
TECHNOLOGY DEPLOYMENT

The need to develop, test, and field new law enforcement tools remains as compelling as ever, given the rapidly increasing technological capabilities of criminals. U.S. government national laboratories that produce advanced technologies and U.S. businesses that supply those technologies to local law enforcement agencies would benefit from a focused effort to develop and deploy crime-fighting technologies to local agencies.

About 95 percent of a typical law enforcement agency's budget is dedicated to personnel. The scarce resources left over are spent on basic equipment, such as cars, radios, and side arms. There is little money available to purchase the new tools necessary to keep up with criminals. As the examples below demonstrate, a new effort to get technology onto the streets is needed to provide modern crime-fighting tools to the nation's local law enforcement agencies.

CURRENT STATUS

NIJ has funded the research, development, testing, and evaluation of numerous technologies to help law enforcement. These range from less-than-lethal technologies, to weapons detection, see-through-walls systems, capture nets, a "smart" gun, a rapid DNA identification system, and more. There are numerous cases where new DNA techniques have helped free people who were wrongly convicted. NIJ has also put on the streets the technologies that it is helping to develop. For example, police now have a better way to stop a fleeing car with less risk to officers and bystanders because of an NIJ technology called RoadSpike. The following are examples of technologies cur-

rently in use by, or being developed and tested for, law enforcement agencies.

Technology Available to Campus Police

The Bureau of Justice Statistics has compiled data on nonlethal weapons authorized for use by officers in college campus law enforcement agencies.¹ Fifty-six percent of campus police departments authorize use of pepper spray, 45 percent use of collapsible batons, 34 percent PR-24 batons, 30 percent traditional batons, 11 percent personal tear gas, 5 percent large-volume tear gas, 5 percent the carotid hold,² 2 percent the choke hold, 2 percent stun guns, and 1 percent flash/bang grenades.³

As of 1995, 99 percent of campus law enforcement agencies used some type of computer. Ninety percent used personal computers, 62 percent a mainframe, 33 percent had a local area network, 6 percent used handheld and 2 percent car-mounted mobile digital terminals (*Sourcebook*, p. 42).

A Computer System to Track Gang Members

In March 1998, California Governor Pete Wilson announced an \$800,000 state investment in a computer system to track gang members. The CalGang system, first developed in Los Angeles, will enable any law enforcement agency in the state to access a master index and share information about the movement of street gangs. Agencies will be able to get on the Intranet system with computer software they can buy for less than \$30. The system will give them photographs of gang members and other identifying information.

Wilson also announced expansion of a program to track more than 33,000 active prison parolees. Information on the statewide computer network includes a parolee's record, aliases, physical description, addresses, vehicles, and even identifying marks, such as tattoos.

¹We have not found similar data on municipal police departments.

²The carotid hold applies pressure to the carotid arteries supplying blood to the head. If applied too aggressively, it can cause death.

³*Sourcebook*, p. 42. These are 1995 data.

Wireless Data Communications

In 1997, the Guilford, Connecticut, Police Department announced completion of its wireless data communications pilot, which allows officers to gather vital suspect information and complete paperwork while remaining in the field.

The officers are equipped with laptop computers with wireless modems, enabling them to access applications and data in Guilford; from the state's mainframe motor vehicle and warrant information in Hartford, CT; from the National Crime Information Center, in Washington, D.C., and from the National Law Enforcement Telecommunication System, in Phoenix, AZ.

Guilford officers have immediate access to information on their computer screen without having to request it by voice radio—enhancing security and leaving the voice dispatch system free for emergency calls. The portable computers have increased productivity at all points, freeing officers from needing to return to the station for information and allowing dispatchers and clerical staff to concentrate on their own tasks.

The Guilford Police Department funded the purchase of the computers and the software through the Federal COPS MORE Program. To qualify for the grant, the department had to show a concrete plan for using mobile computing to keep officers in the field and increasing their contact with the public. The federal grant funded 75 percent of the project, and Guilford contributed 25 percent.

