

NIST's Office of Law Enforcement Standards: Looking Ahead

Unique among NIST's program offices, the Office of Law Enforcement Standards (OLES) addresses the technology and metrology needs of the criminal justice, public safety, public security and greater homeland security communities. For 35 years, OLES's customers have been corrections personnel, forensic scientists and those who are today known as "first responders" -- police officers, firefighters, and others responsible for the safety and security of people and property. Through our work on performance standards for critical technologies such as ballistic body armor, metal detectors, chemical systems and protective equipment, computer forensics, DNA analysis, and public safety communications, OLES has developed unique expertise. And through our working relationships with criminal justice, public safety and public security practitioners, universities, government agencies, professional and scientific organizations, and offices and laboratories throughout NIST, OLES has developed a vast network of resources that can be brought to bear on solving difficult technical challenges.

In 1999 that expertise and those resources earned OLES an invitation to serve on the Standards Coordination Committee of the newly formed InterAgency Board for Equipment Standardization and Interoperability (IAB). Immediately, IAB asked OLES to address one of its highest priorities: developing requirement standards for respiratory protection equipment to ensure that emergency responders would survive chemical warfare agent attacks. This firsthand experience at tackling the challenges of CBRNE countermeasures prepared OLES for the roles it fulfills today. Following September 11, 2001, OLES found itself leading several technical programs related to homeland security. OLES personnel have assumed key roles as managers and consultants at the Department of Homeland Security. OLES has led the efforts of NIST's Homeland Security Strategic Working Group. And, perhaps most indicative of OLES's reputation and competence, the Office's operating budget, derived entirely from work with agencies outside NIST, grew from about \$900,000 in FY1996 to more than \$50 million in FY2006.

This document is a snapshot of the current activities of OLES's six program areas:

- Critical Incident Technologies
- Detection, Inspection and Enforcement Technologies
- Forensic Sciences
- Public Safety and Security Technologies
- Public Safety Communications
- Weapons and Protective Systems

It is also a view of what the Office sees as the future needs of the practitioners it serves and the opportunities these needs offer to NIST.

Critical Incident Technologies (CIT)

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This program manages standards development for the Department of Homeland Security (DHS) Science and Technology Directorate's Standards Office. A number of DHS funded projects are executed through other OLES program areas such as the Public Safety and Securities Technology (PSST) program and the Detection, Inspection and Enforcement Technologies (DIET) program. Details are in the Appendix.

Current Projects

1. DHS Projects: Standards development are currently structured in the thrust areas of:
 - CBRNE Countermeasures (detection, decontamination)
 - Borders and Transportation Security (passenger processing, cargo inspection, surveillance)
 - Preparedness and Response (incident management, Personal Protective Equipment, explosives containment, robot metrics and standards)
 - Cyber Security and Critical Infrastructure Protection (standards and metrics for SCADA, facility security, personnel identification, access control, sensor networks, attack-resistant structural integrity)
2. National Institute of Justice Projects:
 - Development of Bomb Disposal Robot Standards
 - Development of Bomb Suit Standard
3. OLES-Funded Projects:
 - Structural Collapse Prediction
 - Human-Machine Interface Standards for Bomb Disposal Robots

Looking Ahead: Needs and Opportunities

1. The DHS Science and Technology Directorate is currently undergoing a significant reorganization and restructuring which could create an expanded role for OLES program managers to oversee DHS-funded projects. This would put OLES's program area managers in a strong position to propose and develop major program structures. OLES is already tasked with developing long range, integrated standards development plans for CBRNE countermeasures.
2. Growing interest in explosives countermeasures, including stand-off detection, neutralization of improvised explosive devices (IED) and concerns over liquid explosives, presents opportunities for developing new measurements, standards, and technologies.
3. Systems integration and interoperability issues for communications, equipment and other areas (all within OLES's expertise) are becoming increasingly important.
4. The current domestic response environment is blurring the boundaries among the roles, responsibilities and needs of emergency responders. Today, the fire service is concerned about ballistic protection, and law enforcement agencies are equipping themselves with CB protection. New applications for existing technologies require modifications of existing standards.

