Airport Passenger Screening: Background and Issues for Congress

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Summary

Over the next several years, the Transportation Security Administration (TSA) will likely face continuing challenges to address projected growth in passenger airline travel while maintaining and improving upon the efficiency and effectiveness of passenger screening operations. New initiatives to expand the role of TSA personnel beyond screening operations, as well as initiatives to improve screening efficiency and effectiveness through the deployment of new technologies, will likely require additional investment. In addition to annual appropriations of $250 million in FY2008 and FY2009, a portion of the $1 billion identified for aviation security in the stimulus measure (P.L. 111-5) has been designated for acquiring and deploying technologies to screen passengers for explosives.

However, policymakers and aviation security planners have not yet agreed upon a well-defined strategy and plan for evolving airline passenger and baggage screening functions to incorporate new technologies, capabilities, and procedures to more effectively and efficiently detect potential threats to aviation security.

Ongoing challenges to maintaining and improving upon screening functions include: addressing the potential impacts of projected airline passenger traffic growth on screening operations; optimizing screening efficiency and minimizing passenger wait times; addressing potential airport space constraints for screening checkpoints and equipment; improving the capability to detect explosives at passenger checkpoints; optimizing inline explosives detection systems for checked baggage; developing strategic plans for addressing screening technology and human factors needs; and defining the funding requirements to implement these strategic plans.

A number of initiatives related to passenger and baggage screening are currently being evaluated by the TSA. These include tests of new passenger checkpoint layouts and field testing of next-generation checkpoint technologies for detecting explosives, including explosives chemical trace detection devices, whole body imaging systems, and advanced technology (AT) X-ray capabilities.

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Historically, airline passenger screening functions have focused on checkpoint screening using magnetometers to detect metallic weapons on passengers and X-ray systems to examine carry-on items. These methods have changed little since they were first implemented at commercial airports in the United States during the early 1970s. Recently, however, new initiatives to expand the role of TSA personnel beyond traditional physical screening of passengers and their belongings, as well as initiatives to improve screening efficiency and effectiveness through the deployment of new technologies, have been implemented and are being tested. These changes are coming about largely in response to recommendations and statutory requirements to address threats posed by explosives carried by passengers or in their carry-on items.

Addressing the identified need to effectively detect explosives on passengers and in carry-on items will likely require considerable investment and resources. However, policymakers and aviation security planners have not yet agreed upon a clear strategy and well-defined plan for evolving airline passenger screening functions to incorporate new technologies, capabilities, and procedures to more effectively and efficiently detect explosives, weapons, and other threat objects as well as individuals who may pose a threat to aviation security.

Over the next several years, the TSA will likely face continuing challenges to address projected growth in passenger airline travel while maintaining and improving upon the efficiency and effectiveness of passenger and baggage screening operations. Addressing these challenges raises a number of significant policy issues related to allocating resources and funding passenger screening initiatives, adequately addressing human performance issues in the design of future passenger screening systems, and developing effective strategies for deploying next generation screening technologies.

Policy Issues for Airport Passenger Screening

The TSA faces a number of ongoing challenges to maintain and improve upon the effectiveness and efficiency of passenger screening functions. These challenges include:

- Addressing projected airline passenger traffic growth and its potential impacts on screening operations;

- Optimizing screening efficiency and throughput and minimizing passenger wait times;

- Identifying and addressing potential airport space constraints for screening checkpoints and equipment;

- Improving the capability to detect explosives at passenger checkpoints as recommended by the 9/11 Commission and called for in legislation;

- Developing strategic plans for addressing identified technology and human factors needs related to passenger screening; and

- Defining funding requirements to implement these strategic plans.

There are numerous policy issues regarding the strategies and approaches for addressing these ongoing challenges. Some of the key issues are briefly discussed below.

Airline Passenger Traffic Growth

Currently, across the United States and its territories, passenger screening is conducted at about 450 airports. In total, there are more than 750 screening checkpoints and slightly more than 2,000 screening lanes at the nation's commercial airports.[1] The Federal Aviation Administration (FAA) projects that domestic passenger traffic will increase at an average annual rate of about 3% from 2010 through 2020 and international passenger traffic will increase at a rate of approximately 4.5% per year.[2] Based on these projections, passenger volume at screening checkpoints is expected to increase by more than 25% over the next eight years, although a prolonged economic slowdown could moderate the pace of this growth to some degree.

In 2006, the TSA reported that it had screened over 700 million passengers and other individuals accessing the secured areas of airports in the United States. If airline passenger traffic grows as predicted, then the TSA will likely be screening over one billion people annually by 2024, or perhaps sooner if initiatives to conduct random and targeted screening of airport employees, currently being conducted under trial programs at selected airports, are expanded across the entire aviation system. Significant resources will likely be needed to address future screening needs to accommodate this growth without causing an operational impact on screening efficiency and effectiveness.

Screening Efficiency and Passenger Wait Times

With respect to screening efficiency, the TSA has set an objective of keeping average passenger wait times to ten minutes or less ever since its inception in 2002. While the average wait times aggregated across the entire aviation system have generally met this objective, wait times at larger airports, particularly the busiest airports, often exceed ten minutes.[3] Passengers frequently experience long waits in screening checkpoint queues, particularly during peak periods at the nation's busiest airports.

At many larger airports, space constraints and other design considerations have limited the TSA's ability to add additional screening lanes and reconfigure checkpoints to improve the flow of passengers. This has resulted in lengthy wait times during peak periods, sometimes exceeding 40 minutes, at many of the nation's largest airports.

Wait times are not just a problem at large airports, as smaller regional airports may also face challenges with large seasonal fluctuations in passenger volume coupled with screening lane and workforce constraints that may limit the ability to respond to spikes in passenger traffic. Therefore, in addition to accommodating projected future growth in passenger volumes, the TSA faces ongoing challenges at various airports to improve upon the overall efficiency of passenger screening operations and meet stated wait time objectives without sacrificing performance.

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[1] United States Government Accountability Office. Aviation Security: TSA's Staffing Allocation Model Is Useful for Allocating Staff among Airports, but Its Assumptions Should Be Systematically Reassessed, GAO-07-299 (February 2007).

[2] Federal Aviation Administration, FAA Aerospace Forecast: Fiscal Years 2009-2025.

[3] United States Government Accountability Office. Aviation Security: TSA's Staffing Allocation Model.

Space Constraints at Airports

Space constraints within airports are likely to become an increasing concern for the TSA as it seeks to increase the number of screening lanes to meet projected growth in the number of airline passengers. These constraints are also likely to become an increasingly important issue as the TSA is seeking to reconfigure checkpoints over the next several years to accommodate new screening technologies. The TSA is also seeking to expand the footprint of the screening checkpoint queue and screening lanes to provide a more relaxed atmosphere for travelers and provide behavioral detection officers (BDOs) with additional space to mingle and interact with passengers in an effort to improve the detection of suspicious behavior and possible hostile intent. These factors may combine to result in a considerably larger footprint for screening checkpoints compared to current configurations, particularly at older airports constructed when passenger volume was considerably less and the footprint of screening checkpoints was quite small.

Optimizing the layout of screening checkpoints at these airports may require a considerable investment in redesigning and expanding airport facilities to accommodate proposed future changes to screening checkpoints that are intended to optimize efficiency and performance across the entire network of commercial airports.[4] Particular challenges may be encountered at smaller regional airports that have limited capability and access to resources to expand, as well as at large airports with older terminals that were not initially designed with these new security challenges in mind.

Improving Explosives Detection at Passenger Checkpoints

The 9/11 Commission recommended that the TSA give priority attention to implementing technology and procedures for screening passengers for explosives, something not currently done routinely at screening checkpoints. Provisions to improve checkpoint technologies to detect explosives were included in the Intelligence Reform and Terrorism Prevention Act of 2004 (P.L. 108-458, hereafter the "Terrorism Prevention Act").

To address the issue of detecting explosives carried by passengers, the TSA tested walk-through trace detection portals, known as explosives trace portals (ETPs), and has implemented procedures for conducting pat-down searches of passengers for explosives. Full deployment of the walk-through trace detection portals, or puffer machines, for use in secondary screening of selected passengers had been part of the TSA's strategy for screening passengers for explosives, but this initiative has been put on hold due to maintenance issues with deployed systems. The effectiveness of the strategy has also been brought into question by the foiled plot to bomb U.S.-bound airliners using liquid explosives uncovered in August 2006. The TSA is working to identify strategies and technologies that more completely address the explosives threat posed by passengers and carry-on items.

In addition to keeping up with increased volumes of people passing through airport screening checkpoints and improving upon screening efficiency, the TSA faces significant challenges in

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[4] The term "optimize" is used extensively throughout this report. The term is broadly defined as improving or developing as far as possible some measurable aspect of system performance or efficiency through the application of new technologies, policies, procedures, and systems engineering principles. It should be noted, however, that there are often inherent tradeoffs among certain measurable aspects of a system's performance. For example, given current technological capabilities, there are often tradeoffs between system efficiency and system detection capability.

addressing 9/11 Commission recommendations and statutory mandates to improve the ability to detect explosives and bomb-making components carried on passengers and in carry-on items. There are lingering concerns that, without a significant investment to improve the detection of concealed explosives and non-metallic weapons at passenger checkpoints, considerable vulnerabilities will persist. The TSA is pursuing a wide variety of technologies to address the challenge of detecting explosives at passenger screening checkpoints. These technologies include walkthrough explosive trace detection portals, whole body imaging (WBI) systems, bottle liquid scanners, cast and prosthesis scanners, shoe scanners, advanced technology (AT) X-ray systems, and explosives detection systems (EDS) tailored for carry-on screening applications. These various technologies will complement, and in some cases replace, existing checkpoint tools such as magnetometers, hand wands, and explosives trace detection (ETD) equipment.

Under the TSA's current budget plans, in the near term, deployment of this technology will be concentrated at the nation's largest airports and will often be limited to use on those passengers selected for secondary screening or to resolve alarms set off during primary screening. Full scale deployment of technologies to screen all passengers and carry-on items for explosives and other concealed items will involve a considerably larger investment over the long term. However, a specific long term investment and technology deployment strategy has not yet been agreed upon. While these various technologies have reached a level of maturity where they can be operationally deployed, achieving an end state in which all passengers are screened unobtrusively to detect a broad range of threat objects raises a number of policy issues related to the privacy of passengers as well as a long term investment strategy for implementing future checkpoint concepts.

Strategic Planning for Addressing Technology and Human Factors Needs

The challenges to improving screening capabilities stem from the 9/11 Commission's recommendations to improve the detection of explosives on passengers and address human factors considerations related to screener performance.[5] Four years after these recommendations were issued, the Government Accountability Office (GAO) reported that only limited progress had been made in fielding explosives detection technologies at passenger checkpoints, and the TSA lacks a strategic plan for the acquisition and deployment of screening technologies.[6] Moreover, covert testing at passenger checkpoints continues to provide evidence that, despite the considerable federal spending on airline passenger screening since the 9/11 terrorist attacks, the system remains vulnerable, particularly to the threat posed by adversaries attempting to sneak improvised explosive devices (IEDs) or components to assemble such devices through security checkpoints and onboard passenger airliners. These vulnerabilities reflect the lack of adequate technologies deployed at checkpoints capable of detecting explosives materials, as well as limitations in screener performance that is influenced by a variety of human performance factors.

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[5] National Commission on Terrorist Attacks Upon the United States. The 9/11 Commission Report, Washington, DC: July, 2004.

[6] U.S. Government Accountability Office, Transportation Security Administration Has Strengthened Planning to Guide Investments in Key Aviation and Surface Transportation Security Programs, but More Work Remains, Statement of Cathleen A. Berrick, Director, Homeland Security and Justice Issues, Before the Committee on Commerce, Science, and Transportation, U.S. Senate, May 13, 2008, GAO-08-487T.

Provisions in P.L. 110-53 (see section 1607) required the TSA to finalize a strategic plan for checkpoint explosives detection required by the Terrorism Prevention Act, and fully implement the plan within one year of enactment. The act also contained provisions (see section 1612) that eliminate the cap on the system-wide number of TSA screeners, and require specialized training for screeners on security skills such as behavioral observation and analysis, explosives detection, and document examination. The act directed the TSA to hire sufficient personnel to ensure adequate aviation security and reduce average security-related delays to less than 10 minutes. The act also created a separate "Checkpoint Security Screening Fund," specifying that $250 million of the security fees collected during FY2008 were to be deposited into this fund (see section 1601), and made available for research, development, deployment, and installation of equipment to improve the detection of explosives at passenger checkpoints. The act also directed the TSA to carry out a pilot study to examine technologies to improve the security at access control doors and exit lanes for airport secured areas (see section 1613).