TECHNOLOGY DEVELOPMENT

NLECTC has awarded grants for development of technology in the areas of communications, computers and software, forensics, less-than-lethal weapons, protective equipment, security equipment, surveillance and sensor equipment, vehicles and equipment, and weapons and ammunition. Each of the following development projects—and many others—are described on NLECTC's web site at www.nlectc.org/techproj:

- Face Recognition Technology for Internet-Based Gang Tracking
- Integrated Law Enforcement Face-Identification System

- Weapons Team Engagement Trainer
- DNA Human-Identity Testing Using Time-of-Flight Mass Spectrometry
- Forensic Investigations Information Management System
- Various less-than-lethal technologies
- Concealable Body Armor
- Back-Scatter Imaging System for Concealed Weapons Identification
- Handheld Acoustic System for Concealed Weapons Detection
- Ballistocardiogram Human Presence Detection Technology Demonstration
- Vehicle Stopping RoadSpike.

Some of these technologies are quite different from what laypeople might think of as useful to law enforcement agencies. For example, one of NLECTC's projects developed software to help law enforcement agencies make cost-effective decisions for disposal of police patrol vehicles. The software enables agencies to generate a list ranking individual vehicles for disposal to minimize fleet maintenance and repair costs.

The federal government is not the only funder of law enforcement technology development.

Contributions from the private sector should not be overlooked. One of the strategic recommendations from a study conducted by the Los Angeles Police Department was that "departments should establish active liaisons and affiliations with private sector industries engaged in the development of advanced technology, which is either already adapted to or capable of being adapted for law enforcement needs" (Paniccia, 1998, p. 10).

States and a few larger cities also fund technology development. California, for example, has made a substantial investment in a computer system to track gang members, as mentioned earlier.

NIJ's Office of Science and Technology regularly convenes committees of experts to review technological issues bearing on law en-

forcement and corrections. This Law Enforcement and Corrections Technology Advisory Council has identified the following 11 high-priority concerns, each of these are discussed below and in Chapter Five:

- Nonintrusive detection of concealed weapons and contraband
- Safer vehicle pursuit
- DNA testing
- Officer protection
- Less-than-lethal incapacitation
- Information management
- Counterterrorism
- Crime mapping
- Location and tracking
- Secure communications
- Noninvasive drug detection.

Smart Gun

The Smart Gun Prototype II program is a one-year project to develop a firearm that will only fire for a recognized user.⁴ When energized, the gun emits a radio signal that is received by a small transponder worn by the authorized user, which returns a coded radio signal. When the gun receives the signal, a locking pin is removed from the trigger mechanism, enabling the gun to be fired.

FBI data show that about 16 percent of the officers killed in the line of duty are killed by a suspect armed with either the officer's own firearm or that of another officer. In addition, there are currently 10,000 civilian firearms-related injuries and deaths each year due to accidental discharge or unauthorized use of a firearm.

⁴This description is from NLECTC's web site, *www.nlectc.org*.

The need for and applicability of this technology has been aptly described in an NIJ-funded document issued by Sandia National Laboratories, Albuquerque, New Mexico, *Smart Gun Technology Project Final Report* (available in Adobe Acrobat format, <http://www.prod.sandia.gov/cgi-bin/techlib/access-control.pl/1996/961131.pdf>). Sandia identified the law enforcement requirements for smart firearms technology and then investigated, evaluated, prioritized, and demonstrated (by proof of concept) the most promising technologies available.

Prototype I was tested and demonstrated. These tests showed that the technology can work, that all necessary electronic and mechanical components can be made to fit inside a full-size pistol, and that authorization can be made well within the time required to draw and aim. Colt Manufacturing has been funded by NIJ to design and build Prototype II, which will contain more-advanced designs suitable for the law enforcement environment.

Vehicle Stopping

Police pursuits of suspects in motor vehicles have received considerable public attention—in large part due to live coverage by local television news programs.