5. Standards development organizations are involved in power struggles, turf battles, and hostile takeovers of homeland security programs. NIST can exert the leadership to mediate conflicts, coordinate activities, and ensure necessary progress toward national goals.
6. Natural disasters such as Hurricane Katrina involve emergency response procedures and equipment. The experience that NIST is gaining in homeland security is applicable to programs in natural disaster response disciplines.

Detection, Inspection and Enforcement Technologies (DIET)

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This program focuses on technologies that use electromagnetic waves, fields, and signals, including metal detectors, advanced facial recognition systems, x-ray systems for diagnosing explosive devices, and technologies for detecting concealed weapons and conducting through-wall surveillance.

Current Projects

1. Metal Detectors: Revising walk-through metal detector standards; updating test protocols to support multi-lab testing; finalizing testing software; defining electrical properties of reference test objects; developing human electromagnetic phantoms.
2. X-ray Systems for Bomb Diagnosis: Developing metrics and test methods for the parameters that constitute "image quality;" and developing a test bed for characterization of these x-ray systems.
3. IR Cameras: Developing test methods, calibration artifacts, and a reference IR complex scene projector
4. Digital Video: Defining performance metrics and test methods; developing reference visible-light complex scene projector
5. Concealed-Weapons Detection: Developing measurement infrastructure for close-proximity and long-range cryo-cooled imaging systems
6. Through-Wall Surveillance: Developing measurement methods and systems for evaluating TWS systems
7. Highway traffic enforcement devices performance standards: Developing red light camera system standards and revising the sampling process for the IACP traffic enforcement device testing program.
8. Fast fingerprint reader: Developing tools to characterize the performance of non-traditional (ink-based) fast (< 3 s for ten prints) fingerprint reading devices and comparing fingerprint images to those presently in national fingerprint databases.

Looking Ahead: Needs and Opportunities

1. Imaging: Supporting x-ray to megahertz-range RF imaging applications for security, biometrics, and forensics, including development of standards and test beds.
2. Concealed weapon detection and through-wall surveillance: Developing standards and maintaining measurement test beds to provide metrology support to accredited testing

laboratories participating in product conformity tests.

3. Traffic safety: Reasserting NIST's position as the premier laboratory for evaluation of traffic highway enforcement devices, such as lidar, radar, and red light cameras. The reliability of these devices is essential for evidentiary purposes and settling personal liability issues.

Forensic Sciences

Program Manager: Susan Ballou, (301) 975- 8750, susan.ballou@nist.gov

This program creates technologies, tools and procedures that help forensic scientists conduct analyses and obtain accurate results suitable for scrutiny by the judicial process. It led the development of the Standard Bullet Reference Material and other SRMs and developed requirements that has transformed computer forensics. It is developing a microfluidic DNA analyzer packaged that will provide results in minutes yet robust enough for field use. Other projects focus on arson, audio enhancement, controlled and dangerous substances, firearms, gunpowder residues, and their associated databases. The program answers national needs identified by working groups and publications listed in the Appendix.

Current Projects

1. Standard Reference Test Data Set (www.cfreds.nist.gov): Provides validated tests for evaluating computer forensics equipment and examiner skill. Consists of simulated digital cases that can easily be accessed through an interactive website.
2. Computer Forensic Tool Testing (CFTT) (www.cftt.nist.gov): Provides means for verifying the operation and output of commercially available software and hardware, generally termed tools, used to examine computer evidence. The information generated by CFTT assists in the preparation for judicial proceedings, for criminal and terrorist investigations, and for the verification of currently available tools.
3. Ballistic Imaging Evaluation Database: Evaluating the feasibility of developing a database of digital images and ballistic signatures of bullets and casings for every firearm manufactured or imported for sale into the U.S.
4. Reference guides addressing all aspects of computer investigations
5. Detection of trace amounts of controlled and dangerous drugs on latent prints
6. Density measurement for the refractive index of glass standard
7. Burn pattern studies to identify burn characteristics of new materials in an effort to support fire and arson investigations
8. DNA research: Several different projects, each with a different focus, such as to improve the technique, to address degraded or contaminated samples, to speed up the process, to establish validated protocols. NIST's role in DNA forensics has greatly expanded as a result of onsite training and open communication through an active website.