Projected Costs and Funding Issues

The Implementing Recommendations of the 9/11 Commission Act (P.L. 110-53) included a provision establishing an Airport Checkpoint Screening Fund. The fund provided $250 million in passenger security fees for the acquisition and deployment of technologies to improve the detection of explosives at passenger screening checkpoints in FY2008. The FY2009 Department of Homeland Security Appropriations Act (P.L. 110-329) provides $250 million for Checkpoint Support, thus maintaining funding for checkpoint technologies, supplies, and equipment at the level provided under the Airport Checkpoint Screening Fund in FY2008.

In addition to these appropriations, the American Recovery and Reinvestment Act of 2009 (P.L. 111-5) specifies an additional $1 billion for aviation security, designated for the procurement and installation of checkpoint explosives detection equipment and checked baggage explosives detection systems. This additional funding is expected to accelerate the deployment of checkpoint explosives detection technologies over the next two years. Conference report language (see H.Rept. 111-16) specifies that projects should be prioritized based on security risks.

Deploying new technologies and reconfiguring screening lanes to incorporate these technologies and optimize performance and efficiency will likely cost more than $500,000 per screening lane based on TSA average unit costs for candidate technologies.[7] This cost only considers the direct costs for screening lane technology acquisition and installation, and does not include any costs associated with expanding or reconfiguring airport terminals to accommodate new checkpoint designs. Given that there are more than 2,000 screening lanes in operation throughout the United States, the total cost to upgrade screening checkpoints is likely to exceed one billion dollars in equipment costs alone.

Additionally, the costs to operate and maintain this screening equipment is likely to cost tens of thousands of dollars each year per screening lane. Based on these rough estimates, it is apparent that current funding levels for Checkpoint Support will not support a full-scale, near-term deployment of emerging passenger checkpoint technologies. Congress may consider various funding options to expand or accelerate the deployment of these checkpoint technologies. If such

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[7] CRS estimates based on unit costs provided in DHS TSA FY2009 congressional budget justification documents.

options are not pursued, it will likely take ten years or more to achieve full system-wide deployment.

At present, the TSA has adopted a strategy of focusing its efforts to deploy new checkpoint screening technologies on larger airports. However, since the aviation screening system in the United States operates using a single gateway concept, meaning that passengers are only screened once at their originating airport, focusing investments solely on larger airports could result in persisting vulnerabilities at smaller regional airports. These vulnerabilities may further persist without a strategy and commitment to future funding for system-wide deployment of advanced technology systems for detecting explosives and nonmetallic threat items at checkpoints.

Checkpoint Screening Human Performance

The aviation security system is a human system involving extensive reliance on human perception, performance, decision making, and judgment. This is particularly true with regard to checkpoint screening functions where passenger and carry-on screening involve human resource intensive activities to detect and resolve potential threat items. An underlying challenge related to proposed checkpoint expansion and enhancements is addressing ongoing human performance concerns to improve the detection of dangerous items at checkpoints and incorporate human factors considerations in the design and operator training for next generation checkpoint technologies and procedures.

Screener performance is a continuing concern as covert testing results have repeatedly demonstrated existing weaknesses in screening procedures and capabilities that could potentially be exploited by terrorists or criminals seeking to attack the aviation system. These weaknesses may reflect a combination of policies, procedures, technology capabilities, and screener human performance, although weakness in screener human performance has been emphasized as a particular concern which can be affected by various factors. A wide range of human factors considerations pertaining to screening procedures, training, fatigue and alertness, human perception and detection capabilities, and judgment and decision making can have a significant effect on the overall effectiveness of passenger checkpoint screening as well as baggage screening operations.

Passenger checkpoint screening activities at all passenger airports are carried out by about 30,000 screeners who make up about 60-65% of the total TSA screener workforce. The humans that operate the system, particularly the screening workforce, have long been regarded as a potentially highly fallible and vulnerable element of the aviation screening system. This should not be construed as a reflection on the dedication and commitment of individual screeners to performing this critical job function. Rather it reflects a combination of the complex challenges faced by screeners, limitations in human perception and performance, resourceful adversaries who may employ artful concealment methods, and competing job pressures to accurately detect threat objects while maintaining an efficient flow of passengers through security checkpoints. Adversaries seeking to carry out hijackings or bombings by carrying explosive devices, bomb making components, or handheld weapons through screening checkpoints may attempt to exploit various limitations on human perception and performance that may compromise security. A variety of factors may contribute to these human performance limitations, including inadequate training, lack of motivation and job satisfaction, fatigue, and workplace conditions, as well as general human perception and performance limitations.

Potential Impacts of Respecting Privacy on Screening Performance

Balancing individuals' rights and expectations of privacy with screening effectiveness is a human performance challenge. Criminals and terrorists have been known to conceal items in private areas of the body, especially in the small of the back above the buttocks and high on the thigh. Screeners are to carefully inspect these areas during pat downs to adequately check for dangerous items. Also, underwire bras can set off magnetometers, and bras have been used to conceal dangerous items. One of the most intrusive and most controversial aspects of secondary screening is the use of pat-down inspections to check selected passengers or to resolve magnetometer alarms. Specific complaints over pat-down techniques have centered on allegations of inappropriate touching and unprofessional or rude conduct by screeners. More general complaints have focused on privacy concerns and perceptions that the pat-down procedures were intrusive and humiliating.[8]

A 2005, DHS OIG investigation and audit of pat-down screening procedures found that the TSA adequately advised passengers of their rights under the pat-down procedures, and appropriately accommodated those rights.[9] The DHS OIG also found that TSA screeners were adequately trained in pat down inspection procedures and, based on TSA records, additional screening procedures were performed on proportionate numbers of male and female passengers. Finally, the DHS OIG found that the TSA had implemented procedures to investigate and resolve passenger complaints regarding the screening process.

The TSA maintains a screening Performance Management Information System (PMIS) where recorded complaints are logged. Operations research analysis teams and federal security directors review complaints logged in the database to track trends and identify areas of concern and take appropriate actions, including possible disciplinary actions, to resolve specific issues. Complaints involving allegations of discrimination based on color, race, gender, religion, or national or ethnic origin are forwarded to the TSA's Office of Civil Rights for further investigation. Despite considerable concern raised by some regarding inappropriate behavior during pat-down screening procedures, the DHS OIG found no systematic problems with the technique.

Nonetheless, privacy groups, such as the American Civil Liberties Union (ALCU), continue to express concern over potential intrusion on individual rights and alleged cases of sexual harassment and abuse of passengers, particularly female passengers, by TSA screeners.[10] These concerns, however, raise a significant challenge for the TSA: to maintain high levels of security, which necessitate resolving all alarms and screening in detail those passengers ascertained to pose an elevated security risk, while maintaining the privacy rights and dignity of passengers identified for these secondary screening measures. The principal option under consideration for addressing these concerns is the use of whole body imaging technologies, discussed below. While these technologies offer a potential alternative to pat-down screening techniques, they too, raise privacy concerns because the images generated by these systems can reveal private areas, physical

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[8] Department of Homeland Security, Office of Inspector General, Review and Audit of the Transportation Security Administration's Use of Pat-Downs in Screening Procedures (REDACTED), November 2005, OIG-06-10.

[9] Ibid.

[10] American Civil Liberties Union, TSA Pat-down Search Abuse, December 21, 2004, New York, NY.

characteristics that individuals may wish to keep private, as well as prosthetics and other assistive medical devices.

In the fast-paced environment of the passenger checkpoint, pat-down searches may be rushed and certain areas may be overlooked. The difficulty in detecting threat items on passengers is compounded by the requirements to respect the privacy of individuals discussed above, as well as social and cultural norms and individual differences regarding interpersonal contact and expectations of privacy and modesty. Some have also noted cultural sensitivities toward handicapped and disabled individuals and point out that screeners are sometimes hesitant to perform intrusive searches, particularly on individuals wearing various prosthetics.[11] Terrorists and criminals can and have exploited these aspects of individual privacy by concealing prohibited items in body cavities and near private areas of their bodies, and could also exploit a screener's reluctance to perform thorough searches of prosthetic devices. Covert testers also use these methods to conceal simulated threat items in an effort to test screeners' abilities to detect items under real-world conditions and identify vulnerabilities in checkpoint screening that can potentially be reduced through procedural modifications and/or changes to screener training. These covert tests have revealed weaknesses in screener performance to detect weapons, simulated explosives, and components of explosive devices.

Covert Testing

Much of the concern over the performance of airport screening operations has arisen from information that has been made public regarding the results of covert testing operations. Covert testing using rudimentary mock bombs and guns started soon after screening checkpoints were first established in the early 1970s. Following the bombing of Pan Am flight 103 in December 1988, the FAA began more sophisticated "red team" tests to identify weaknesses in screening performance and other aspects of aviation security. The term red team harkens back to the Cold War era military exercises where red teams – so designated in reference to the Soviet Union's red flag and the association of red with communist groups – adopted strategies and tactics of an enemy force in simulations and war games.

The use of aviation security red team testing was suspended for a period of time following the 9/11 attacks, largely over concerns that red team practices could potentially put testers in danger or cause significant panic among passengers because of the acute focus on aviation security and the lingering public fear following the attacks. In 2003, the TSA's Office of Internal Affairs and Program Review (OIAPR) resumed covert testing of passenger screening checkpoints, checked baggage screening operations, and airport access control measures. At present, this function falls under the responsibility of the TSA's Office of Investigations (TSA-OI). In addition to nationwide covert testing conducted by the TSA-OI, Federal Security Directors (FSDs) at each airport are to perform local covert testing. The local testing was initially called the Screener Training Exercises and Assessments (STEA), but is now known as the Aviation Screening Assessment Program (ASAP) and has been revamped to better reflect the types of threat objects that may be used by terrorists based on the latest intelligence and threat information.

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[11] Jeanne Meserve and Mike M. Ahlers. "TSA Tester Slips Mock Bomb Past Airport Security." Cable News Network (CNN), January 28, 2008.

While specific performance metrics for covert testing are considered security sensitive, various media reports of test results suggest that failure rates are often quite high, particularly with respect to screeners missing simulated improvised explosive devices and explosive components. For example, it has been reported that during tests conducted in 2006, TSA screeners missed fake bombs 75% of the time at Los Angeles International Airport (LAX), and 60% of the time at Chicago O'Hare Airport (ORD).[12] The TSA contends that the results, on the surface, appear discouraging, but are a reflection of highly sophisticated concealment methods being used by testers to uncover specific system vulnerabilities so that corrective action can be taken.

According to the TSA "... as security officers adapt and begin to consistently discover covert testing methods, testers start all over again, creating more difficult and harder-to-detect tests. This years' long game of cat and mouse more closely simulates real terrorist probing and operations and keeps officers alert and informed of the latest techniques and improvements."[13] The TSA points out that this type of testing is fundamentally different from the static, unchanging performance evaluations that were employed prior to the 9/11 attacks. Since the present day test protocols are constantly changing, the TSA has primarily used them to provide a snapshot of specific vulnerabilities in the system. It has not systematically assessed whether screener performance is improving or getting worse over time, although it asserts that improvements have been made. According to the TSA, the covert testing methods are primarily used as a tool for assessing and identifying areas where performance improvements are needed and are potentially achievable through additional training, operational emphasis, or procedural redesign.

The TSA plans to complete more than 2,500 covert tests of passenger screening checkpoints annually during FY2008 and FY2009 in an effort to continually identify vulnerabilities and take corrective action to improve checkpoint screening based on the latest intelligence and information regarding terrorist weapons and explosives that pose a threat to commercial aviation and methods for concealing these threat objects.[14] While specific test results are considered security sensitive information, it has been reported that current failure rates are comparable to those observed in 1987 when screeners failed to detect about 20 percent of concealed items during on-the-job performance testing.[15] However, the TSA asserts that the testing methods used at that time was in no way comparable to current covert testing methods.

Concerns over advance warning given prior to covert testing and screener performance evaluations has been a longstanding issue. While media reports have suggested that some recent TSA covert tests were leaked to screeners, the TSA maintains that its procedures are designed to minimize the likelihood that screeners will be tipped off regarding a covert test operation, while providing appropriate notification to TSA airport level management and local law enforcement to ensure that the tests are conducted safely. Nonetheless, cases of screeners being tipped off regarding covert testing have been documented. For example, in 2004, the DHS IG found that screeners at the Jackson-Evers International Airport in Mississippi had been given information regarding upcoming covert tests, including details about the gender and race of the testers, the type of test items being used, and the location of test items on the tester and in carry-on and

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[12] Ibid.

[13] Transportation Security Administration, Covert Testing: Why is Covert Testing Important?

[14] Transportation Security Administration, Fiscal Year 2009 Congressional Justification, Transportation Security Support.

