST technical staff. NIST's engagement with industry in these standards activities also provides us the ability to learn first-hand about industry's measurement, standards and research needs, and this provides valuable input into our prioritization of current NIST programs and planning for future programs.

Mr. Chairman, I would like to highlight for you some of NIST's specific programmatic activities that directly relate to standards development for a wide variety of first responder equipment. Given the foundational nature of NIST's research mission in measurement science and standards, NIST technical expertise is being brought to bear across multiple sectors. From telecommunications interoperability for public safety to materials research, NIST technical expertise, in collaboration with industry, academia and other federal entities, such as the Department of Homeland Security's Science and Technology Directorate (DHS S&T), can improve the reliability, safety, and performance of equipment used by first responders across the country.

Examples of NIST Standards Activities Related to First Responder Equipment

700 MHz Public Safety Broadband Communications

This Subcommittee is very aware of challenges facing the first responder community. One of the most important issues is the current inability of telecommunications equipment to talk across systems, or "interoperate". NIST is deeply involved in the effort to foster interoperability.

The public safety community is experiencing a generational shift in technology that will revolutionize the way it communicates. Traditionally, emergency responders have used land mobile radio technology that has limited data capabilities and suffers from a large installed base of stove-piped proprietary systems with non-contiguous spectrum assignments. As a result, public safety has long struggled with effective cross-agency/jurisdiction communications and lags far behind the commercial sector in data capability. The Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96)⁴ has allocated \$7 billion in funding and made new broadband spectrum in the 700- megahertz (MHz) band available to public safety, setting the foundation for a unified system operating on common spectrum bands that will foster nationwide roaming and

³ <http://www.whitehouse.gov/sites/default/files/omb/memoranda/2012/m-12-08.pdf>

⁴ Middle Class Tax Relief and Job Creation Act of 2012 (P.L. 112-96) - <http://www.gpo.gov/fdsys/pkg/PLAW-112publ96/pdf/PLAW-112publ96.pdf>

interoperability and provide access to broadband data, video, mapping, GPS applications, and more.

The new nationwide public safety broadband network will rely on commercial cellular technology. However, the public safety community has several unique requirements that are not reflected in current broadband technology or the roadmap for future standards development. In an effort to identify those gaps in public safety's requirements and represent those to international standards bodies, the Public Safety Communications Research (PSCR) program⁵—with support and funding from DHS S&T—has stood up a 700-MHz public safety broadband Demonstration Network at the NIST/National Telecommunications and Information Administration (NTIA) laboratory at the Department of Commerce's Boulder, Colorado campus, that serves both as a vendor-neutral environment where public safety, industry, and other stakeholders can observe how new broadband technologies can meet public safety's unique communication needs as well as a test bed to aid in requirements gathering and standards development.

Leveraging the expertise of the PSCR staff and the unique assets of the Boulder facilities, including NTIA's Table Mountain Radio Test Site, PSCR has obtained an experimental spectrum license and has deployed an over-the-air broadband network, operating in the 700 MHz public safety broadband spectrum. The Demonstration Network has successfully acquired 700-MHz Band Class 14 LTE broadband equipment—including eNodeBs, devices, evolved packet cores, and test equipment—free of charge as part of a Cooperative Research and Development Agreement (CRADA) process.

Research gleaned from Demonstration Network testing and evaluation will allow us to understand where current commercial standards meet public safety's needs and where there are gaps. The gaps that are identified will be incorporated into a standards development strategy.

Broadband presents a unique opportunity for public safety to define their requirements before deployment and only purchase systems that conform to the standard. It is crucial that public safety's requirements are incorporated into the LTE standard so that Federal grant dollars and taxpayer dollars are spent only on equipment that is interoperable and allows first responders to better carry out their mission of protecting lives and property. PSCR's Demonstration Network exists to facilitate this requirements gathering and standards development.

Body Armor

NIST has also been involved in research efforts with other federal agencies such as the National Institute of Justice (NIJ) to develop standards related to public safety and criminal justice. One standard maintained by NIJ describes how body armor used by first responders should perform, and includes methods for testing and evaluating the armor. This standard has existed since 1972, and a testing program that relies on the standard has been in place since 1978. Nearly every piece of body armor worn by police officers in this country complies with the NIJ body armor standard.

⁵ PSCR is a joint program of the Department of Commerce's NIST/OLES and NTIA/ITS that provides research, development, testing, and evaluation to foster nationwide communications interoperability for first responders.

An influential piece of legislation was enacted in 1998 that accelerated adoption and use of protective body armor by law enforcement. The Bulletproof Vest Partnership Grant Act of 1998 provided matching federal funds to qualifying local and state agencies to make their body armor procurement dollars go farther. Grant recipients were required to have mandatory wear policies. As a result of this legislation and related grants: 1) agencies were able to afford body armor for all of their officers, and officers were required to wear it; and 2) the body armor industry had incentives to continue advancing technologies to improve body armor.

