Vulnerability Mitigation: Technology Assessment and Deployment

"WE MUST USE TECHNOLOGY … TO SPEED THE FLOW OF COMMERCE ACROSS OUR BORDERS, AND TO IDENTIFY FREQUENT TRAVELERS WHO POSE NO RISK." — PRESIDENT GEORGE W. BUSH, MAY 14, 2002

"TRANSPORTATION SECURITY IS BEST ACHIEVED THROUGH WELL-CONCEIVED SECURITY SYSTEMS THAT ARE INTEGRATED WITH TRANSPORTATION OPERATIONS." — NATIONAL RESEARCH COUNCIL*

Mitigating vulnerability to new terrorist threats requires the rapid development, prototyping, and deployment of systems that are tailored to shifting lines of attack. An effective physical security system is well integrated; combines state-of-the-art security and information technologies; and meets the current needs of its users, yet is flexible enough to accommodate evolving security concerns. A key characteristic is a "layered" design of subsystems with different security features. If one layer fails, there are many others to compensate. Properly linked, they compose a system that can deter a multiplicity of threats.

Although robust protection against attack is of paramount concern, it must be achieved without impeding legitimate business and necessary government activities. This objective is challenged by the tremendous flow of people and goods across U.S. borders and through government facilities. Dangerous people and cargo must be screened out from the majority who pose no risk. In developing and implementing security systems that protect many of our nation's borders and critical facilities, the Volpe Center applies systems solutions that optimize security, mobility, and economic viability.

This section summarizes much of Volpe's security systems work for a range of federal agencies. Whether Volpe develops new technology or integrates commercial-off-the-shelf tools, each system is tailored for the client's needs.