Looking Ahead: Needs and Opportunities

- 1 There is a need to expand the Standard Reference Test Data Set program to develop tests for

other forensic skills and to evaluate the performance of additional types of equipment. The new program should also incorporate audio, video and imaging technologies.

2. The National Institute of Justice wants to promote self-funded testing facilities that will establish an agreement with NIST to conduct side-by-side testing of computer forensic tools.
3. Additional resources would enable the Ballistic Imaging Evaluation Database program to pursue new avenues of research that were identified throughout the project term. Of particular interest is the possibility of developing a technology that would capture characteristics of spent bullets and casings different from those currently used. Such a development could revolutionize ballistic imaging and comparative analysis software/tools.
4. Federal forensic laboratories and international forensic laboratories are seeking uniformity in standards and metrics. NIST should take the lead and coordinate activities to ensure utilization of its expertise by recognition of NIST United States mandate for standards development.
5. Disasters such as 9/11 and hurricane Katrina have required novel use of DNA technology. The experience that NIST has gained through responding to these disasters should be promoted into other areas of forensic science.

Public Safety and Security Technologies (PSST)

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The Public Safety and Securities Technology (PSST) program develops suites of performance standards, test protocols, reference materials and reference data, conformity assessment programs and user guides to support public safety and security. Among its thrust areas are Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) detection standards and certification programs, decontamination standards, riot control personal protective equipment (PPE), less-than-lethal technologies such as pepper spray, and non-intrusive drug detection methods and standards.

The program supports the DHS Science & Technology (S&T) Directorate's mission to encourage purchase of standardized equipment with government grants or other public funding by developing standards and testing programs based on first responder mission requirements as submitted under Management Directives 10600.1 and 10601. Execution of the DHS funded projects is coordinated with the Critical Incident Technologies program area.

DHS is currently sponsoring the CBRNE portions of the program, while NIJ is funding work on riot control PPE, pepper spray, and non-intrusive drug detection methods.

Current Projects

The program is conducting a broad range projects. Detailed information can be found among the resources listed in the [Appendix](#). Among the major deliverables being developed are:

1. Chemical warfare agent (CWA) vapor point detection equipment standards
2. Toxic industrial chemicals (TICs) detection standards
3. Standoff CWA detection standards
4. Biological warfare (BWA) agent detection standards

5. Trace explosives detection equipment standards
6. Suspicious powders collection and sampling standards
7. Explosives detection equipment calibration standards
8. Standard Reference Materials (SRMs) for explosives and CWAs
9. Decontamination materials standards
10. Decontamination equipment standards, test procedures and protocols
11. Oleoresin capsicum canister standards for law enforcement applications
12. Non-intrusive drug detection test protocols for drugs in saliva, sweat, and hair
13. Equipment user guides and selection, care and maintenance (SCAM) guides

Looking Ahead: Needs and Opportunities

- 1 NIST should become the agent responsible for future updates of standards being developed through existing DHS and NIJ projects. This would provide steady funding and engage NIST in ongoing research and equipment testing that can lead to significant advances.
- 2 PSST is undertaking the conversion of United Kingdom standards for extremity protection into U.S. standards. There are many similar opportunities for NIST, with organizations around the world developing standards that may be applied to our national needs.
- 3 Develop CB equipment test methods and protocols using simulants, which would reduce costs by limiting the need for live agent testing
- 4 Develop standards for stand-off detection methods and equipment for CBE threats
- 5 Develop safe CB decontamination methods and equipment, and
- 6 Develop non-intrusive drug detection methods that are acceptable to the courts and the criminal justice community.

Public Safety Communications Systems

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The Public Safety Communications Systems program provides technical expertise to the DHS SAFECOM Program, which is building a framework for fully interoperable communications among all first response agencies. It is also developing standards for voice, data and image transfers, evaluating existing devices and services, and developing a uniform assessment process for testing the conformity of mobile radio equipment with P25 requirements.