To keep pace with technology advances, standards must continually be updated to reflect and encompass technological advancements while not inhibiting innovation by being overly prescriptive. Lags in updating standards may affect the adoption of newer technologies. New technologies may be introduced in advance of standardization. In the former case, delays may occur in the widespread deployment of new technologies. In the latter case, confidence in the technology or the reliability of the equipment utilizing the technology may suffer.

Consider an incident in 2003 when a police officer's body armor, or vest, was perforated by a round it was rated to stop. This incident illustrates the importance of ensuring that standards and technologies advance together. Until the late 1990s, most body armor worn by police officers was made of either aramid (Kevlar or Twaron) or polyethylene (Spectra or Dyneema). In this case, the armor was made out of a relatively new material, polybenzobisoxazole, or PBO, that was first introduced into body armor in 1998. The perforation of this vest in the 2003 case was the first known field failure in the 30-year history of the body armor standards program. In response to this incident, the U.S. Attorney General launched a safety initiative to examine soft body armor containing the material PBO.

Until this time, materials in common use had been studied previously and the most significant environmental factor affecting armor performance—liquid water—was a long-standing part of the standard testing protocol. NIST was tasked to undertake a research effort to examine PBO and its performance in fielded body armor performance and to make recommendations for improvements in the standards and testing program. NIST research revealed that PBO degrades due to exposure to moisture (humidity in the air or liquid water) as well as folding. It was clear that a revised version of the NIJ body armor standard that incorporated some measure of resistance to these environmental degradation factors was essential for officer safety.

Beginning in 2005, NIST provided assistance to NIJ to develop a revised body armor performance standard to address a number of concerns, one of which was the ability of the armor to withstand environmental and wear conditions that armor might see over its lifetime. NIST developed a soft armor conditioning protocol, through which armor is exposed to an environment of elevated temperature, humidity, and mechanical tumbling, and then subjected to ballistic tests. This protocol has been incorporated into the most recent revision of the NIJ body armor standard issued in July 2008 and continues to be used in NIJ's body armor Compliance Testing Program.

Since all officers want body armor that is lighter and more comfortable, new materials and new construction methods for body armor continue to be introduced into the marketplace. The body armor standard must be able to address the safety of new materials, both in initial use and over

time. The armor conditioning protocol in the NIJ standard is an excellent first step in assessing the long term field performance of body armor, but more work needs to be done and is in fact, the subject of ongoing research at NIST.

First Responder Equipment

NIST is also creating critical solution-enabling measurement science and technical contributions underpinning emerging standards, codes and regulations that are used to improve safety and effectiveness of the U.S. fire service. In 2009, the fire service responded to over 1.3 million fires⁶ that resulted in 78,000 fire fighter injuries and 83 fatalities⁷ with an estimated cost of \$8 billion.⁸ In order to reduce the number of fire fighter fatalities and injuries, science-based performance metrics are necessary to improve fire fighter safety and enhance fire ground effectiveness. For both equipment and tactics, it is critical that performance can be measured and evaluated in a scientifically sound manner. The lack of adequate measurement science directly impacts the protective equipment and tactics utilized by the over one million fire fighters in over 32,000 fire departments in the U.S.

To respond safely and effectively in hazardous environments, fire fighters need access to better technology and equipment. If relevant performance data is available for existing equipment or tactics, then a meaningful performance metric can be developed, but too often the necessary data is not readily available. Lab- and full-scale tests in combination with science-based metrics will allow industry to evaluate and improve their own products and develop new technology.

For the past nine years, NIST has been an active leader and participant in developing measurement science for fire service technology. Our Fire Research Laboratory has unsurpassed experience in fire testing and is a trusted source of unbiased, science-based, quantifiable recommendations to standards developing organizations including the National Fire Protection Association (NFPA), ASTM, International Organization for Standardization (ISO), and the International Code Council (ICC).

NIST's unique role as a non-regulatory federal agency, deep technical expertise, and unique assets enables industry, academia and federal entities to work with NIST collaboratively, to the benefit of all parties involved. NIST works with local and state fire services, manufacturers, the National Institute for Occupational Safety and Health (NIOSH) National Personal Protection Technology Laboratory, the Fire Protection Research Foundation of NFPA and others in this space.

In partnership with first responders, NIST identifies and prioritizes research needs for the fire service. This process focuses NIST's efforts on priorities identified by the fire fighting community. The 2005 National Fire Research Agenda Symposium,⁹ which was attended by over

⁶ Karter, M.J., Fire Loss in the United States During 2009, National Fire Protection Association, Quincy, MA, August 2010.