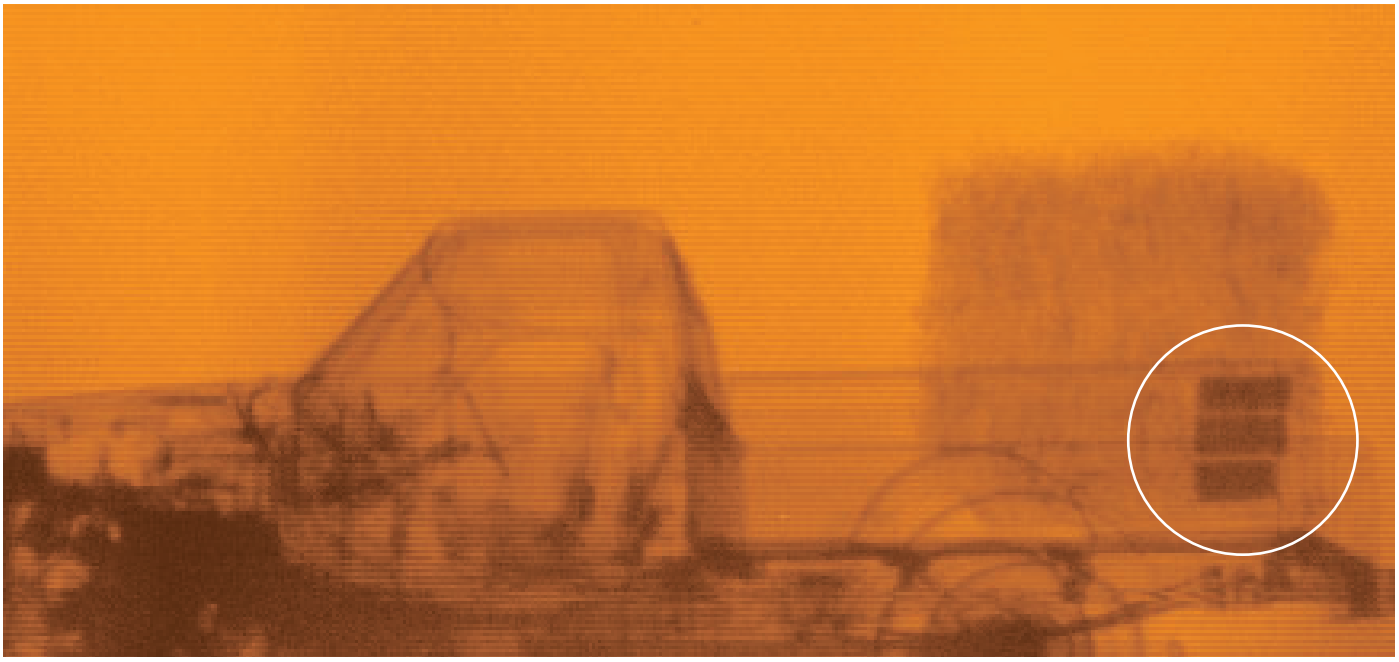
Annual Influx of People and Goods

- **500 million people** enter the United States, of whom 330 million are non-citizens
- **16 million cargo containers** arrive by truck and ship
- **7,500 foreign-flag ships** make 51,000 calls in U.S. ports
- **Millions of people** seek entry to U.S. facilities at home and abroad

DETECTING EXPLOSIVES AND WEAPONS IN AIRPORTS

Early in the 1970s, in the aftermath of the first wave of airplane hijackings, the Volpe Center was asked to evaluate electromagnetic detectors for concealed weapons that skyjackers might carry on board. The Center evaluated technology borrowed from the coal-mining industry, which had for some time been using pass-through metal detectors with its coal conveyor belts to check for stray pieces of broken machinery as the coal came out of the mine. The detectors were redesigned to make them suitable for use with people, and by 1973, the first systems were being installed in U.S. airports. The same detectors are now also used in many public buildings.

**Making the Nation Safer: The Role of Science and Technology in Countering Terrorism, National Research Council, The National Academies Press, 2002.*



TECHNOLOGY AGAINST TERRORISM: Imaging systems screen vehicles for anomalies, such as that circled above. This truck's cargo may be hiding explosives.

Shortly thereafter, Volpe teams began evaluating equipment designed to detect explosives in cargo and luggage. For 20 years, the Volpe Center participated in a number of initiatives to develop explosives-detection strategies and devices and studied ways to deploy these strategies in airports and buildings. Volpe continued to support the Federal Aviation Administration in evaluating new refinements of existing x-ray and CAT-scan techniques, and new approaches to sensing explosives, such as vapor detection. In 1996, an analytical model developed by the Volpe Center was used to help determine the most cost-effective strategy for national implementation of baggage screening systems.

PROTECTING U.S. BORDERS

At busy points of entry, the large numbers of people to be processed and the pressure to keep people moving may result in inadequate scrutiny of some travelers by border agents. In 1992, Immigration and Naturalization Service officials, faced with the problem of screening ever-larger numbers of people, asked the Volpe Center to research how biometric technology might be used to automate and streamline immigration processing. This research led to the development of two systems for border control at busy ports that facilitate the processing of known, trusted individuals: INSPASS and SENTRI.

These systems have significant efficiency benefits for frequent travelers. Equally important, they have tremendous security benefits, because they remove the pre-cleared, low-risk traveler from traditional inspection lines, enabling immigration agents to focus on other travelers.

INSPASS was an airport security system that used biometrics to verify identity. Volpe designed the system to allow registered travelers who passed extensive background investigations to bypass the full immigration process by going straight to an INSPASS kiosk, which integrated hand-geometry and card-reader technologies to identify travelers.

SENTRI screens both vehicles and travelers. It was originally designed for ports of entry on the U.S.–Mexican border where its use has reduced some two-hour waits to three minutes. Transponders on registered vehicles trigger retrieval of information about the people authorized to travel in those vehicles. Inspectors can visually verify identity and check the current status of occupants, then allow or prevent entry. Volpe developers tested facial-recognition technology for SENTRI, but it proved ineffective at certain times of the day due to shadows and glare.

Volpe continues to build on the SENTRI concept, applying it to meet the security needs of other clients, such as the Department of Defense (DoD). The Center's biometrics

Leveraging Existing Technology to Counter New Threats

Understanding the larger context of their work empowers Volpe staff to expand their perspective and find innovative ways to apply technologies and lessons learned in one mode or project to other areas.

These dual-use technologies often facilitate operations while protecting facilities and people. Navigation technologies developed by Volpe for ships traversing the Panama Canal and Saint Lawrence Seaway are being used to monitor and protect U.S. ships in domestic and foreign ports. Technology first developed to facilitate crossings at the U.S.-Mexico border has recently been enhanced to protect critical government installations at home and overseas.