[15] Sara Kehaulani Goo. "Airport Screeners Do Poorly, Panel Told." The Washington Post, April 23, 2004, p. A8.

checked baggage.[16] Also, it was revealed that in April 2006, TSA headquarters staff used an internal electronic communications system to provide field level personnel with heads up information regarding possible covert testing operations, providing details regarding testing methods.[17] The TSA responded that it was investigating the allegations, but preliminary findings indicated that the internal communication regarding the testing was considered suspicious by a headquarters official who decided to forward it to federal security directors at airports across the country, but the email was recalled 13 minutes after it was sent. Based on these findings, the TSA concluded that the dissemination of information regarding the upcoming covert test did not appear to be a deliberate attempt to tip off screeners or screening supervisors. Former TSA Administrator Kip Hawley testified that there was nothing to indicate that anyone within the TSA attempted to tip off airport security screeners regarding covert testing in this incident.[18]

In addition to concerns over possible advance warning of covert tests, concerns have also been raised that the TSA does not have adequate processes in place to systematically document causes of covert testing failures and carry out appropriate remedial action. A GAO audit of TSA's covert testing programs, including covert testing of passenger screening, baggage screening, and airport access control systems, found that the TSA-OI has failed to systematically record, document, and inform management of causes for test failures as would be expected if federal government standards for internal control were fully implemented.[19] The GAO further noted that the TSA lacks a systematic process to ensure that recommendations by TSA-OI are fully considered, and management decisions for adopting or rejecting these recommendations are appropriately documented.

While the TSA-OI made numerous recommendations to the TSA's Office of Security Operations during the period reviewed (March 2003-June 2007), the GAO found that often, in more than 40% (18 out of 43) of cases, TSA management either took no action or it was unclear how the action taken addressed the recommendation. The lack of a formal process made it difficult to assess how the recommendations related to covert testing results, and in turn, how actions taken remedied problems identified by the TSA-OI. The GAO concluded that without such a process, the TSA's ability to strengthen aviation security based on the findings and recommendations of covert testers is limited, and it recommended that the TSA establish a system for documenting the results and recommendations stemming from covert testing and to track actions taken in response to these recommendations.

In addition to the internal covert testing by the TSA's Office of Inspections, both the Department of Homeland Security Office of Inspector General and the GAO independently conduct periodic audits and inspections of TSA screening functions that often include covert testing methods. While many of the details of these audits are considered security sensitive, the results of these tests have provided Congress and observers with important insights regarding the persisting vulnerabilities at airport passenger screening checkpoints.

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[16] Department of Homeland Security, Office of Inspector General. Letter Report: TSA's Management of Aviation Security Activities at the Jackson-Evers International Airport, August 2007, OIG-07-73.

[17] Honorable Bennie G. Thompson, Chairman, Homeland Security Committee, U.S. House of Representatives, "Cover Blown: Did TSA Tip Off Airport Screeners about Covert Testing." Statement Released November 14, 2007.

[18] "TSA: Airport Screeners Weren't Tipped Off," Air Safety Week, November 19, 2007.

[19] United States Government Accountability Office. Transportation Security: TSA Has Developed a Risk-Based Covert Testing Program, but Could Better Mitigate Aviation Security Vulnerabilities Identified Through Covert Tests, August 2008, GAO-08-958.

Most notably, in a series of covert tests conducted in 2007, GAO investigators demonstrated that, even when proper procedures were followed, checkpoint screening often failed to detect concealed explosives and components that could be used to construct an explosive device potentially capable of downing an airliner.[20] For these tests, the investigators constructed two improvised devices: an improvised explosive device (IED), consisting of a liquid explosive that would be triggered by a low-yield detonator (i.e., a blasting cap); and an improvised incendiary device (IID), constructed from commonly available products including a liquid component. The investigators obtained the materials to construct these devices at local stores and over the Internet, spending less that $150. The investigators then employed various methods to conceal these items on their persons and in carry-on baggage, demonstrating that it is possible to pass either a constructed device or the components to build an IED or an IID through airport screening checkpoints without detection. In all cases, screeners failed to detect or prohibit the carriage of IED and IID components, including liquid components.

The GAO noted that the specific security weaknesses exploited in these covert tests, which were not divulged for security reasons, were identified by reviewing publicly available information, including information often shared through the Internet and readily available to terrorist groups. By exploiting these weaknesses, the investigators were able to pass these components, including banned liquid items, through various security checkpoints. While the investigators were subjected to secondary screening for unrelated reasons in some instances, pat-down searches and other secondary screening methods failed to detect the improvised explosives or prohibited items. In other instances, screeners challenged the investigators for failing to fully comply with various procedures, including procedures regarding permissible quantities and packaging of liquids.

The GAO concluded that its "tests clearly demonstrate that a terrorist group, using publicly available information and few resources, could cause severe damage to an airplane and threaten the safety of passengers by bringing prohibited IED and IID components through security checkpoints."[21] In reviewing these results, the TSA has acknowledged checkpoint vulnerabilities related to human performance, screening procedures, and checkpoint technologies. The GAO asserted that improvements in these areas may further reduce the risks to commercial aviation posed by IEDs and IIDs.

While the GAO's specific recommendations focusing on ways to improve screener detection of threat objects made to the TSA were not publicly divulged, the GAO also urged the TSA to take the following actions to enhance checkpoint screening operations:

- Establish dedicated airport screening lanes to handle those passengers posing an elevated risk and for those passengers with special needs;

- Introduce more aggressive, visible, and unpredictable checkpoint procedures, such as random pat-down and hand-wand screening; and

- Continue to develop new technology at checkpoints to better detect concealed items.

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[20] United States Government Accountability Office. Statement of Gregory D. Kutz, Managing Director, Forensic Audits and Special Investigations, and John W. Cooney, Assistant Director, Forensic Audits and Special Investigations. Aviation Security: Vulnerabilities Exposed Through Covert Testing of TSA's Passenger Screening Process. Testimony Before the Committee on Oversight and Government Reform, House of Representatives, November 15, 2007.

[21] Ibid., p. 10.

These recommendations for action reflect a continuing concern that, despite considerable investment in checkpoint screening technologies and personnel since the terrorist attacks of September 11, 2001, significant vulnerabilities persist in checkpoint screening operations. In testimony before the House Committee on Homeland Security on November 14, 2007, former DHS Inspector General Clark Kent Ervin stated that "[t]he sad fact is that for all the dollars and attention that has been focused on screener performance since 9/11, study after study ... shows that it is just as easy today to sneak these deadly weapons past screeners [as] it was on 9/11."[22]

While Ervin's conclusions have been somewhat controversial and widely disputed by the DHS and the TSA, his general recommendations parallel various initiatives put forward by Congress and the Bush Administration to improve screener performance. Specifically, Ervin recommended extensive training and frequent retraining of screeners under simulated real-world conditions; remedial action for screeners and supervisors that fail performance tests and termination of those employees that habitually perform on a sub-par level; and systemwide deployment of next generation screening technologies, such as whole body imaging and advanced X-ray systems. These recommendations reflect specific needs for improvements in human factors and training for screening personnel as well as investment in screening technologies. The TSA is actively pursuing an approach to address checkpoint screening technology and human factors through its recently launched checkpoint evolution initiative.

Threat Image Projection

In addition to covert testing, which tests screener performance in detecting concealed threat items on passengers and in carry-on items under operational conditions, the performance of screeners that inspect X-ray images of carry-on items is routinely monitored and evaluated using a technology called Threat Image Projection (TIP). This technology provides the capability to overlay virtual, computer-generated, threat objects over X-ray images of passenger's screened property during normal screening operations or to present virtual images of baggage containing concealed threat items. TIP was first fielded by the FAA in 1999.

Following the terrorist attacks of September 11, 2001, TIP was discontinued as an operational performance tool over concerns that screener responses to TIP images would increase delays amidst the heightened focus on aviation security threats. However, viewing the technique as a valuable operational testing and performance tool, the TSA reintroduced TIP in 2003 using a greatly expanded database of threat images said to be more representative of weapons and concealment tactics that may be used by terrorists. In comparison to the FAA TIP system prior to the 9/11 attacks which had about 200 images in its database, the TIP system in use by the TSA today has over 2,000 images,[23] with new images constantly being added based on identified threats and concealment methods identified through intelligence and field operations. Fielded X-ray equipment in use at screening checkpoints is TIP-ready. That is, these machines are designed to store and display TIP database images, and are therefore referred to as TIP-Ready X-ray or TRX equipment. These systems are networked, and linked into TSA laboratories that create and distribute new TIP imagery periodically based on intelligence regarding new threat items and concealment methods.

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[22] Statement of Clark Kent Ervin Before the Committee on Homeland Security, House of Representatives, Cover Blown: Did TSA Tip Off Airport Screeners About Covert Testing?, November 14, 2007.

[23] Transportation Security Administration, Aviation Security System of Systems: THEN and NOW.

On TRX equipment, images of weapons and explosives are projected on the X-ray images of actual bags being screened. This is done for several purposes. First, by providing periodic threat images to the screeners, the system promotes alertness and acts as a mitigation for boredom and complacency, two factors that can have a significant negative impact on human performance. Second, the ability to collect data regarding screening performance and screener sensitivity in real-world settings serves as an invaluable tool for human factors researchers studying screener performance. For example, these researchers can look at performance as a function of time of day and time on shift, to optimize the scheduling of shifts and breaks for screeners. Researchers can also use the TIP data to identify particular threat items or methods of concealment that are often missed, and in response can tailor recurrent screener training and re-qualification to emphasize and correct specific weaknesses, either on a systemwide, an airport-by-airport, or even on an individual screener level. Third, TIP provides a quantifiable means to evaluate the performance of screeners at individual, work group, airport, or systemwide levels of analysis. As such, it can be used to track progress over time and can be used to document deficient levels of individual performance that establish grounds for dismissal. TIP has been one of the most significant technology changes to carry-on screening since X-ray screening techniques were first implemented in the early 1970s, and directly addresses human performance aspects of checkpoint screening functions.

However, TIP is limited in its scope and provides data on only one aspect of screening operations: screener preliminary threat identification of X-ray images. TIP does not provide data on whether proper procedures were carried out once a threat object was suspected and flagged by the X-ray screener, whether explosive trace detection (ETD) systems were properly used to conduct secondary evaluations of suspected explosives, and so on. Also, TIP does not provide any data on the screening of passengers themselves or their checked baggage; it only provides data on the screening of carry-on baggage. Nonetheless, TIP is widely regarded as an important screener evaluation tool, and it will likely remain an integral part of advanced technology (AT) X-ray equipment deployment in the future.

X-Ray Imagery and Carry-On Baggage Screening Performance

Current generation X-ray systems provide significantly higher resolution than systems that were deployed at airports in the 1990s and prior. However, these systems only provide a single view angle, typically an overhead view, of screened items. Nonetheless, in addition to increased image resolution, image coloration and other image enhancement features allow screeners to more easily differentiate organic and metallic materials and provide the capability to use color contrast to better differentiate certain elements of the X-ray image. For example, the coloration allows organic materials to stand out from inorganic materials making it easier to detect dense organic matter that may be indicative of an IED, and provides differential coloration of metals to allow for easier detection of metallic weapons.

In addition to selective coloration, newer X-ray systems allow for a wide array of image enhancement functions to highlight or turn off and declutter certain features in a process known as image "stripping." However, some research has shown that individual image enhancements do not necessarily improve IED detection compared to viewing of the original X-ray image,

suggesting that the greatest advantage derived from current single-view X-ray systems may be their improved image resolution.[24] Nonetheless, viewing multiple image enhancements in combination – such as stripping out organic items or metallic items, or displaying a negative image – can potentially help resolve image ambiguities and possibly improve detection. While currently deployed X-ray systems have these capabilities, time pressures at busy screening checkpoints may often preclude detailed examination using various combinations of these image enhancement capabilities.

Object orientation in the X-ray view is often a key determinant to whether an object will be recognized or detected. Prohibited items, such as guns and knives, presented at odd viewing angles can often be missed, even by highly trained screeners. At present, the main tool to address detection performance of objects presented at difficult-to-recognize view angles is through the use of computer-based training using TIP imagery of threat items presented at various view angles. Since threat object recognition and detection is a skill that is likely to continually improve with experience and exposure to both TIP imagery and artfully concealed real-world threat items, retention of high-performing experienced X-ray screeners is likely to remain a key component of maintaining high levels of screening performance.

Research has also shown that pre-employment screening to assess aptitude for interpreting X-ray images, recognizing objects and detecting prohibited items can substantially increase X-ray screening performance.[25] Thus, with regard to establishing and maintaining effective X-ray image screening performance, it appears that a specific emphasis should be placed on screener selection and training, as well as initiatives to retain high-performing X-ray image screening personnel. Besides improvements in screener selection and training in methods of performing pat-down searches and interpreting X-ray images, addressing additional human factors issues related to the screener work setting – including fatigue, motivational factors, and environmental considerations, such as lighting, noise, and operations tempo – may also yield improvements in the ability to detect threat items and individuals with hostile intent.