From 1990 to 1994, an average of 331 people nationwide per year died as a result of police pursuits; 78.9 percent of these were in the pursued vehicle. An average of about 68 “uninvolved” people died each year as a result of high-speed pursuits. In California, approximately 2 percent of all pursuits result in serious injury, and about one-half of 1 percent involved a fatality. Research conducted to date indicates strong public approval of police pursuits as long as certain safeguards are in place.⁵

The Pursuit Management Task Force recently convened by the NIJ offered the following priority listing of recommendations:

⁵This section quotes extensively from Bayless and Osborne (1998).

1. More resources for research, development, testing, and commercialization of viable pursuit termination, management, and prevention technologies, to include
 - an accelerated “Phase III” program to deliver electrical, electromagnetic, or other technology prototypes for operational testing and evaluation by local and regional law enforcement agencies
 - encouragement of civilian law enforcement agencies to participate with vendors and suppliers in developing prototypes
 - encouragement of continued cooperation between agencies of the Department of Defense (DoD) and civilian law enforcement to transfer appropriate defense technology for law enforcement use.
2. Aggressive development of
 - retractable direct injection electrical systems
 - radiative electrical systems, including high-power microwaves
 - cooperative systems with law enforcement activation
 - auditory/visual sensory enhancements (improved warning devices).
3. A national model for collection of pursuit statistics.
4. State legislation making fleeing from lawful detention/arrest in a motor vehicle a serious crime with significant penalties.
5. Federal efforts to further public education about pursuits.
6. Research to improve interagency tactical communications technology.

Counterterrorism

Table 3 shows the most frequently cited technology needs for combating terrorism, as identified by a 1998 study sponsored by NIJ.

Table 3
Technology Needs for Combating Terrorism

Function	Need
Apprehension and riot control	Improved nonlethal weapons
Command, control, and communications	Improved and/or more readily available, secure communications for the “beat cop” Improved interagency communications
Defense against cyberterrorism	Improved detection, forensics, and counter-measures for cyber attacks
Defense against nuclear, biological, or chemical weapons ^a	Improved means to detect and categorize NBC threats Improved, affordable protective suits
Detection, disablement, and containment of explosive devices	Improved means of explosives detection Improved robots for disarmament and disabling of explosive devices Improved containment vessels and vehicles for explosive devices
Intelligence	National intergovernmental information system with current intelligence on terrorism
Surveillance	Improved “see-through-the-wall” capability Improved electronic listening devices Improved long-range video monitoring Improved night-vision devices
Training	Improved training to combat terrorism

SOURCE: TriData Corporation (1998), p. 16.

^aReferred to in the TriData report as weapons of mass destruction.

Communications Systems

The local law enforcement community’s ability to fight crime would be significantly enhanced if personnel could communicate and exchange data in a seamless fashion. Numerous cases have been reported in the news in which a lack of interoperability has led to the escape of suspects, including the murder of police officers. Communications provides the backbone that supports local law enforcement agencies’ efforts to combat crime. But in most communities,

radio systems supporting police, fire and emergency medical services are overwhelmed. Worse, current frequency allocations and technologies make it impossible for adjacent agencies to talk to each other. To help address this, the Clinton administration has successfully freed up 24 MHz of new radio frequencies; however, modernizing the public safety wireless infrastructure so it can take advantage of this new spectrum will be a massive undertaking.

Most communication among law enforcement agencies is by telephone, but electronic bulletin boards and web sites are increasingly used. Police planning staffs spend significant time (on average 13 percent of their time) responding to requests from outside agencies (NIJ, 1998).

The Crime Identification Technology Act of 1998 authorizes \$250,000,000 for assistance to states each year, for five years, for a broad range of crime technology activities. The act provides for system integration for criminal justice purposes to help states develop and upgrade their anticrime technology from the patchwork of existing programs, integrate law enforcement and public safety records and communications, and integrate and interface with national criminal information and public safety databases.