The evolution of these systems is a prime example of Volpe's work as investment—of work done for one agency benefiting other agencies and, ultimately, the public good.

research continues to determine appropriate security applications, such as ID cards for transportation workers.

Biometrics: Key to Future Security

Biometrics are measurable physical characteristics or traits unique to each individual. The most familiar is the fingerprint, but hand geometry, retinal characteristics, or facial characteristics are also commonly used. The Volpe Center has developed several security systems that incorporate biometrics, a key element of cutting-edge access-control systems.

TRACKING VITAL ASSETS

The Volpe Center is home to the INTRANSIT (INternational TRANSportation Information Tracking) Program. INTRANSIT supports local, federal, and international agencies in surveillance, tracking, mapping, and communications for logistics and security. An INTRANSIT system can be modified and installed as needed to record and transmit data from moving vehicles, containers, or personnel located anywhere in the world.

INTRANSIT's electronic and satellite-monitoring capabilities have contributed to a number of international security operations. For example, from 1992 to 1995, the Volpe Center participated in the monitoring of goods shipments to enforce the sanctions imposed in Yugoslavia. Volpe staff developed a system that greatly reduced opportunities for violations.

In Bosnia, Somalia, and Haiti, the Center's INTRANSIT Program also successfully applied "smart-tag" technology that tracks containers and vehicles and can identify the contents of key shipments, enhancing visibility of assets moving to and from deployment areas. This project was in operation from 1992 to 1998.

As part of the INTRANSIT program, the Volpe specialists who developed the SENTRI system have also been working for the DoD on a security system known as Guardian. The Center originally developed this vehicle-tracking and communication system for the U.S. military in the early 1990s during Operation Desert Storm. Then in 1998, the second generation Guardian system was deployed.

The system provides tracking and satellite messaging for force-protection purposes, using Global Positioning System and satellite communications, and can be deployed anywhere in the world on virtually any vehicle with DC power. This low-cost, portable, vehicle-tracking system can be tailored for specific needs using off-the-shelf components. Guardian tracking units are currently deployed on DoD vehicles primarily in Southwest Asia.

SUPPORTING THE ENTRY POINT SCREENING PROGRAM

Swift, streamlined response to security needs requires the cooperation of many agencies to identify requirements, develop solutions, and execute projects. The Technical Support Working Group (TSWG) is an interagency group whose mission is to provide rapid research, development, and prototyping of new technology for the Combating Terrorism Technology Support Office of the DoD. TSWG asked the Volpe Center to serve as the program manager for the Entry Point Screening (EPS) Program because of the Center's expertise in technology application and program management. The primary concern of the program is protecting people and facilities against

large vehicle bombs; it focuses on non-intrusive inspection technology to screen personnel, vehicles, vessels, mail, and cargo.

A Volpe staff member manages all EPS projects, which identify, evaluate, and integrate innovative technologies and procedures. Evaluations are undertaken at high-risk DoD and civilian agency locations in the United States and overseas. Projects include: the Advanced Vehicle/Driver Identification System, Military Mobile Vehicle and Cargo Inspection System, Vehicle Inspection Checklist, Small Watercraft Inspection Guide, High-Volume Mail Room Scanner, Undercarriage Inspection Systems Development and Assessment, and 3-D Barrier Impact Response Model, as well as Operation Safe Commerce and the Vessel Identification and Positioning System.

Screening Entry to Military Installations — AVIDS

Strategic U.S military installations, whether at home or overseas, are prime terrorist targets. So when the 101st Airborne Division began deploying to Afghanistan from Fort Campbell, Kentucky, the significant increase in traffic passing through its gates prompted efficiency and security concerns. A Volpe-developed screening system—the Advanced Vehicle/Driver Identification System (AVIDS)—has proven successful in addressing these concerns. Like other Volpe-developed screening systems, it improves security and throughput at entry points by providing the posted officer with current information about arriving individuals and their vehicles. In fact, AVIDS is the most sophisticated of Volpe's screening systems. The product of lessons learned over the years by Volpe developers, AVIDS is easily modified for different environments. The Volpe team that designed, installed, and deployed the prototype system at Fort Campbell will soon do the same at strategic locations in the Middle East Operations Area.