With regard to advancements in screening technology, next generation advanced technology (AT) X-ray systems are capable of providing multiple image views, usually two views that provide both a overhead view and a profile view of the X-rayed item. Some of these systems also incorporate computer image interpretation algorithms that automatically search for, and either highlight or alert the operator to, suspected threat items such as explosives and weapons. These features, however, can often be viewed negatively by operators and can slow the screening process if they generate high numbers of false alarms or false positives. The specific performance characteristics of AT X-ray systems being acquired and deployed by the TSA, including information about their false alarm rates, is not publicly available, but remain important considerations in the selection of systems and system features for operational deployment. Policy considerations regarding the acquisition and deployment of AT X-ray systems are further discussed in the section on "Next Generation Checkpoint Technologies."

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[24] Adrian Schwaninger, "X-ray Imagery: Enhancing the Value of the Pixels," Aviation Security International, October 2005, pp. 16-21.

[25] Ibid.

Passenger Checkpoint Efficiency

While the ability to detect threats is the primary metric for evaluating passenger checkpoint system performance, maintaining checkpoint efficiency has also been given a high priority. However, the well documented phenomenon of speed-accuracy trade-offs in human performance highlight the fact that increasing system throughput can lead to missed threats and a deterioration of system effectiveness. Therefore, policymakers and aviation security strategists have generally focused on striking a balance between maintaining reasonable wait times and high levels of threat detection. While research and engineering has focused on optimizing screening lane efficiency and effectiveness, longstanding wait time objectives have been set by policy, largely based on what is regarded as reasonable to expect by the traveling public.

Passenger Wait Times

It has been the Department of Transportation's and the TSA's longstanding goal that passengers should not wait, on average, more than 10 minutes to pass through an airport security checkpoint. This can be traced back to the objectives laid out for checkpoint efficiency by then Secretary of Transportation Norman Mineta in 2002 as responsibility for checkpoint screening functions was being turned over to the TSA.[26]

The challenge in determining the number of checkpoints that will meet specified wait time criteria largely derives from the variability and fluctuation in daily and hourly passenger volumes. Typically a representative busy hour is picked to model the passenger demand for screening. The TSA has identified a variety of methods for selecting the busy or peak hour to be used in modeling passenger screening demand. Data can be derived from either annual enplanement forecasts or from airline flight schedules, with adjustments made for the percentage or amount of passengers that are transferring from other flights and do not impose demand on the screening checkpoints.

The number of checkpoints required can then be estimated based on the modeled passenger demand for checkpoint screening for a representative busy hour divided by the hourly throughput achievable from a single checkpoint. For example, if the model predicted 3,000 passengers per hour, and the achievable throughput per screening lane was 300 passengers per hour (five passengers per minute), then ten screening lanes would provide an optimal number with no excessive queuing. However, this may result in excessive capacity during non-peak periods. To better balance resources with reasonable wait times, space requirements for queuing passengers awaiting to pass through screening checkpoints, known as queue length requirements, can be assessed by determining passenger average arrival rate over the selected busy hour, multiplied by the average or expected wait time, divided by the number of checkpoint lanes to process these passengers.

For example, if it were expected that 3,000 passengers would arrive during the hour, the arrival rate would be 50 passengers per minute. If the target wait time was 10 minutes, then the total queue size would be 500 passengers, and in a ten screening lane configuration, that would translate to 50 passengers in queue per lane. According to design guidelines issued by the TSA,

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[26] Remarks of Norman Y. Mineta, Secretary of Transportation, Travel and Tourism Industry Unity Dinner, March 6, 2002, Washington, DC.

space allocation for queues should provide somewhere between seven and 15 square feet per person,[27] resulting in a total square footage allocation for queuing passengers of between 3,500 and 7,500 square feet in this example.

In this manner, the TSA can determine the optimum number of screening lanes and gauge the space allocation requirements for queuing passengers to meet peak passenger demand loads. However, space constraints at airports may prevent achieving these objectives, at least without overcrowding passengers in queue which can heighten aggravation and tension making it more difficult to spot suspicious individuals, and it can also heighten security risk because these overcrowded queues could become prime targets for a shooting or bombing attack. In various locations, unique airport factors may have a notable impact on the optimum number of screening lanes as well as the configuration of those lanes. More significantly, airport space limitations and other factors limiting available resources to set up and staff screening lanes may result in less than optimal numbers of screening lanes.

Wait time objectives are a key consideration in determining the number of screening lanes and screeners needed across the nation's airports. The screening lane requirements, in turn, drive space requirements at airports for housing security checkpoints and terminal layouts to accommodate passenger screening operations. The TSA models its staffing allocation and screening lane requirements using a model that attempts to screen 85% of passengers within the 10 minute target time frame based on passenger volumes projected for each airport's peak travel month.[28] The TSA notes that on only about 7 percent of days out of the year will passenger volumes exceed these levels, resulting in expected wait times of more than 10 minutes. Predictably, many of these days occur during peak travel periods during the Thanksgiving and Christmas holiday times. While this model, which forms the basis of the TSA's staffing allocation, is designed to minimize the number of passengers experiencing waits of more than 10 minutes, in practice many more passengers experience waits of longer than 10 minutes.

At the busiest airports, designated as security category X and category I airports,[29] average wait times have consistently exceeded the 10 minute goal (See **Figure 1**). Since these larger airports account for more than three-quarters of passenger boardings, a good portion of airline travelers routinely experience wait times in excess of the 10 minute goal. While the average wait times at these large airports are a few minutes greater than the 10 minute target, lengthy wait times, sometimes exceeding 40 minutes, are not uncommon during peak travel periods at major airports. However, consistent peak period waits of more than 40 minutes are often grounds for further examination from a TSA optimization team to identify staffing, screening lane, or other resource issues that may be contributing to these long waits.[30] The GAO has recommended that the TSA establish a mechanism for periodically assessing the assumptions of its screener staffing

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[27] Transportation Security Administration. Recommended Security Guidelines for Airport Planning, Design and Construction, Revised June 15, 2006.

[28] U.S. Government Accountability Office. Aviation Security: TSA's Staffing Allocation Model Is Useful for Allocating Staff among Airports, but Its Assumptions Should Be Systematically Reassessed. February 2007, GAO-07-299.
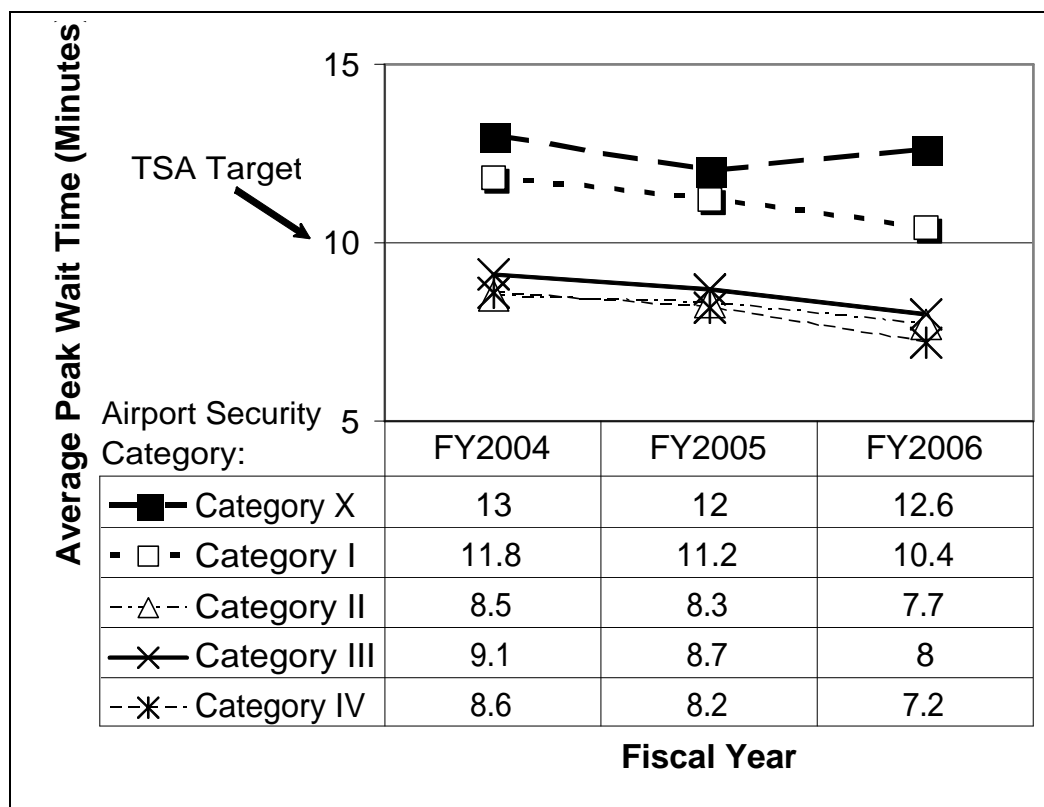
[29] Commercial passenger airports are assigned to one of five security categories (Category X, I, II, III, or IV) based on consideration of passenger volume and other risk factors. The nation's busiest airports are assigned to either Category X or Category I.

[30] U.S. Government Accountability Office. Aviation Security: TSA's Staffing Allocation Model, February 2007.

allocation models as it continues to refine and optimize screener staffing and screening lane lanes.[31]

Figure 1. Average Peak Wait Times at Screening Checkpoints
FY2004-FY2006

Airport Security Category:	FY2004	FY2005	FY2006
Category X	13	12	12.6
Category I	11.8	11.2	10.4
Category II	8.5	8.3	7.7
Category III	9.1	8.7	8
Category IV	8.6	8.2	7.2

Fiscal Year

Source: U.S. Government Accountability Office (GAO). *Aviation Security: TSA's Staffing Allocation Model Is Useful for Allocating Staff among Airports, but Its Assumptions Should Be Systematically Reassessed.* February 2007, GAO-07-299.

The Link Between Checkpoint Efficiency, Airport Terminal Design and Vulnerability Reduction

Despite various efforts to improve checkpoint efficiency and reduce passenger wait times, checkpoint lines remain vulnerable terrorist targets for bombings, shootings, or the potential release of chemical or biological agents because they often consist of large congregations of individuals in the "non-sterile" portion of the airport terminal, that is prior to screening for possible threat items. Inefficiencies at screening checkpoints that result in long screening queues and congestion in airport terminals introduce unique vulnerabilities that may be mitigated through various efforts to increase checkpoint efficiency, but may also be mitigated by specific design considerations to minimize congestion and isolate long screening queues from open, accessible areas of the airport terminal.

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[31] Ibid.

Toward this objective, airport and security checkpoint queue design considerations might consider options for better restricting access to security screening lines and better controlling access to the areas in and around checkpoint lines to address these vulnerabilities. Additional streamlining of passenger screening checkpoints may further reduce these vulnerabilities. In addition to streamlining checkpoint procedures, the TSA is examining ways to integrate next generation screening technologies as part of its new "checkpoint evolution" initiative.

Queuing Practices and Procedures

For some time, the responsibility for the passenger screening checkpoint queues has been an issue. Previously, the TSA had taken a much more limited role in controlling and monitoring the lines that formed in front of security checkpoints. Airports had the primary responsibility for controlling access to these lines, and on an airport-by-airport basis, procedures varied for queuing, including whether to set up dedicated lines for elite travelers (e.g., first and business class travelers), and for airline crews. Access controls for security screening queues was primarily a function carried out by airport contract employees serving as document checkers. More recently, the TSA has been hiring and deploying Transportation Security Officers (TSOs) to serve as document checkers, eliminating the need for airport document checkers to control access to screening lines. The TSA has adopted the title of TSOs for the TSA screener workforce to better reflect the more diversified job functions and roles of these employees, including document checking, behavioral observation, and bomb appraisal functions. In addition, the continued expansion of the Registered Traveler program, which potentially offers the opportunity for streamlined checkpoint processing for passengers who voluntarily submit background information for vetting by the TSA, is also changing the manner in which screening lines operate.

At many airports, queues to enter checkpoint screening lanes have been designed to provide "elite" flyer lanes that the airlines make available to first class, and sometimes business class travelers, as well as to their best customers who have reached certain status levels in airline frequent flyer programs.[32] While the airlines maintain that they have the right to offer elite passengers curbside-to-curbside perks, including dedicated queues to enter checkpoint screening lanes, some people have complained that security screening is paid for equally by everyone through equivalent passenger security fees and general fund contributions, and therefore, all passengers should receive equal treatment. However, the TSA contends that separating seasoned passengers familiar with screening procedures from others benefits everyone through better efficiency and resource allocation at the screening checkpoints.[33]

More recently the TSA has moved forward with a system of lane self-selection or tailored screening lanes, allowing expert travelers to select expedited lanes, while families traveling with small children and individuals needing additional assistance are funneled through screening lanes better equipped to handle these traveler's special needs. Also, the Registered Traveler (RT) program offers paying RT members who have been vetted and issued biometric identity cards either preemptive queuing or dedicated checkpoint lanes. Whether these concepts will replace or complement "elite" flyer lanes remains an issue for the TSA, airlines, and airports as they seek to determine the best model to accommodate travelers and expedite the screening process. The tailored screening lane initiative and the RT program are described in further detail below.