Current Projects

1. Land Mobile Radio Standards Development
 - Working with the TIA P25 Committees to accelerate development of standards for digital land mobile radio systems
 - Within the last 12 months, three of the highest priority standards have been completed and have been or are about to be published
 - Working with TIA and the P25 Steering Committee to develop a P25 compliance testing program to provide public safety with needed information on the functionality and compatibility of radio systems
2. Future Public Safety Network Standards
 - Developing a Public Safety Statement of Requirements for Wireless Communications which will provide qualitative and quantitative information on the voice, video, and data services public safety needs to have

- Developing a Public Safety Architecture Framework by applying enterprise architecture processes to the public safety communications field, thereby providing public safety with the means to develop independent, yet interoperable communications architectures
 - Developing mission critical voice and video quality of service parameters for public safety based on results from subjective laboratory tests of over 30 first responders
3. Testing of Interim Interoperability Devices
 - Testing radio gateway devices, based on public safety priorities, to determine if these devices operate as advertised

Looking Ahead: Needs and Opportunities

1. Land Mobile Radio Standards Development
 - In-building propagation measurements
 - Modeling and simulating land mobile radio networks
2. Future Public Safety Network Standards
 - Modeling and simulating possible public safety networks at various frequency assignments
 - 3D geo-location
 - Representing public safety interests on existing standards committees
3. Testing of Interim Interoperability Devices
 - Evaluating *ad hoc* networks and their applicability to public safety
 - Evaluating existing video and data services being offered to the public safety community

Weapons and Protective Systems (WPS)

Program Manager: Kirk Rice, (301) 975-8071, kirk.rice@nist.gov

The WPS program developed the first minimum performance standard for ballistic-resistant body armor and keeps the standard current with changing technologies and ballistic threats. It also leads standards development related to stab-resistant body armor, metallic handcuffs, ballistic materials, helmets, and firearms. The program relies on partnerships with several NIST laboratories, scientific and technical organizations, government agencies, and criminal justice practitioners. A list of these partners is found in the [Appendix](#).

WPS's work in performance standards for body armor is at the center of the Bulletproof Vest Partnership (BVP) Grant Act established by Congress in 1998 to provide matching funds to agencies for the purchase of protective body armor. Also, in November 2003, the U.S. Attorney General launched the Body Armor Safety Initiative in response to a body armor failure, and WPS was charged with leading efforts to assess the performance of Zylon®-containing body armor, with special focus on the material's degradation from aging and environmental factors.

Most Significant Current Programs

1. Ballistic-Resistant Body Armor
2. Stab-Resistant Body Armor

Both programs keep standards current by researching changing technologies and threats. The deliverables include reports and technical papers on important findings such as degradation

mechanisms, impact of environmental exposure, measurement of mechanical properties, chemical analyses, characterization of ammunition types, and simulations of bullet failure. Three NIST draft reports to NIJ have been submitted to the U.S. Attorney General to describe activities and findings under the Body Armor Safety Initiative; a revised performance standard, a body armor artificial aging protocol, and recommendations for an improved conformity assessment program are in preparation.

Looking Ahead: Needs and Opportunities:

- NIST is advocating that body armor compliance testing laboratories be accredited based on the National Voluntary Laboratory Accreditation Program (NVLAP) model, or equivalent. This will also require the development of an interlaboratory test program.
- NIST requires a standing program to continue its work in characterizing existing and emerging body armor materials
- A longer-term program is needed to evaluate behind-armor injuries that occur in the field and provide data for future revisions to the standards
- Research focused on degradation mechanisms has spawned ideas for new ballistic materials that are potentially more resistant to degradation and yet still possess desirable mechanical properties. NIST should establish programs to pursue research in this area.
- Funding should continue to be made available to NIST staff to serve as technical agents on behalf of the public safety community, to ensure that practitioners' needs are reflected in equipment performance requirements.
- Many types of protective equipment for first responders are not certified through conformity assessment programs. NIST should consider identifying appropriate conformity assessment bodies and working with them, the industry, and practitioners to establish sustainable programs that certify a wider range of essential equipment.