Before AVIDS was deployed at Fort Campbell, traffic would back up at entry points as people wishing to enter showed an ID at the gate, then security personnel paged through a paper roster of 12,000 names to try to verify admittance. The Volpe team developed a database that includes photographs, identity information, access status, and other vital data. Force-protection personnel also have real-time access to selected information in databases of the Department of State and other agencies. Now a registered person wishing to enter presents his or her AVIDS photo ID card. When the screening officer scans the card, the wireless system checks the database for verification and

The Volpe Center Manages all TSWG Entry Point Screening (EPS) Projects

The primary concern of the EPS program is detecting large vehicle bombs. The following projects apply non-intrusive inspection technologies to screen vehicles, vessels, mail, personnel, and cargo for improved explosive, and chemical, nuclear, biological, and radiological threats.

Undercarriage Inspection Systems

Undercarriage inspection systems—which run the gamut from "a mirror on a stick" to automated, drive-over imaging technology—help detect vehicle bombs. A recent competitive comparison assessed commercial systems versus operational environments to help direct R&D efforts.

Force Protection "Pocket Tools"

Even the best technology must be integrated with proper procedure to be effective. The Vehicle Inspection Checklist and the Small Watercraft Inspection Guide are pocket-sized reference documents for DoD Force Protection and federal, state, and local security personnel. Thousands have been delivered to U.S. and Canadian agencies. The team is also developing guides for screening rail cars and personnel.

High-Volume Mail Room Scanner

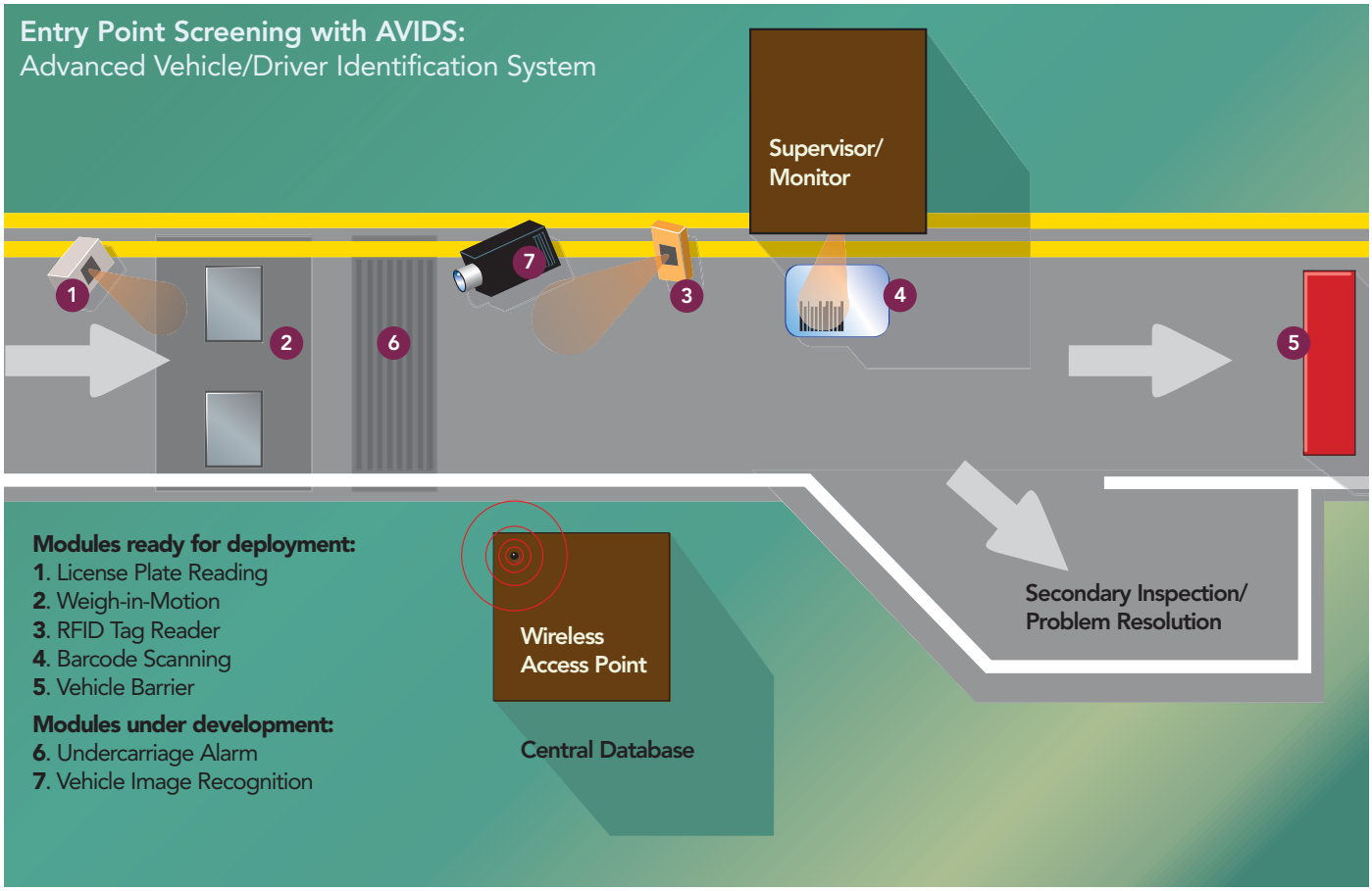
The seemingly mundane daily mail can carry extreme danger. The high-volume mail scanner is portable, so it can be deployed at major facilities worldwide to rapidly scan and segregate parcels and flat mail that may contain explosives or other threats.