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[32] Sara Kehaulani Goo, "First Class Fast Lane," The Washington Post, August 2, 2005, p. D01.

[33] Ibid.

The Tailored Self-Select Screening Lane Initiative

In an effort to explore ways to make checkpoint screening queuing processes more efficient and expedient for passengers, the TSA has field tested an initiative for passengers to self-select among one of three designated screening lanes based on their knowledge and experience with TSA screening procedures and the number of carry-on items in their possession. In field tests of this concept at the Salt Lake City, Utah, airport and Denver International Airport, the TSA has adopted a skiing analogy, setting up a "Black Diamond" fast lane for expert travelers that are completely familiar with screening procedures and are traveling with a single carry-on bag. A "Blue Square" lane has been designated for frequent flyers somewhat familiar with TSA procedures, or more experienced flyers that have multiple carry-on items. Finally, a "Green Circle" lane has been established for families with small children, parents carrying infants and toddlers in strollers, others needing special assistance, as well as those unfamiliar with checkpoint security procedures that require additional guidance.

For some travelers, lane selection is constrained. For example, those carrying multiple bags would not be allowed to choose the Black Diamond lane, and those traveling with small children or strollers would be routed to the Green Circle lane. However, other travelers would be free to self-select their lane. For this reason, choosing a Black Diamond lane might not always be the fastest route if it is often chosen, particularly if it is chosen by individuals that really don't have a full understanding of the security screening procedures and restrictions. This could lead to frustration and aggravation among delayed passengers expecting a streamlined process by choosing the expert lane. While this is a difficult issue to address, passenger checkpoint experiences among all travelers, including expert travelers, may be improved though passenger education.

Nonetheless, the TSA has noted that in the trial program, passengers choosing the Black Diamond lanes have experienced significantly reduced wait times. Smoother operations in other lanes have also been observed. For example, the TSA attributes a reduction in the confiscation of prohibited items to families feeling less rushed and having more time to prepare for the screening process. The TSA contends that "[s]ecurity is best served by a calm screening environment ..."[34] and has indicated that it is seeking to expand this initiative to additional airports that will be selected based on airport and airline support, and consideration of checkpoint configuration and passenger characteristics.[35] By the end of FY2008, the TSA had expanded the use of these self-select lanes to 32 airports. According to TSA observations, since implementing the program, expert lanes have seen an average 21 percent increase in throughput (with some as high as 40 percent), while alarm rates for lanes designated for families and those needing extra assistance have been reduced by an average of 11 percent.[36] Based on these results, the TSA has expanded the use of self-select lanes at several airports throughout the United States.

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[34] Transportation Security Administration, TSA Announces Expansion of 'Diamond' Self-Select Lanes. Press Release, March 5, 2008.

[35] Ibid.

[36] Transportation Security Administration, Black Diamond Self Select Lanes, Helping Passengers Move at Their Own Pace.

The Registered Traveler Program

In addition to the tailored self-select screening lane initiative, the TSA regards the Registered Traveler (RT) program as another potential means to streamline checkpoint processing of participating passengers that pose a known low risk, allowing the TSA to better concentrate its resources on screening passengers of unknown or elevated risk (e.g., conducting secondary screening of passengers selected based on similar name matching to suspected terrorists, terrorist sympathizers, or supporters of terrorist organizations; resolving alarms that occur during primary screening; and assessing the risk of passengers exhibiting suspicious behaviors). The registered traveler concept was recommended by airlines and airports soon after the 9/11 attacks as a means to vet trustworthy travelers and allow security screening efforts to concentrate on those passengers of unknown risk, or particularly, passengers posing an elevated risk. It was initially believed that such a system could encompass most of the flying public, allowing security screening efforts to be highly focused on those travelers that were not part of the program. Within weeks after the 9/11 attacks, the DOT's Airport Security Rapid Response Team included among its recommendations the urgent need to establish a nationwide program for voluntarily submitting information for vetting passengers who would be issued "smart" credentials, to expedite processing of the vast majority of travelers, thus allowing aviation security resources to be focused most effectively, an idea that became known as the "trusted traveler" concept. The recommendation was reflected in statutory language included in the Aviation and Transportation Security Act (ATSA; P.L. 107-71) and gave the TSA the authority to pursue a voluntary system for passenger vetting and identity authentication using biometrics.

To date, the RT program has been quite limited in its scope, available primarily to frequent travelers at a small number of airports under a trial program. As of December 2007, the TSA estimated that about 64,000 individuals were participating in the RT trial program, only a very small fraction of the tens of millions of annual airline travelers. The TSA, however, began expanding the RT program in the summer of 2008 beyond the original 19 airports that participated in the trial program. RT is now available to any airport that requests it.

The RT program was originally implemented under a public-private partnership model, in which volunteer passengers, who submit background information for vetting along with biometric data, are issued biometric identity cards issued by private service providers once cleared through the background check process, which is coordinated by the TSA. The TSA has since dropped the background check process and now describes the RT program as strictly a private sector enterprise.[37] The RT vendors are responsible for card issuance and identity verification of program participants as they enter screening checkpoints, however security screening remains the responsibility of the TSA.

In some airports, RT participants are simply given preemptive queuing into screening lanes used by all other passengers, while other airports have dedicated screening lanes for RT program participants. Additionally, at some airports, like Orlando International Airport (MCO), RT program participants have been used to test out emerging technologies, like shoe scanners, allowing them to reduce or eliminate some of the hassles associated with passenger screening. The concept has been to provide RT participants with some sort of expedited screening experience as an incentive for participation. In turn, the TSA was expected to benefit by

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[37] Transportation Security Administration, "Registered Traveler Interoperability Pilot Program," *Federal Register*, 73(147), July 30, 2008, pp. 44275-44278

maintaining basic screening requirements for RT participants, thus allowing it to better focus more extensive resources on non-participating passengers that pose an unknown or elevated risk. However, the TSA has largely concluded that current technologies are not advanced enough to offer RT participants an opportunity to bypass minimal screening requirements, because the required background checks do not eliminate the possibility that an RT participant could take hostile action threatening aviation security, and that the main benefits of the RT program are its identity verification capabilities.[38]

From its experience during pilot testing, the TSA determined that the security threat assessment conducted on RT applicants is largely redundant with terrorist watchlist checks conducted on all passengers each time they fly, and found that other elements of the background check performed "are not core elements in determining threats."[39] Therefore, under the fully deployed RT program, the TSA decided to eliminate the additional elements of the background check process and do away with the $28 fee it passed on to RT applicants to offset related costs.[40] While the RT program is now available to all airports, its future now seems uncertain as the benefits to both the TSA and program participants based on experience during testing appear to be much more limited than originally anticipated.

Moreover, just as the TSA announced nationwide availability of the RT program in the summer of 2008, it took action to suspend Verified Identity Pass, Inc., which serves as a vendor for the RT program under the brand name Clear®, from processing new applications after a laptop computer containing unencrypted applicant personal data from about 33,000 RT applicants was reported missing from San Francisco International Airport (SFO). This potential data breach prompted the TSA to suspend further enrollment in the Clear® Identity Pass RT program while it conducted audits of Verified Identity Pass, Inc., data security procedures. The suspension was quickly lifted after the laptop was recovered and the company put in place procedures to encrypt all enrollee personal data.[41] The incident and the potential threat of data breaches, however, raise considerable questions about the protection of private information under such programs during a time when there is considerable anxiety over identity theft. Security breaches such as this may cause potential applicants to reconsider whether the potential benefits of moving more quickly through security lines with fewer hassles are worth the risk of potential identity theft. Data security, therefore, appears to be another key issue for the future direction of the RT program.

Questions also remain regarding how hassle-free RT security lines are and how much time RT participants really save at security checkpoints. According to the TSA, it is up to individual airports to determine if they wish to participate in this program. As TSA moves forward with RT, the airline industry, which once backed this program as a means to reduce hassles for frequent fliers, now characterizes the manner in which it is being implemented as having limited and questionable benefit. The use of the program as a testbed for streamlined screening technologies and procedures has thus only provided limited benefits and reductions in travel hassles to participants. Nonetheless, some RT vendors have been pushing forward with the concept of

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[38] Ibid.

[39] Transportation Security Administration, "TSA Lifts Cap and Eliminates Fee on Registered Traveler," Press Release, July 24, 2008.

[40] Transportation Security Administration. "Registered Traveler Interoperability Pilot Progam," Federal Register, 73 (147), July 30, 2008, pp. 44275-44278.

[41] Transportation Security Administration, "Update On Verified Identity Pass, Inc. Clear®'s Registered Traveler Enrollment," Press Release, August 11, 2008.

promoting the RT program as an opportunity to stimulate the development of advanced screening technologies, particularly technologies that can improve checkpoint efficiency. For example, Verified Identity Pass, Inc., has offered technology developers a $500,000 prize for the development of technologies that can further streamline checkpoint processes, focusing on the scanning of shoes, laptops, and outer garments.[42] The company indicates that it would pursue partnerships with the winning developer to obtain TSA certification of promising new technologies and would ultimately seek to purchase systems for screening RT participants.

While the potential benefits of the RT program have not been fully realized, Congress included language in the FY2008 Consolidated Appropriations Act (P.L. 110-161) directing the TSA to establish an international RT program that incorporates biometrics and e-passport technologies to be used in conjunction with US VISIT and the Visa Waiver Program. Under the existing RT program, some international carriers have been participating for outbound flights originating from JFK and Newark Liberty airports. The future of both domestic and international RT implementation remains an issue of particular interest with regard to how this program may be able to someday work in coordination with other screening initiatives to streamline the process for certain passengers, thereby facilitating a risk-based allocation of screening resources to focus on those passengers that present an unknown or elevated risk.

Options for Further Streamlining Passenger Checkpoint Procedures

Additional efficiencies may be gained in passenger checkpoint screening if some current requirements could be met using more expedient alternatives. Two procedural requirements in particular are believed to be major factors in decreasing passenger throughput and increasing the so-called hassle factor: the requirements to remove shoes for X-ray screening and the requirement to remove laptops and other large portable electronics, such as portable DVD players, from carry-on baggage so that they can be screened separately. Eliminating these requirements, or taking steps to streamline these aspects of the screening experience, is therefore seen as having a potentially significant impact on improving checkpoint efficiency.

Shoe scanners that may eliminate the need to remove shoes for scanning were initially tested on participants in the Registered Traveler (RT) pilot program in 2007. However, the model manufactured by GE tested under the RT program was found to not meet TSA's detection criteria and further testing of the systems was suspended.[43] In August 2008, the TSA initiated field testing of a different model shoe scanner, the L3 PassPort, at Los Angeles International Airport. The shoe scanner systems currently under evaluation use explosives trace detection methods and puff air over the shoes to collect samples for analysis.[44] The systems are designed to detect traces of nitrate-based and peroxide-based explosives, but they do not generate an image of the shoe or screen for metals.[45] During these trials, the TSA will still require passengers to remove their shoes after being scanned by the machines to make sure the technology does not miss any explosives

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[42] "Clear Offers 500K Prize for New Checkpoint Technology," Aviation Week's Airports, 26(1), January 8, 2008, pp. 1-2

[43] Transportation Security Administration. "Status Update on Testing of General Electric Kiosk for Registered Traveler," News & Happenings, TSA, October 9, 2007.

[44] Benet Wilson, "TSA Tests L3 Shoe Scanners at LAX Airport Checkpoints," Aviation Daily, August 7, 2008.

[45] Steve Surjapurta, "May We Leave Our Shoes On at Airport Security?," Tripso Travel News, August 1, 2008.

threats.[46] However, pending the outcome of these trials, shoe scanners may eventually be deployed to airports nationwide potentially allowing most passengers to keep their shoes on during the entire screening process.

The TSA is also in the process of approving designs for laptop carrying cases that are specifically designed to allow laptop computers to remain in the bag as they pass through the X-ray scanner. The TSA requires that the bag designs provide an unobstructed X-ray image of the laptop computer by itself.[47] This is accomplished through the use of a pull out or flip out laptop sleeve or compartment that allows the laptop to be scanned by itself, away from the other compartments and contents of the carry-on. Passengers will be instructed to place only the laptop in this sleeve to avoid the laptop image from being obscured by power cords, peripheral devices, or other items stowed in the carry-on bag. Since use of the TSA-approved laptop cases is voluntary and requires an investment by travelers, it may be some time before this has any meaningful impact on improving checkpoint efficiency. For laptop-toting travelers, however, the reduced hassle of not having to remove then re-pack laptop computers may been seen as a considerable incentive by itself to purchase one of these cases, even if it doesn't guarantee shorter wait times at screening checkpoints in the near term.