One of the NLECTC communications projects is providing New York State with system engineering support for a wireless communications network. Another, the State and Local Communications Interoperability Analysis project, provides background data, requirements definitions, and direct assistance support to state and local law enforcement, corrections, and public safety agencies to alleviate problems associated with differences in radio systems and operational procedures. Yet another NLECTC project is demonstrating and evaluating use of telecommunications technology to provide medical care in corrections environments.

TESTING AND EVALUATION

The proposed initiative would expand the NLECTCs' current testing and evaluation programs—including partnering with the DoD testing capabilities and Department of Energy (DoE) national laboratories—so that the local law enforcement community can be confident that the tools they receive work as advertised under realistic condi-

tions. These testing programs will enable law enforcement to make the best investment possible in new equipment and, more importantly, save lives, for example, as shown from experience with soft body armor.⁶ Of the 307 models of body armor tested in 1997, only 124—about 40 percent—passed. The Bulletproof Vest Partnership Grant Act of 1998 funds provision of armored vests for police officers. In considering the act, Congress found that, although bullet-resistant materials helped save the lives of more than 2,000 law enforcement officers between 1985 and 1994, nearly 25 percent of law enforcement officers are not issued body armor.

Technologies Tested in Mock Prison Riot

In April 1998, OLETC sponsored a second annual mock prison riot, designed to give corrections and law enforcement officials from across the country an opportunity to witness a crisis management exercise that tested and demonstrated the newest technologies. Table 4 lists some of the more than 60 technologies that were demonstrated.

OLETC Commercialization Projects

Here we briefly describe several commercialization projects and the role OLETC played in them.⁷

- **Counter Point Correctional Vest.** A low-cost, lightweight stab- and slash-resistant vest for corrections officers who face a lesser ballistic threat than most police officers. OLETC provided commercialization assistance to allow the inventor to rapidly identify the potential market for this product, establish an integrated commercialization methodology, and provide the tools to effectively initiate market entry.

⁶The police need for body armor has increased as criminals have become more heavily armed. Of the 687 officers killed by firearms in the decade ending in 1993, more than half were killed by relatively powerful weapons: 25.2 percent by .38 caliber handguns, 12.1 percent by .357 Magnum handguns, 9.5 percent by 9 millimeter handguns, and 7.4 percent by 12 gauge shotgun (Zawitz, 1995).

⁷Information in this section is from Office of Law Enforcement Technology Commercialization (1999).

Table 4
Technologies Tested in Mock Prison Riot

Technology	Commer- cialized	Description
Body Armor	Yes	A bulletproof vest said to be capable of stopping a nine-millimeter submachine gun, a .44 Magnum, and all lesser threats
Entanglement Net	Yes	A device that shoots a five-square-meter net to stop a fleeing suspect
Night-vision devices	Yes	A head- or hand-mountable device that allows officers to see in dark areas by greatly intensifying the available light
Pupil Measurement Device	No	Detects drug or alcohol use, providing an officer with probable cause to perform other tests
RoadSpike	Yes	A long strip that lies on the ground; when a vehicle rolls over the strip, hollow point spikes embed and slowly flatten the tires
Silent Witness	Yes	A secured audio recording device carried by an officer to monitor officer/suspect interactions; can be downloaded for incident review
Spider Alert	Yes	Personal alarm designed to track employees
Tiger Vision	No	An imaging technology using invisible infrared light to give officers greater vision in total darkness

SOURCE: *Making Corrections Technology Work for You*, LRP Publications, May 1998, pp. 6–8.

- **Explosive Ordnance Disposal Technician Training Kit.** A bomb technician training kit developed by the United States Navy Explosives Ordnance Disposal Technology Division. OLETC has assisted the navy in managing the entire commercialization process by developing a commercialization plan, performing user and market analysis, managing the competitive licensee selection process, and assisting with the development of a Cooperative Research and Development Agreement.
- **Integrated Law Enforcement Face Identification System.** A special integrated facial identification system that can screen

over one million mug shots in less than two seconds. The system is currently under development by OLETC.