3-D Barrier Model

The Three-Dimensional Barrier Impact Response Model will contribute to the development of improved security barriers to protect against vehicle bomb attacks at U.S. installations.

Military Mobile Vehicle and Cargo Inspection System

To meet the critical need for mobile systems that can detect explosives, the EPS Program reconfigured a commercial imaging system for inspecting vehicles and cargo. It was designed for rapid deployment to established bases or with U.S. expeditionary forces, and can inspect moving or static vehicles. A system was deployed overseas in fall 2001. (See image on page 15)



delivers information directly to the officer's handheld scanner. The officer knows immediately whether the person is admissible or non-admissible. If the person is non-admissible, the system notes what action should be taken. Average processing time has been significantly reduced while security has greatly improved. Under certain threat conditions, no one who is not registered is allowed in; visitors must go to the enrollment station to register.

AVIDS initially focused on identifying an individual first, then verifying the associated vehicle. Currently a vehicle screening system is being developed as well. However, most such systems use transponders that are installed in enrolled vehicles, which can complicate use overseas. So the Volpe team is developing technology that can "recognize" particular vehicles by reading the license plate and the configuration of the vehicle, including unique characteristics such as dents and scratches. It is expected that in 2004 the team will have integrated two new modules into one: an Arabic license plate reader and vehicle image recognition module.

AVIDS uses facial recognition during the enrollment process to guard against double enrollment, and to evaluate enrollees against a select group of persons wanted by law enforcement. Biometric verification will be incorporated for pedestrian traffic.

Protecting High-Valued Vessels in Port—VIPS

The morning of October 12, 2000, USS *Cole* was refueling in the port of Aden, Yemen, when a small, local service vessel that purported to be assisting in the scheduled operation approached the *Cole* and suddenly exploded. What had appeared to be a routine maintenance procedure was in fact a well-planned terrorist attack. The local boat had been loaded with explosives that blasted a 40-by-40 foot hole in the *Cole's* side, killing 17 sailors and injuring 39 more.

In response to the *Cole* attack, the DoD has taken several actions to increase port security in foreign nations and domestically. One product of this effort is the Vessel Identification and Positioning System (VIPS). Leveraging existing vessel-tracking technology developed by Volpe for the Panama Canal and the Saint Lawrence Seaway, VIPS protects U.S.-flagged ships by tracking and identifying nearby vessels in harbors and ports. Volpe's Center for Navigation designed, constructed, and field-tested VIPS.