APPENDIX

Critical Incident Technologies

Additional information on the CIT program area, our partners, and sources of requirements can be found in the following areas:

- ANSI Homeland Security Standards Panel (HSSP)
- ANSI Homeland Security Standards Database (HSSD)
- ASTM F23 Protective Clothing Committee
- ASTM E54 Homeland Security Applications Committee
- CBRNE Standards Development Program FY03-07
- DHS Grants & Training Systems Assessment and Validation for Emergency Responder (SAVER) program
- DHS S&T Standards Portfolio
- DHS S&T Standards Working Groups
- Edgewood Chemical Biological Center
- InterAgency Board for Equipment Standardization and Interoperability (IAB) Standards priorities and Standardized Equipment List (SEL)
- Natick Soldier Center
- National Bomb Squad Commanders Advisory Board (NBSCAB) Strategic Plan
- National Fire Protection Association (NFPA)
- National Institute for Occupational Safety and Health (NIOSH) Personal Protective Technology Laboratory (NPPTL)
- NIJ Critical Incident Technologies Program
- NIJ Personal Protective Equipment (PPE) Technical Working Group (TWG)
- NIJ Explosives Technical Working Group
- NIST Homeland Security Strategic Working Group
- NIST/OLES web pages
- NIST Equipment Guides
- Responder Knowledge Base (RKB)
- Technical Support Working Group (TSWG)

Forensic Sciences

The program identifies the needs of the forensic community through participation in a broad range of working groups, including:

- National Institute of Justice Technical Working Groups (NIJ TWGs)
- Scientific Working group for the Analysis of Seized Drugs (SWGDRUG)
- Scientific Working group for Digital Evidence (SWGDE)
- Scientific Working group for Material Analysis (SWGDMAT)
- Scientific Working group on DNA Analysis Methods (SWGDM)
- Scientific Working group for Imaging Technology (SWGIT)
- Scientific Working group on Friction Ridge Analysis, Study and Technology (SWGFAST)
- Scientific Working Group for Forensic Document Examination (SWGDOC)
- ATF Technical Working Group for Fire and Explosions (TWGFEX)

Needs are also identified through evaluation of Federal and state circuit court decisions and from guidance provided by:

- *Electronic Crime Needs Assessment for State and Local Law Enforcement* April 2001
<http://www.ncjrs.gov/pdffiles1/nij/186276.pdf>
- *Forensic Sciences: Review of Status and Needs*
<http://www.ncjrs.gov/pdffiles1/173412.pdf>
- *American Society of Crime Laboratory Directors-Laboratory Accreditation Board (ASCLD-LAB) Accreditation Manual* <http://www.asclد.org/index.htm>

Public Safety and Security Technologies

Additional information on this program area's current projects and the technologies involved can be found in:

- NIST/OLES web pages
- NIST Chemical/Biological Equipment Guides
- InterAgency Board for Equipment Standardization and Interoperability (IAB) Standardized Equipment List
- ANSI-HSSP Database
- ASTM E54 and F23
- DHS's RKB and SAVER on-line databases
- Technical Support Working Group (TSWG)
- National Fire Protection Association (NFPA)
- AOAC
- ECBC
- NIOSH/CDC websites
- OSHA
- EPA
- the NBC Industry Association.

Weapons and Protective Systems

Among the Weapons and Protective Systems program's partners in its body armor projects are:

- NIST Laboratories: BFRL, MSEL, MEL, ITL, EEEL, which conduct research aimed at improving our understanding of ballistic materials degradation, develop methods for measuring changes in ballistic materials, characterize bullet and body armor materials, and assess test methods.
- Technical Support Working Group (TSWG)
- U.S. Secret Service
- U.S. Army
- NIJ's Body Armor Technology Working Group and the Law Enforcement and Corrections Technology Advisory Council (LECTAC) provide practitioner advice and assist with identifying and prioritizing user needs
- Home Office Scientific Development Branch, U.K.