- **RadarVision.** A see-through-walls technology using time-modulated radio signals. OLETC has assisted the developer in introducing the technology to a number of federal market sectors.
- **RoadSpike.** A remotely activated, retractable spike barrier strip to safely conclude high-speed vehicular pursuits. OLETC's role in the commercialization process was to identify candidate U.S. manufacturers, perform market and financial evaluations, and to assist the inventor and manufacturer to conclude a formal licensing agreement.
- **Tiger Vision.** A patented, low-cost, hand-held, multipurpose low- or no-light, night imaging system that operates on a standard camcorder battery or 12-volt car battery. OLETC's role in the commercialization process consisted of performing market research and financial analyses, developing a commercialization plan, profiling and identifying candidate manufacturing partners, and assisting the developer and a candidate manufacturer to conclude an acceptable license agreement.

Technology Too Good to Be True

The *Star Trek* crew used a hand-held device to detect life forms on alien planets. Is it possible to actually have such a device, to enable police to locate hidden suspects at a safe distance?

Enter the DKL *LifeGuard*, with the following advertised performance characteristics:

The DKL *LifeGuard* can localize living humans up to 600 meters away, day or night, in open ground. At shorter ranges, people can be located through concrete and steel walls, earthen barriers, inside stationary or moving vehicles, and underwater. The *LifeGuard*'s patented dielectrokinetic technology enables it to distinguish humans from all other living things, even a gorilla or an orangutan. It is compact, portable, and effective in most weather conditions. There are no known electronic or other countermeasures to the *LifeGuard*, and it is silent, passive, and undetectable. There are three *LifeGuard* models, each with its key features (World Wide

Web, <http://www.dklabs.com/Model3.htm>, as it appeared February 25, 1999).

Fortunately for police departments contemplating buying these \$6,000–\$14,000 devices, NLECTC and Sandia tested them. Their findings:

The results of the March performance tests were that the device failed to perform as advertised and performed no better than random chance, despite being operated well within advertised specifications and by an operator provided by the manufacturer (Murray, 1998).

SUPPORTING TECHNOLOGY ACQUISITION

Factors in Acquisition Decisions: The Example of Less-Than-Lethal Technology

Many acquisition decisions are so complex that the need for expert help is obvious. The following description of factors related to less-than-lethal (LTL) technologies illustrates this.⁸

Behavioral and Legal Considerations. To date, law enforcement has for the most part deployed a limited range of LTL weapons. The reasons for this range from cost, effectiveness, availability, and reliability issues to the unpredictability of effects and concerns about liability. For example, although a given LTL weapon may have minimal medical implications for normal healthy subjects, a high percentage of the individuals on whom law enforcement officers may use these weapons are mentally impaired or may be under the influence of drugs or alcohol. For some individuals with mental illness or those on depressants or stimulants, a technology's effects may be enhanced and longer-lasting than anticipated. Other individuals may have a higher pain threshold or impaired judgment. In addition, law enforcement and corrections may be reluctant to deploy a new technology, munitions, or LTL weapon if there are concerns about its getting into the wrong hands.

⁸Factors provided by Lieutenant Michael Grossman of the Los Angeles Sheriff's Department.

Training. Police training tends to focus primarily on technique, with little integration of the full range of force options an officer may employ (e.g., physical constraint) in lieu of or in combination with a given technology (Pilant, 1993). For some technologies, “one size fits all” training may be appropriate; for others, training must be tailored to the user. Some LTL weapons, for example, may require that an officer not only be tactically skilled, but also knowledgeable in the full gamut of use of force options—from vocalization to grappling to the application of lethal force. Those in specialized units, such as SWAT (Special Weapons and Tactics) teams, will have more training on movement and tactical situations and a greater exposure to a wider range of situations; whereas patrol officers may be given more-standardized training.

Cost. The adoption of a new technology must take into account the cost of equipping an entire department or specialized units, along with training costs. In law enforcement, limited budgets make acquisition and training costs a central issue. Or cost considerations might lead a department to make certain technologies available only to specialized units or designated supervisors.