The state-of-the-art system employs Differential Global Positioning System technology in specially designed transponders, which are installed on U.S.-flagged vessels. All communications from the transponders are encrypted and signed with a

digital signature to ensure that they are available only to U.S. military forces. Security operations and force protection units can track all equipped vessels in real time on a geographic display.

Although U.S. vessels in foreign ports still do business with local agencies, before any local service vessel can approach a U.S. vessel, it is boarded and inspected by an explosive-detection team. Once it has been ascertained that the vessel does not contain explosives, a VIPS transponder with tamper-awareness systems can be installed on that vessel so that its movement can be closely monitored.

Originally intended for use in foreign ports only, VIPS will also protect U.S. ships in domestic ports. The system is being field-tested with the U.S. Navy and Coast Guard at U.S. ports and was recently deployed in Norfolk, Virginia and Boston, Massachusetts.

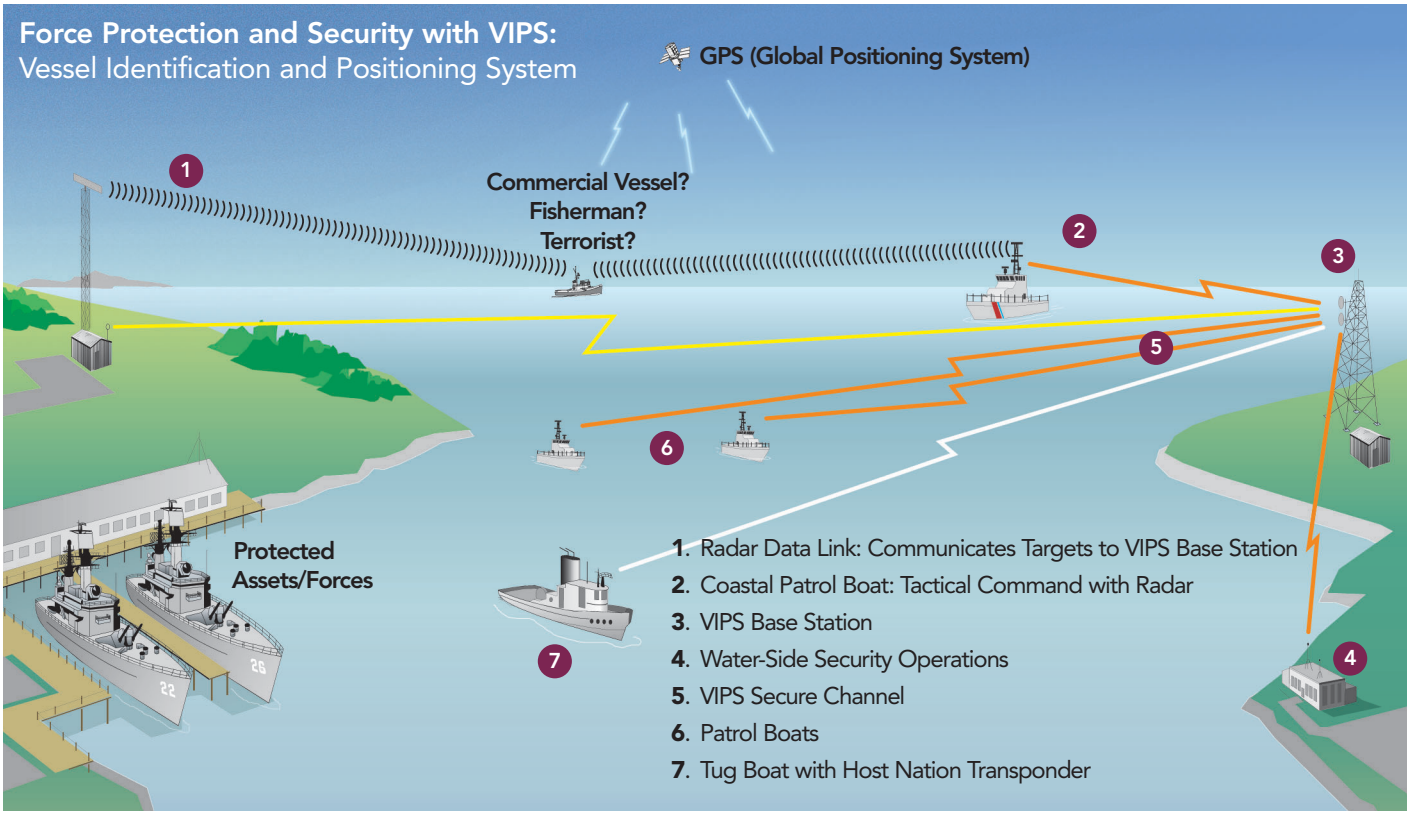
INTEGRATING SCREENING TECHNOLOGIES INTO PORT OPERATING ENVIRONMENTS

The myriad security challenges faced by large ports require a comprehensive approach. A multidisciplinary Volpe team is supporting a DoD counter-terrorism project that will demonstrate the integration of entry point and other screening technologies into an overall system solution. Volpe will assess existing practices and demonstrate the integration of systems to control the entrance to and exit from port facilities by cargo, vehicles, employees, and the public.

Employing lessons learned from other security projects performed for TSWG, DOT, and DoD, the Volpe team will select screening technologies for incorporation into the Port of Norfolk's operating environment. The team will evaluate these tools in the larger context of information systems and processes at a facility that handles DoD cargo containers of military assets or commercial goods bound for U.S. military forces.

MAKING CARGO CONTAINERS SMART AND SECURE

More than half of all goods that enter the United States arrive by oceangoing cargo containers. As discussed in the "Risk Assessment" section of this issue, the largely unsecured global supply chain presents ample opportunity for terrorists to again use the transportation system as a weapon. Historically, a small percentage of containers have been



inspected, and these have already arrived in port. Given the vast numbers of containers arriving in U.S ports daily, inspecting all containers after they arrive would create untenable dockside congestion. The delays could also allow weapons to enter the country and detonate before inspection.

The Customs and Border Protection agency is taking a proactive role in making the maritime trade environment more secure while accommodating the need for efficiency in global commerce. Customs and Border Protection is working to screen and secure containers before they leave their points of origin, and ultimately to ensure their security throughout the supply chain.