⁷ Karter, M.J., and Molis, J. L., US Firefighter Injuries – 2009, National Fire Protection Association, Quincy, MA, August 2010.

⁸ "The Economic Consequences of Firefighter Injuries and Their Prevention," NIST GCR 05-874, March 2005.

⁹ National Research Agenda Symposium Report of the National Fire Service Research Agenda Symposium June 1 – 3, 2005 Emmitsburg, Maryland.

50 organizations, including the fire service, manufacturers, the International Association of Fire Chiefs, International Association of Fire Fighters, National Voluntary Fire Council, DHS, and the U.S. Fire Administration (USFA) identified and prioritized research needs for fire fighters. Some of the “urgent and critical issues” that were identified included improved respiratory protection, situational awareness technology, tactical decision aids, lessons learned/fire reconstructions, and strategies that would reduce injuries and fatalities. Over 60 participants at the 2009 NIST Innovative Fire Protection Workshop identified tactical decision aids, improved respirators, and enhanced turnout gear as high priority research needs.

Examples of Fire Fighter Standard Solutions

- Self-Contained Breathing Apparatus (SCBA) Lenses: Fire fighters wear protective equipment to protect themselves from exposure to the harsh environment. SCBAs are designed to provide clean breathing air and prevent exposure to toxic combustion gases. NIOSH investigators noticed SCBA thermal degradation issues after the deaths of several fire fighters. NIST partnered with NIOSH to characterize the performance of the SCBA face piece in the fire fighting environment and determined that exposure to high thermal radiant flux caused the viewing lenses to soften, form holes, and fail. With funding from the DHS United States Fire Administration and DHS S&T, NIST studied the conditions that may be encountered by fire fighters and the effects of those conditions on SCBA face piece lenses. This led to recommendations for a new test methodology and performance criteria to the NFPA Technical Committee on Respiratory Protection Equipment which are to be included in the 2013 Edition of NFPA *Standard 1981 on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*.
- Thermal Imaging Cameras: Thermal imaging cameras (TIC) are becoming increasingly valuable tools for first responders; however, there were initially no performance standards that addressed the unique conditions in which first responders operate. Evaluating the performance of thermal imagers requires the resources to characterize the performance of thermal imagers, both in lab- and full-scale experiments and then developing performance metrics and standard testing protocols. NIST developed performance metrics and testing protocols to evaluate and ensure predictable performance of thermal imaging cameras that were incorporated by the NFPA Technical Committee on Electronic Safety Equipment into the 2010 edition of NFPA 1801 *Standard on Thermal Imagers for the Fire Service*. As this standard was put into place, each of the over 32,000 fire departments across the U.S. gained access to thermal imaging cameras that would perform as expected in the harsh fire conditions.
- Personal Alert Safety Systems (PASS): Fire fighters can be overcome by heat or smoke of a fire and may be unable to alert other fire ground personnel to their need for assistance. PASS devices are designed to signal for aid if a fire fighter becomes incapacitated. NIOSH investigators noticed that there was evidence the PASS alarm signal failed to function or was not heard by other personnel in the area. NIST again partnered with NIOSH to characterize the performance of PASS devices in the firefighters’ environment. NIST determined that exposure to high temperature environments typical of what a firefighter encounters caused the loudness of the PASS alarm signal to be reduced enough to become indistinguishable from background noise on the emergency scene. As the PASS cooled, the alarm signal on most of the units returned to pre-exposure sound levels. NIST researchers, supported by DHS S&T, developed a

new high temperature functionality requirement and test protocol for inclusion in the 2007 edition of NFPA 1982 *Standard on Personal Alert Safety Systems (PASS)*, a life-saving improvement for each of the 1.25 million fire fighters whose PASS devices were upgraded.

Conclusion

NIST continues its pursuit of measurement science to improve test methods and standards for advancing innovation for products used by everyone in the first responder community. NIST, in conjunction with other federal agencies, is focusing on developing test methods in a number of areas, ranging from telecommunications interoperability to determining the performance of Radio Frequency Identification (RFID) and fire fighter locator systems, fire fighter radios, and fire fighter protective clothing in rough-duty environments. NIST has other activities focused on specific environments of interest in which the first responder community operates, such as guidance on non-traditional means to mitigate the fire hazard due to ventilation and suppression activities within structures in a manner that provides optimum safety and effectiveness for the fire fighter; and development of improved standards and building codes through simulations and experiments on structural vulnerabilities to wildland-urban interface (WUI) fires.

Mr. Chairman, thank you again for the opportunity to testify today. I would be happy to answer any questions the Subcommittees may have.