Checkpoint Procedures for Liquids

In addition to checkpoint delays caused by laptop and shoe screening requirements, the TSA limitation on liquids carried through security checkpoints, implemented in 2006, has resulted in considerable confusion, delays, and hassles for airline passengers and has had a significant impact on checkpoint efficiency and passenger wait times.

Immediately following the detection of the terrorist plot targeting airliners bound for the United States and Canada from London's Heathrow Airport in August 2006, the TSA responded by banning the carriage of all liquids and gels by passengers through airport screening checkpoints. The total ban on liquids and gels remained in effect for several weeks. During this period, limited exceptions were made for breast milk for babies, liquid medicines, and other liquids regarded as being medically necessary. Beverages purchased beyond the screening checkpoint were not included in the ban, largely because the threat of passing bomb-making materials to an airline passenger using liquids purchased from vendors in the secured areas of airport terminals was considered minimal, and other security measures, such as background checks for airport workers, were viewed as limiting the possibility that terrorists might exploit beverage distribution to airport vendors as a means to get liquid explosives beyond airport security checkpoints.

In September 2006, the TSA relaxed the passenger liquid ban to some degree, establishing specific quantity limits and special procedures for carrying liquids through screening checkpoints. The TSA ultimately settled on a procedural approach for passengers to carry limited quantities of liquids through checkpoints and onto aircraft in a manner facilitating screening and inspection of those liquid items. The TSA refers to these procedures as the "3-1-1 for carry-ons" concept, with the objective of providing a simple-to-remember memory aid for travelers. Under 3-1-1, travelers are allowed to carry through the checkpoint liquids in bottles with a liquid volume of *three*

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[46] Art Marroquin, "Airport Security to Test Shoe Scans," LA Daily News (Los Angeles, CA), August 2, 2008.

[47] Transportation Security Administration, "New Security Simplifying Laptop Bag Procedures," TSA News & Happenings, July 29, 2008.

ounces or less, are limited by how many of these bottles will comfortably fit within a *one* quart clear plastic bag, with a limit of *one* such bag per traveler.

By November 2006, the European Union, along with Canada and other countries in Europe, Asia, and the South Pacific, adopted the 3-1-1 protocols in an effort to harmonize international aviation security procedures with TSA procedures. The TSA believes that roughly half of the world's aviation travelers must adhere to these procedures for carrying liquids through security screening checkpoints.

The 3-1-1 procedures were designed to allow the carry-on of liquid toiletry items in specified quantities for those passenger traveling on short trips and not checking baggage and for making reasonable accommodations to allow for accessible liquid medicines and toiletry items on longer flights. However, placing liquids in checked baggage is still preferred by the TSA. In addition to these allowable liquids, passengers are allowed to bring on board liquid medicines, as well as baby formula and food, breast milk, and juices to provide for a traveling infant. These items are allowed in reasonable quantities exceeding the three ounce limit imposed on other liquids and are not required to be placed in the quart-sized bag. While these procedures have been designed to provide reasonable accommodations for passengers traveling on short trips or with special needs for access to liquid medicines, necessary dietary supplements, and items to care for infants, the procedures often cause confusion and delays at airport screening checkpoints. The TSA has made extensive efforts to educate and inform the public regarding these procedures, and has been exploring the use of tailored screening lanes to separate passengers that might be unfamiliar with these procedures from seasoned air travelers seeking an expedited process to get through airport screening.

The TSA has responded to public criticism over the liquids ban and subsequent 3-1-1 procedures by pointing out the significance of the liquids explosives threat. However, an aspect of the liquids ban that has raised considerable criticism of the TSA is that the threat posed by liquid explosives was widely understood prior to the U.K. liquids bombing plot. Liquid explosives had been used in the downing of Korean Airlines flight 858 in November 1987, and Ramsi Yousef used an improvised liquid explosive device to bomb Philippine Airlines Flight 434 in December 1994, smuggling the chemicals onboard in a contact lens solution bottle. He and his co-conspirators were plotting to use similar liquid explosive devices, assembled in the aircraft lavatory, to destroy as many as twelve U.S.-bound aircraft from Asia as part of the so-called Bojinka plot concocted by Yousef and his uncle, Khaled Sheikh Mohammed. Authorities believe that the U.K. liquids explosives plotters similarly sought to assemble liquid explosive devices in aircraft lavatories, but unlike the Bojinka plot, intended to carry out suicide attacks, killing themselves along with all on board these aircraft. Despite the previous attacks involving liquid explosives, it was only after this plot was uncovered by British authorities that the TSA felt compelled to take action and impose significant constraints on the carriage of liquids through screening checkpoints and onboard aircraft.

While it appeared unlikely that security procedures for carrying liquids on board aircraft would be significantly modified or relaxed anytime soon – until new technologies capable of reliably detecting liquid explosives could be developed, tested, and fully deployed at airports – the TSA announced that it would begin phasing out restrictions on carry-on liquids by the fall of 2009.[48] Former TSA Administrator Kip Hawley indicated that, by the end of 2010, passengers should be

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[48] Thomas Frank, "TSA likely to ease restrictions on liquids in 2009," USA Today, October 28, 2008.

able to again carry liquids through screening checkpoints, but would be required to place bottles and other liquid containers through X-ray machines separately.

Passenger Education and Informational Materials

The TSA has launched several initiatives to inform the public regarding specific checkpoint requirements, procedures, and limitations. The efforts to inform passengers regarding the 3-1-1 policy on liquids serves as an example of how the TSA has made considerable efforts to provide the traveling public with adequate information regarding screening and security procedures to make passengers experiences as efficient and hassle-free as possible, given current policies, strategies, and approaches to screening. However, many security procedures remain confusing, in part, because they have changed in response to changing threat assessments, or have been applied inconsistently in the past.

Public education is likely to increase in importance as the TSA rolls out various new checkpoint screening technologies over the next several years. While some of these technologies have been field tested on a limited basis at various airports across the country, ongoing initiatives to deploy these systems nationwide represent the most significant change to the passenger checkpoint experience since mandatory use of magnetometers and X-ray screening of carry-on items was implemented 35 years ago.

Checkpoint Evolution and Related Initiatives

To address the challenges of improving screening performance, enhancing the capability to detect explosives, and increase checkpoint efficiency and throughput, the TSA is testing new checkpoint concepts that integrate emerging screening technologies and address various operational and human factors needs. In March 2008, the TSA launched an initiative called Checkpoint Evolution encompassing a variety of planned improvements to airport screening checkpoints. Former TSA Administrator Kip Hawley noted that "[t]his is the first significant change to the checkpoint since the 1970s," a reference to the fact that the layout of airport screening checkpoints in the United States, has remained relatively unchanged since they were first implemented in the early 1970s.

A Checkpoint Evolution Team at the TSA has developed a prototype concept for the checkpoint of the future that is showcased on the TSA website.[49] The prototype future checkpoint concept entered operational testing and evaluation at Baltimore Washington International Thurgood Marshall Airport (BWI), in Terminal B, which services Southwest Airlines, in April 2008. This prototype includes multiview AT X-ray equipment, millimeter wave whole body imaging (WBI) portals used for continuous random screening, and liquid bottle scanners.[50] However, the investment strategy and deployment schedule for deploying various future checkpoint concepts currently under evaluation remains unclear.

In addition to potentially improving the efficiency and effectiveness of the screening process, proposed changes to the screening checkpoint may help reduce congestion at "soft target"

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[49] See [http://www.tsa.gov/evolution/index.shtm]

[50] Transportation Security Administration. "Checkpoint Changes to Improve Security and Calm Process," TSA News & Happenings, April 28, 2008.

locations such as airport lobbies. Various design elements of the proposed future checkpoint provide potential mitigation of the threat of explosives carried through the security checkpoint and possibly for the threat of shootings or bombings in and near the checkpoint queue. By designing more streamlined queuing process, and queuing areas that are better separated from the public spaces in the airport terminal, the TSA hopes to achieve enhanced capabilities for surveillance and behavioral detection of potential threats of this kind.

The TSA is also seeking to implement methods to make the screening checkpoint a calmer, less chaotic environment in hopes that this will allow screeners and behavioral detection officers (BDOs) to more easily spot suspicious behaviors. Former TSA Administrator Kip Hawley noted that "[c]alm allows things to stand out more. It creates a better environment to observe hostile intent."[51] According to the TSA, a calmer checkpoint environment can also help to ease perceived time pressures and other distractions that may hinder screener performance.

Elements of the future screening checkpoint queuing area design include mood lighting, soothing music, improved signage to direct and instruct passengers, and museum-style storyboards that convey personal stories of various TSA screeners. In the prototype, panels and informational boards also function as barriers to better separate the checkpoint queue from the rest of the passenger terminal. The queuing area also includes a "prep stop," giving passengers a location to discard or recycle any trash or prohibited items, such as beverages, and organize and bag other items prior to screening. Travel document checking stations, staffed by TSA document checkers, are to be positioned at the transition between the queue and the screening lanes.

In the screening lanes, various technologies and procedures to streamline the screening process are included in the future checkpoint concept. For processing carry-on bags, the prototype system integrates an automatic conveyor and bin return system. The proposed automated conveyor system is to have the capability to separate alarm items (i.e., suspicious items that require additional scrutiny) from cleared carry-on items. Cleared items are to proceed down the conveyor to a collection area where passengers can gather their possessions.

One highlighted feature of the prototype system is the use of sensitive cameras in the collection area to identify and alert passengers when items, including items as small as coins, are left behind in the conveyor bins. Once the bins are emptied, the system would automatically return them via a reverse-direction conveyor belt to the beginning of the conveyor for reuse, thus eliminating the labor-intensive function of moving and stacking bins currently performed by TSOs.

On the back end of the future checkpoint configuration, the TSA plans to install "re-composure benches," to allow passenger to reassemble their items that may have been removed or opened during the screening inspection process, and an "end zone" where travelers can regroup with their families or others traveling with them before proceeding to their boarding gate.

Two significant challenges to implementing the proposed checkpoint evolution concept are acquisition and sustainment costs and airport space requirements. The Bush Administration's Budget Request for FY2009 specified $11.5 million for checkpoint reconfiguration and expansion costs, matching FY2008 levels. However, much of this has been slated for expanding the number of screening lanes at various airports across the country to meet the expected growth in passenger air travel rather than for reconfiguring existing screening lanes. Future funding needs to

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[51] Thomas Frank, "TSA Tries Soothing Screening Process," *USA Today*, March 30, 2008.

implement checkpoint evolution concepts beyond initial field testing is yet to be determined. These checkpoint evolution concepts are currently being field tested in conjunction with other initiatives to deploy next generation checkpoint screening technologies aimed at addressing lingering concerns over the limited ability to detect explosives on passengers and in carry-on items.

Next Generation Checkpoint Technologies

Since the early 1970s, passenger screening checkpoints have relied almost exclusively on the use of magnetometers, or walk-through metal detectors (WTMDs), as the sole means for primary screening for weapons or other prohibited or dangerous items being carried by passengers. These machines induce pulsed magnetic fields and sense any interruption or disturbance in those fields, usually caused by the presence of metallic objects, as individuals pass through these fields.[52] These devices, however, are not capable of detecting explosives or nonmetallic threat items. Also, checkpoint screening of carry-on items for explosives, weapons, and other threats is carried out using X-ray systems are limited in their ability to assist human operators detect objects or make determinations regarding potential threat objects based on the X-ray image.

In its final report, the 9/11 Commission recommended that "[t]he TSA and the Congress must give priority attention to improving the ability of screening checkpoints to detect explosives on passengers."[53] Congress responded by including language in the Intelligence Reform and Terrorism Prevention Act (P.L. 108-458), directing the Department of Homeland Security to "... give a high priority to developing, testing, improving, and deploying, at airport screening checkpoints, equipment that detects nonmetallic, chemical, biological, and radiological weapons, and explosives, in all forms, on individuals and in their personal property."[54] The legislation also directed the TSA to develop a strategic plan for deployment of explosives detection equipment at airport checkpoints, including technologies such as walkthrough explosives detection portals, document scanners, shoe scanners, and X-ray backscatter devices. These various technologies are discussed in further detail below. The Implementing Recommendations of the 9/11 Commission Act of 2007(P.L. 110-53) reiterated the requirement for developing this strategic plan, and also established a Checkpoint Screening Security Fund, requiring that $250 million collected from passenger and airline security fees be deposited in this fund in FY2008. Funding for Checkpoint Support, which encompasses checkpoint technology acquisition has been maintained at the $250 million level for FY2009 (See P.L. 110-329).