Volpe's extensive knowledge of intermodal cargo transportation and state-of-the-art security technology makes the Center an excellent choice to support Customs and Border Protection in developing smart and secure containers. Volpe staff have evaluated Customs and Border Protection demonstrations of technologies such as electronic seals, and have reviewed available commercial products for application to container security. The Center was able to apply lessons learned on another recent project, Operation Safe Commerce (see the "Risk Assessment" section), which was also developed as part of a broad nationwide effort to maintain open borders and facilitate commerce while improving security.

DEVELOPING AN ID CARD FOR TRANSPORTATION WORKERS

The people who work in transportation facilities help ensure public safety and safeguard national security. Transportation workers must be proficient, professional, and worthy of the public's trust. Within a week of the September 11, 2001 attacks, DOT Secretary Mineta established a committee to evaluate security in surface modes of transportation and provide recommendations for improvement. A common concern of all six modal groups of the committee was the need for a uniform identification program for transportation workers. The Credentialing Direct Action Group (CDAG) was tasked with examining the feasibility of an ID card system employing smart card and biometrics technologies that verifies the identity of transportation workers, validates their background information, and accounts for the access and activities of authorized personnel.

A Volpe security expert participated in the CDAG group assessing smart card technology. Earlier, a Volpe biometrics expert developed recommendations for the Transportation Security Administration's (TSA) Biometrics Go-Team, which was created to determine appropriate uses of biometrics in transportation security; its recommendations were used by the CDAG.

TSA is responsible for security in airports and ports as well as on the nation's railroads, highways, and public transit systems. As such, it intends to develop a consistent, intermodal identification program for all transportation workers who require access to secure areas at transportation facilities. A Volpe team is working with TSA and the Federal Transit Administration to evaluate the application of secure credentials for transit workers, as well as issues of interoperability among agencies and systems.

Developing and implementing an enterprise-wide system that creates digital credentials for workers and tracks their whereabouts and activities is a complex undertaking. Daunting enough is the integration of technology and information systems and the collaboration of multiple agencies. But the issue of personal privacy in an open society may be its most challenging aspect. TSA's Transportation Worker ID Card program seeks to create a system that is easy to use, is used, and assures the workers of privacy to the maximum extent consistent with the mission.