Risk Management. Risk management, in practice, largely deals with damage limitation and legal liability, since most of the risk-management activity in this country takes place in an adversarial environment (Morgan, 1981). It is not enough to analyze risks or even to develop a strategy to manage risk; attention must also be given to communicating what is known about the risk to decisionmakers and the public (Leiss, 1996). Legal scholars have contributed to the field of risk communication, seeking to develop a neutral framework for characterizing the weight of evidence underlying risk assessments (Walker, 1996).

Sweetman (1987) lists the following desirable characteristics of LTL and other tactical technologies:

- Quick deployability and decisiveness in their application with a high probability of instantaneous control over a suspect
- Effects that are temporary and observable, with minimal medical consequences and predictable duration
- A high probability of affecting only the intended target

- Features that minimize the potential for abuse
- Reliability and durability
- Compactness, light weight, and ease of access
- Wide public and departmental acceptability
- Compatibility with the other force options available to an officer for a given type of situation.

An LA Story: Differences Technology Can Make

A 1989 workload study conducted by the Los Angeles Police Department (LAPD) found that officers spent as much as 40 percent of their time performing administrative duties. Patrol officers and detectives were hampered by archaic manual reporting procedures such as filling out paper-and-pencil reports, following complex procedures for bookings, waiting in line to check out vehicles or change watch, and manually filing/searching for records. Each time they arrested a suspect, they had difficulty accessing vital crime history information. Mobilization in the face of a natural disaster or other emergency was accomplished by “calling around” to see who was available for deployment. Daily field deployment relied on bulletin boards that utilized thumbtacks and magnets. The LAPD was functioning in the technological equivalent of the 1960s and had not been able to benefit from the technological advances that have increased productivity and efficiency throughout the business world.

To remedy the situation, the Mayor of Los Angeles formed a public-private alliance (called the Mayor’s Alliance) that provided 1,200 computer workstations and related technology for the LAPD. Individual stations are equipped with electronic mail, voice mail, and local area network (LAN) capabilities. The LANs automate crime reporting and investigative procedures and, in the future, will include and maintain critically needed databases for personnel deployment, evidence tracking, and vehicle management. This new technology is expected to decrease the time required by officers to perform administrative and reporting tasks by 25–30 percent.

COPS MORE funding complements the Mayor’s Alliance effort to create a comprehensive equipment and technology package that includes the extension of LANs to the field and to detectives assigned

to both specialized and geographic areas,⁹ creation of a paperless reporting system with laptop computers, development of a data architecture for reengineering business processes within the LAPD,¹⁰ extension of fiber-optic connectivity, installation of video case filing (Bellow, 1993), and development of a conditions-of-probation system.¹¹

Reducing the time officers spend in administrative functions will increase their productivity by an estimated 18–19 percent, which is the equivalent of deploying 682 currently sworn officers into the field.

PROSPECTS FOR IMPROVED TECHNOLOGY DEPLOYMENT

It should be evident from the discussion above that the needs for improved law enforcement technology are great and that much new technology is being developed. The need for testing and communication of test results is also evident. This service can most economically be provided by the federal government and, by helping state and local law enforcement make good acquisition decisions, this federal investment can more than pay for itself in savings to local agencies. In addition, by promoting commercialization of technologies with law enforcement potential, better technology can become available sooner and often at lower cost. In the next chapter, we discuss how federal funds can be used to improve the technologies in state and local crime labs.

⁹Other cities adopting such systems have found that officers can save 40–60 percent of the time they spend in preparing reports, with an overall productivity improvement of 15–30 percent.

¹⁰Developing a data architecture and reengineering the LAPD's outdated business processes are expected to result in dramatic improvements in performance departmentwide. Reengineering experts estimate increases in efficiency of 30–50 percent.

¹¹In March 1997, the New York City Department of Probation began installing a state-of-the-art electronic reporting system to allow probation officers to better manage large caseloads and focus on rehabilitation and other important duties.