Over the past few years, the TSA has been field testing a wide variety of checkpoint technologies aimed at improving the screening of passengers and carry-on items, particularly to address the need for improving the detection of explosives at passenger checkpoints. A summary of some of the key emerging checkpoint technologies that are now reaching technical maturity for field testing and deployment in airport settings is provided in **Table 1**. A more comprehensive examination of screening technologies and technical approaches follows. These technical approaches include explosives chemical trace detection methods; whole body imaging systems;

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[52] Tim L. Hudson and Matthew J. Frankel, "Staying Ahead of the Game: The Future is Now for Advanced Passenger Screening," Airport Magazine, April/May 2007, pp. 46-50.

[53] National Commission on Terrorist Attacks Upon the United States. The 9/11 Commission Report (Authorized Edition). New York, NY: WW. Norton & Company. p. 393.

[54] P.L. 108-458, Sec. 4013; 49 U.S.C. §44925.

advanced technology X-ray capabilities; and other methods, such as computed tomography (CT)-based explosives detection systems (EDS) and the use of magnetic resonance imaging (MRI) technologies for detecting explosives and other threat objects in carry-on items.

Table 1. Emerging Checkpoint Technologies

Emerging Technology	Description	Estimated Per Unit Acquisition Cost
Advanced Technology (AT) X-Ray	X-ray systems with advanced visual detection capabilities including multi-view imaging and automated explosives detection algorithms	$199,845
Whole Body Imagers (WBIs)	Imaging systems using X-ray backscatter or millimeter wave (mmW) imaging technologies to inspect for concealed weapons and explosives under passenger clothing. These units can be used in place of metal detection wands and physical pat-down inspections	$256,872
Bottle Liquid Scanners (BLS)	A new handheld detection capability to discriminate explosives or flammable liquids from common benign liquids carried by passengers or in carry-on items	$42,419
Cast and Prosthesis Imagers	Specially designed low dose X-ray backscatter devices to screen casts and prosthetic limbs for possible concealed weapons and certain explosives	$56,567
Shoe Scanner Systems	Devices to scan shoes for explosives using nuclear quadrupole resonance imaging techniques. Field tested under the Registered Traveler Program but found to not yet meet minimum detection standards	$ Not Specified
Explosives Trace Detection Portals	Walkthrough portals using explosive trace detection methods to inspect passenger for trace indicators of explosives.	$211,924
Automated Carry-On Bag Explosives Detection System	Automated detection capability for inspecting bags for explosives and weapons using computed tomography (CT) based solutions. Seen as a possible means for either complementing or replacing current manual X-ray image analysis processes	$506,778

Source: Transportation Security Administration, *Congressional Justifications – Aviation Security*, FY2008 and FY2009.

Explosives Trace Detection Technologies

Several technologies that use various explosives trace detection methods are available for screening passengers and carry-on items for explosives. Available explosives trace detection technologies that may be considered for checkpoint use include explosives trace detection (ETD) machines tailored for checkpoint screening lane use to screen carry-on items; handheld bottled liquids scanners that use explosive trace detection screening methods; and walk-through explosives trace detection portals for screening individuals.

Explosives Trace Detection (ETD) Machines

ETD machines have been a fixture at aviation screening checkpoints and for checked baggage screening at smaller regional airports since the TSA assumed responsibility for passenger screening. These systems are capable of detecting minute quantities of elements found in explosive compounds using a variety of techniques, including mass spectrometry, gas chromatography, chemical luminescence, and ion mobility spectrometry,[55] to measure the chemical properties of vapor or particulate matter sampled from passengers, carry-on items, checked baggage, or cargo. It is generally believed that ETD systems will continue to play a central role in the screening of carry-on items to detect traces of explosives for items belonging to individuals singled out for secondary screening, or items flagged for additional screening based on the analysis of the TSA screener viewing the X-ray image of the item during the primary screening process.

Bottle and Liquid Explosives Scanners

Following the August 2006 U.K. aircraft liquid bombing plot, the TSA has been keenly interested in identifying an effective technology for detecting explosives in liquids and flammable liquids without requiring direct contact with a sample. Observers have noted that it would have been extremely difficult to detect liquid explosives, like those the terrorists had planned to use, employing checkpoint screening technologies and techniques in place at that time.[56] Since then, the TSA has been working with a number of vendors of bottled liquid scanner (BLS) technology to identify candidate systems for field testing.

So far, two handheld units, the Fido PaxPoint developed by ICx Technologies and the SABRE 4000 developed by Smiths Detection have been acquired by the TSA for field testing. The SABRE 4000 relies on ion mobility spectrometry, a common trace detection method proven effective in detecting minute quantities of explosives and chemical weapons. The Fido PaxPoint uses a different trace detection technology that relies on amplifying fluorescent polymers, a technique that utilizes a film lining that reacts when exposed to minute quantities of explosives. The sensitivity of these devices is considered to be sufficient enough to detect explosive traces and vapors through bottles and other sealed containers, including peroxide-based explosives as well as nitrogen-based explosives. These units cost roughly $43,000 each. Under the TSA's proposal for FY2009, it intends to deploy a cumulative total of 250 of these units, which would enable them to be available at roughly two-thirds of all screening lanes at Category X and

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[55] These terms refer to a variety of techniques used to identify unknown chemical compounds that are applied in the aviation security setting primarily, and often exclusively, to test for the presence of explosives.

[56] Norman Shanks and Steve Wolff. "The Liquid Bomb Threat." Air Safety Week, August 21, 2006, p. 1.

Category I airports. This, however, is considerably scaled back from earlier estimates that the TSA would acquire a cumulative total of 800 of these units by the end of FY2008.[57] Both devices have been deployed in field tests at several large airports.

While these devices also have the capability of detecting chemical warfare agents, it appears that the TSA is primarily interested in the explosives detection capabilities of these devices and has not formally addressed the potential threat of chemical attacks in airline passenger cabins, although chemicals like Sarin and VX nerve agent have been used in non-aviation terrorist attacks in the past.

The TSA has also considered various other technologies capable of detecting liquid explosives through a sealed container that use X-ray quadrupole resonance imaging, acoustic/ultrasound, Raman spectroscopy, and electromagnetic resonance techniques. Researchers are also working on laser irradiation techniques for detecting peroxide-based explosives.[58] These various techniques, however, can encounter difficulty in accurately identifying explosives through opaque containers and tend to yield relatively high numbers of false positives making them impractical for deployment at airport screening checkpoints given the current state of technology maturity of these systems.[59]

Walkthrough Explosives Trace Detection Portals

In 2004, the TSA initiated pilot testing of walkthrough explosives trace detection portals. When passengers pass through these semi-enclosed portals, puffs of air are blown at them to provide airborne samples of elements on their person. The samples are automatically collected and analyzed by the unit to detect the presence of explosives using explosives trace detection techniques. The system relies on an ion mobility spectrometry process that provides versatile detection of both positive and negative ions using a proprietary ion "trap."[60] The system is capable of detecting a broad spectrum of explosives in a matter of a few seconds. However, citing reliability problems, the TSA suspended further deployment of these systems, and was reportedly reassessing how to proceed.[61] The TSA has not sought to acquire additional trace portal systems, focusing instead on testing and deployment of whole body imaging (WBI) technologies, which are discussed in further detail below.

Whole Body Imaging Technologies

As part of the TSA's overall approach to improving the detection of explosives and nonmetallic weapons at passenger screening checkpoints, it is currently exploring the use of whole body imaging technologies for detecting concealed items carried by passengers. Whole body imaging solutions offer an integrated approach to passenger screening insofar as these technologies can reveal concealed items carried on a person, including traditional metallic weapons, non-metallic

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[57] "TSA Adds More Bottle-Screening Devices at Airport Checkpoints." Aviation Daily, November 16, 2007.

[58] "New Analytical Tool Developed for Liquid Explosives Detection." Science Daily, October 13, 2006.

[59] Kevin Bullis, "A Better Liquid-Explosives Detector," MIT Technology Review, December 1, 2006.

[60] General Electric, "The United States Transportation Security Administration (TSA) has installed the GE EntryScan³ Walk-through Explosives Detector to Screen Passengers at Boston Logan Airport's Terminal a Security Checkpoint." September 9, 2006.

[61] Eric Lipton, "Screening Tools Slow to Arrive in U.S. Airports," The New York Times, September 3, 2006.

weapons, and explosive devices. These systems, however, cannot provide an indication of whether a concealed item is made of explosives material. Nonetheless, detection of a concealed item can alert screeners to conduct more thorough screening to determine the specific characteristics of the item through methods such as explosives trace detection or walkthrough explosives detection portals.

The TSA is continuing to study specifically how whole body imaging technologies could be integrated with other technologies in future checkpoint screening solutions. The Transportation Security Laboratory (TSL), a component of the DHS Science and Technology Directorate, has been mulling a concept it refers to as the "tunnel of truth." This future checkpoint concept, which would submit passengers to a battery of screening techniques while being transported on a moving walkway, incorporates whole body imaging technologies along with trace detection portal technologies.[62]

Because of the ability to detect a broad array of concealed items, many view whole body imaging systems as a candidate technology for primary screening as part of a system such as the future "tunnel of truth concept," although in current field testing the TSA is providing this technology solely as an option for passengers selected for secondary screening as an alternative to a pat-down search, and as a procedure applied to individuals randomly selected for secondary screening.

Since whole body imaging technologies are regarded by some as highly invasive, critics of these systems have argued that they should only be used in limited circumstances. For example, the American Civil Liberties Union (ACLU) has urged Congress to ban the use of whole body imaging technologies as a method for primary screening. The ACLU maintains that "[p]assengers expect privacy underneath their clothing and should not be required to display highly personal details of their bodies."[63] The ACLU has also raised concerns that, if used as a primary screening method, whole body imaging technologies would, in their opinion, cause unnecessary delays by increasing the number of questionable items detected on persons passing through the checkpoint that would need to be resolved through additional screening techniques such as explosives detection portals and conventional metal detectors. The ACLU maintains that these technologies require "a tremendous invasion of privacy with little speed or efficiency gains."[64]

It should also be noted that while these technologies may be considered by some as being more invasive, they offer a potential capability for detecting nonmetallic threat items, particularly explosives, that does not currently exist with magnetometer screening. In this regard, WBI systems directly address 9/11 Commission recommendations and congressional mandates to develop and deploy capabilities to detect nonmetallic threat items at airport screening checkpoints. It is therefore, arguably inappropriate to directly compare these whole body imaging systems to current screening checkpoint operations that do not have the capability to address these mandates.

The TSA is currently field testing two candidate whole body imaging technologies for use in detecting explosives and non-metallic weapons carried by passengers. The first of these

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[62] "TSA Tunnel of Truth May Come Your Way," *Airport Magazine*, August/September 2008, p. 66.

[63] Statement of Timothy D. Sparapani, ACLU Legislative Counsel, Before the Senate Committee on Commerce, Science, and Technology, Regarding the U.S. Transportation Security Administration's Physical Screening of Airline Passengers and Related Cargo Screening, April 4, 2006.

[64] Ibid.

technologies is known as X-ray backscatter technology and involves images generated by detecting radiation reflected off objects irradiated with X-rays. The second technology, millimeter wave (mmW) imaging technology generates images by examining reflections of extremely high frequency electromagnetic waves. Both technologies have the capability of penetrating objects that can normally conceal objects in a visual scene, including clothing, baggage, and even steel containers and automobiles. Broadly speaking, both of these technologies offer the potential for unobtrusive monitoring and scanning capabilities for security applications, including possible covert scanning applications in the aviation security context and perhaps in other security applications.

In addition to potential use at airport screening checkpoints, both X-ray backscatter and millimeter wave technologies are also being considered for screening air cargo, carry-on items, checked baggage, and also for screening vehicles parked near airport terminals and vehicles entering access-controlled areas. While there is a broad array of potential security applications for these technologies, this discussion focuses on the use of these technologies for screening passengers at airport screening checkpoints. Identified concerns over this specific application of either of these competing technologies include protection of personal privacy, ability to detect items hidden in private and concealed areas on an individual, and possible health concerns regarding exposure to radiation emitted during the screening process.

X-Ray Backscatter Imaging Systems

Unlike traditional X-ray machines that measure the X-ray absorption pattern of different materials, X-ray backscatter technology works by emitting a X-ray beam and measures the scatter or reflections of the beam. The key difference is that organic materials do not absorb much of the X-ray, allow the beam to mostly pass through, thus making traditional X-rays – which measure absorption characteristics – a poor system for differentiating organic material. X-ray backscatter systems, on the other hand, do a much better job of differentiating organic materials, because different chemical elements in the material deflect these beams quite differently. This makes backscatter a well suited technology for detecting organic explosives in either solid or liquid form as well as drugs. The ability to provide high quality imaging of organic matter, however, raises privacy concerns because X-ray backscatter technology can accurately image body parts normally concealed under clothing. This has raised considerable concerns among privacy advocates, as noted above, and it has resulted in the TSA requiring that specific privacy filters and special operating procedures be put in place to maintain the privacy of individuals being imaged by these systems.