PROTECTING CRITICAL GOVERNMENT STRUCTURES

Protecting the nation's highly visible and sensitive structures is vital to maintaining our nation's morale as well as its security. Volpe involvement in facilities security extends back to the late 1980s. Early work studied how new technologies, such as biometrics and intrusion detection, could be used to enhance security at military bases worldwide. In 1998, the Center completed the design and implementation of integrated security systems for the State Department's Headquarters and the Treasury Department's Bureau of Engraving and Printing in Washington, D.C. Volpe teams are now upgrading these systems.

The advanced security system Volpe is implementing for the U.S. Department of State (DOS) is highly complex. It is one

"A cargo container arriving at a U.S. seaport today can be virtually anywhere in the heartland of America via truck and/or rail tomorrow." — DOT Secretary Norman Mineta, address before a House Transportation subcommittee, December 2001

of the first applications of smart cards for access control to buildings and computer systems. Ultimately, the system will accommodate 35,000 DOS users at facilities worldwide. Another ambitious program goal is interoperability with other federal agencies that are also deploying smart card security systems.

DOS staff will use a secure ID card that will allow them entry to only those physical areas and information networks for which they are cleared. The ID card will identify them, verify identity, and generate and store encryption keys and certificates to provide a digital identity.

Secure and efficient processing of visitors is also fundamental to protecting the government's lead foreign affairs agency. This is particularly challenging in facilities such as the Main State Department Building in Washington, D.C., which receives more than 1,000 visitors each day. Volpe has integrated an innovative visitor registration component into the new system. The automated process maintains a detailed electronic log of each visit, from the submission of a visitor request form by a DOS staffer through the visitor's arrival at, activity in, and departure from the facility.

The state-of-the-art DOS system has been designed and built according to government and industry standards to enable the flexibility to meet future security requirements as they arise.

VULNERABILITY MITIGATION LESSONS LEARNED

Vulnerability mitigation efforts must address complex and interrelated aspects of the transportation system, including personnel, physical facilities, information systems, and operations. Security strategies must be designed to provide layers of security using a concept of "security-in-depth." To be most effective, mitigation measures should be considered throughout the transportation system and logistics supply chain.

The high cost of introducing security measures is often offset by improved efficiencies that result from establishing secure systems. Integrating screening technologies that authenticate people and cargo improves their throughput in the transportation system. For example, the use of the SENTRI system at the U.S.-Mexican border has freed up resources to concentrate on non-registered users; the introduction of AVIDS at Fort Campbell has resulted in improved efficiency as well as better security.

A systems approach is essential to the success of transportation security projects. Given that transportation operators face stringent schedule requirements and tight budgets, solutions must consider operational efficiency and economic viability, as well as security. In some transportation environments, throughput requirements and cost concerns may require non-technical solutions such as modified procedures. The Volpe Center is well equipped to form multidisciplinary teams to address all of these aspects.

To develop and deploy an effective transportation security system, implementation teams must have an in-depth knowledge of the operational requirements of transportation organizations, as well as transportation and security technologies. In addition, topics such as environmental impact, human factors, and privacy must be addressed. Policies, procedures, and training are critical components of system deployment; training that includes simulated security incidents helps personnel understand vulnerabilities and how to respond to emergencies.

Security technologies are most effective when implemented as part of an integrated system combining technologies such as access control, intrusion detection, closed-circuit television, and digital video. Integrated systems using an "open architecture" apply technology interface standards whenever possible. This approach provides for interoperability among components, flexibility in choosing technology vendors, and scalability so the system can be expanded over time. Finally, an "evolutionary approach" to security system design has proven to be most effective. This approach involves users in rapid prototyping of solutions, which are designed with increased functionality in each phase of implementation. Prototyping systems in the field enhances the development team's understanding of operational requirements and allows potential users to provide valuable input prior to final deployment.

The importance of collaboration throughout security system planning, development, and deployment cannot be overemphasized. The intricacies of transportation systems and their security challenges requires that stakeholders be involved early and consistently to ensure buy-in and successful implementation of effective security solutions.