The use of X-ray backscatter devices may also generate some concern over public health and safety because these devices emit ionizing radiation, albeit in very small doses. It is estimated that each scan exposes an individual to 10 microRems of radiation, which is about 1% of the radiation exposure experienced every day. The system in use in testing by the TSA meets American National Standards (ANSI) requirements and is regarded as safe for all passengers, including small children and pregnant women.[65] The X-ray backscatter technology also provides an alternative to traditional X-ray machines for screening carry-on items, and systems are available that use backscatter technology for inspecting carry-on items, however, the TSA's present initiatives to acquire and deploy advanced technology X-ray systems for carry-on screening do

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[65] American Science and Engineering (AS&E), Inc., TSA Z Backscatter Pilot. AS&E, Billerica, MA.

not include X-ray backscatter solutions, relying instead on high resolution X-ray systems capable of providing multiple image views.

Millimeter Wave Imaging Systems

Millimeter wave screening technology refers to an array of screening devices capable of creating high detail images of items otherwise visually concealed. These devices emit electromagnetic waves in the 30-300 giga-Hertz (gHz) frequency range, that are capable of penetrating a variety of items that cannot be seen through, including clothing, vehicles, and shipping containers. For this reason, millimeter wave technologies potentially have a broad array of security applications, including the screening of individuals, vehicles, shipping containers, baggage, or other items. The screening devices capture the reflections of these waves as they bounce off visually concealed items. Depending on the composition of the material, some of the energy will be reflected and some will be absorbed. While metals and the human body tend to be highly reflective and will appear light or white in the generated image, materials such as plastics, ceramics, and organic materials, including organic explosives, will be partially reflective, and seen as partially transparent in the image generated using this technology.[66]

The resolution of current millimeter wave imaging systems allows for a relatively high detail image to be generated. However, like X-ray backscatter screening of individuals, images must be generated from multiple angles or views because, as mentioned above, millimeter waves are largely reflected by the human body and do not penetrate through the body to see items concealed on the other side. Also, like X-ray backscatter technology, millimeter wave imaging systems can detect concealed items, but cannot analyze the composition of those items. Therefore additional screening techniques would be needed to determine whether a detected item contained explosive material. According to the vendor, the millimeter wave screening technology currently being evaluated by the TSA can scan individuals in about two seconds.[67]

Since the millimeter wave signals emitted by these devices are non-ionizing and are emitted at very low power levels, health and safety concerns have not been a significant issue related with this technology. While some still question the potential health effects of exposure to electromagnetic energy, the TSA points out that the millimeter wave imaging systems currently being field tested emit 10,000 times less energy than a typical cell phone transmission.[68] For TSA screeners, occupational exposure is regulated by Occupational Safety and Health Administration regulations and standards, and exposure to the traveling public would be expected to be much lower than these levels in most cases.[69]

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[66] D.M. Sheen, D. L. McMakin, H. D. Collins, T. E. Hall, & R. H. Severtsen, Concealed Explosive Detection on Personnel Using a Wideband Holographic Millimeter-Wave Imaging System. Proceedings of SPIE—Volume 2755 Signal Processing, Sensor Fusion, and Target Recognition V, Ivan Kadar, Vibeke Libby, Editors, June 1996, pp. 503-513.

[67] L3 Communications, Active Millimeter Wave Screening.

[68] Transportation Security Administration, Millimeter Wave.

[69] See, especially, 29 CFR §1910.97 - Nonionizing radiation.

Advanced Technology X-Ray Equipment

The TSA has been using the term Advanced Technology or AT X-ray to refer to a wide range of possible next generation X-ray screening systems to be deployed for screening carry-on items at passenger checkpoints. The TSA has been field testing three different systems that provide a variety of enhanced features including improved resolutions, multiple views, and automatic explosives detection capabilities. The TSA has requested funding through FY2009 to deploy more than 900 of these systems, primarily at Category X and Category I airports. The TSA anticipates that it will have deployed enough of these units to provide coverage of 60% of lanes at these larger airports by the end of FY2009. The systems cost, on average, about $200,000 each.

Category X and Category I airports are slated to be the first to get these new technologies. The strategy reflects a view that focusing efforts on the largest airports will encompass the greatest number of passengers and the highest risk flights. The aviation screening system in the United States, however, operates using a single gateway concept, meaning that passengers are typically only screened once at their originating airport. Terrorists may exploit knowledge that smaller airports may not have the same level of advanced checkpoint technologies as larger airports to try to minimize detection. Such concerns may prompt additional policy debate over whether focusing on the largest airports first is the best strategy, or if targeted or accelerated deployment of these technologies to include small and mid-sized airports could provide an alternative strategy for minimizing such a threat.

Other Candidate Technologies and Applications for Aviation Security Screening

A variety of other technologies are available and have been suggested as options for screening carry-on items. For example, some vendors have developed small-footprint computed tomography (CT) based scanners tailored for passenger checkpoint use that have throughput rates on the order of 400 bags per hour and include automated explosives and weapons image detection algorithms. CT-based systems are also capable of generating 3-D or multi-angle images of scanned items for image analysis by screeners. While these systems offer some unique advantages over AT X-ray by incorporating automated EDS detection algorithms used for checked baggage, and allowing for the viewing of 3-D images or viewing the item from virtually any perspective, they are considerably more expensive than available AT X-ray systems. A key policy issue is whether the potential enhancements these technologies offer compared to AT X-ray provides a benefit equal to or greater than the cost difference. This may be a difficult question to answer depending on testing methods and assumptions. Findings may indicate that CT-Based systems for passenger checkpoint screening may provide unique benefits in some instances, but at present, the TSA appears to favor the use of AT X-ray technologies to replace current generation X-ray systems in most, if not all, instances.

Also, the DHS Science and Technology Directorate has been working with Los Alamos National Laboratory to develop and test ultra-low field magnetic resonance imaging (MRI) scanning capabilities to screen for threat items. Researchers have developed a prototype system that may eventually be integrated into checkpoint screening systems to establish a reliable liquid explosives detection capability. The system, called SENSIT (for "sense-it"), is being designed to identify and differentiate fluids by including a database of MRI signatures for both threat and non-threat liquid items. Potential advantages of using ultra-low field MRI technology is that it is

considered non-invasive, widely regarded as being safe for human exposure, and can potentially be integrated with the existing airport screening checkpoint architecture.[70]

Millimeter wave technology, discussed above in reference to whole body imaging systems, also has the potential of being adapted for use in screening carry-on items, although it is not clear that this would provide any advantages over advanced technology X-ray systems. Millimeter wave systems, however, have another potential application in covert, passive scanning of objects. For example, patrol vehicles could potentially use millimeter wave scanning systems to inspect vehicles standing at passenger pick-up and drop off points for suspect items, such as possible explosive devices. In the terminal, such technology also has potential application for the remote inspection of unattended or otherwise suspect items from a distance using, for example, robotic sensor platform. However, such potential applications of this technology pose considerable policy and legal questions regarding individual privacy rights and reasonable cause for search. At present, therefore, the application of this technology in the aviation security domain appears to be limited to consensual searches of passengers conducted at screening checkpoints.

While the major push for these new technologies is to improve both the detection capabilities and the efficiency of the screening process for airline passengers, concerns have been raised that airport workers that access sterile and secure areas are often exempted from screening procedures as a matter of routine. Tests of programs for screening workers on either a mandatory or on a random basis has raised questions over how such requirements may impact equipment and staffing needs if implemented on a nationwide basis.

Screening Airport Workers

The lack of mandatory screening for airport workers has been an issue of debate for some time. At most airports, identification checks, along with random or targeted screening, are used in lieu of 100% physical screening for airport workers. It has been estimated that nationwide about 600,000 such workers access secured areas of airports each day. In 2003, Representative DeFazio expressed particular concern over these practices, noting that this lack of checkpoint screening of airport workers creates vulnerabilities in which workers, or individuals with counterfeit or stolen worker identification, could pass threat objects into secured airport areas or travel on aircraft without security screening by using electronic tickets.[71]

The TSA and airport operators have voiced concerns that full checkpoint screening of airport workers would be very time consuming and would significantly impact limited security screening resources and TSA's ability to process airline passengers through screening checkpoints.[72] While procedures vary from airport to airport, prior to 2007, only Miami International Airport had implemented a system requiring 100% physical screening of all airport workers accessing secured areas. However, a security incident in the spring of 2007 brought the issue to national attention.

On May 5, 2007, the TSA was alerted to possible weapons on board a Delta Airlines flight from Orlando, Florida to San Juan, Puerto Rico after Orlando police received a tip from their

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[70] "Detecting Liquid Explosives," Air Safety Week, November 19, 2007.

[71] National Public Radio. "Some Members of Congress Raising Concerns about Potential Security Lapses at Airports," Morning Edition, May 22, 2003.

[72] "Technical corrections bill passes out of subcommittee." Aviation Daily, Vol. 352, No. 35, p. 3, May 19, 2003.

anonymous crime hotline.[73] The TSA ordered that the flight be reverse-screened upon arrival in San Juan.[74] In other words, all passengers, carry-on items, and checked baggage were screened again as the passengers disembarked in San Juan. The search unveiled 14 guns – 13 semiautomatic handguns and a .22 caliber rifle – and eight pounds of marijuana in a carry-on bag toted by a Comair employee traveling on the flight.[75] He and others accomplices, also employees of Comair in Orlando, were able to smuggle these items onboard the airplane because their access credentials allowed them to bypass passenger screening checkpoints. The incident highlighted the long debated insider threat posed by airline employees that are not routinely screened before accessing sterile and secure areas of airports.

Following the incident, the TSA ramped up employee screening and security measures.[76] However, neither the TSA nor Congress has required airports to implement 100% screening of all airport employees. As noted above, only Miami International Airport had a program in place prior to this incident to screen 100% of airport employees accessing secured areas. Following the incident, Orlando International Airport implemented a similar program. However, at other airports, screening is conducted only on certain airport workers or, more typically, is done on a random basis, if at all.

The TSA is currently testing various techniques for random and targeted screening of airport workers accessing secured areas of airports under its Aviation Direct Access Screening Program (ADASP). The ADASP was initiated in July 2006, and according to the TSA, the program places an emphasis on unpredictable, random screening of airport employees, items carried by them, and vehicles passing through airport access points. The Airports Council International - North America (ACI-NA) asserts that the random, unpredictable nature of worker screening under the ADASP will make it difficult for terrorists to ascertain and exploit operational patterns.[77] Moreover, the TSA emphasizes that its personnel can be "surged" on very little notice to step up airport worker screening in response to threat intelligence or other indicators of heightened risk.[78] Therefore, both the TSA and the industry support the risk-based, random screening concept being developed under the ADASP as opposed to a more costly and resource intensive effort to conduct 100% screening of airport employees, similar to what was implemented in Miami and Orlando.

As noted above, both Miami International Airport (MIA) and Orlando International Airport (MCO) have implemented full screening programs for airport workers, requiring all those accessing sterile and secured areas to undergo physical inspection. Additionally, a trial program at

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[73] Armen Keteyian, Pia Malbran, and Phil Hirschkorn, CBS News Investigative Unit, "14 Guns And 8 Bags Of Pot On A Plane, Lax Security For Airport Workers Leads To Arms And Drug Smuggling," CBS News, March 8, 2007.

[74] Testimony of Kip Hawley, Assistant Secretary, Department of Homeland Security, Transportation Security Administration, Before the United States House of Representatives, Committee on Homeland Security, Subcommittee on Transportation Security and Infrastructure Protection, April 19, 2007.

[75] Armen Keteyian, Pia Malbran, and Phil Hirschkorn, CBS News Investigative Unit, "14 Guns And 8 Bags Of Pot On A Plane, Lax Security For Airport Workers Leads To Arms And Drug Smuggling," CBS News, March 8, 2007.

[76] Testimony of Kip Hawley, Assistant Secretary, Department of Homeland Security, Transportation Security Administration, Before the United States House of Representatives, Committee on Homeland Security, Subcommittee on Transportation Security and Infrastructure Protection, April 19, 2007.

[77] Testimony of Greg Principato, President, Airports Council International - North America, Hearing on Aviation Security: The Necessary Improvements to Secure America's Airports, Before the Subcommittee on Transportation Security and Infrastructure Protection, Committee on Homeland Security, House of Representatives, April 19, 2007.

[78] Testimony of Kip Hawley, Assistant Secretary, Department of Homeland Security, Transportation Security Administration, Before the United States House of Representatives, Committee on Homeland Security, Subcommittee on Transportation Security and Infrastructure Protection, April 19, 2007.

Boston Logan International Airport (BOS) requires 100% physical screening of airport workers and vehicles accessing the airfield. While 43 TSA screeners were added to staff five airfield checkpoints at BOS, an airport official speculated that a full-time requirement to screen all airport workers at airport perimeter checkpoints and at designated terminal checkpoints prior to accessing sterile area may require as many as 1,300 additional TSA screeners at BOS alone.[79] However, it is important to point out that, unlike the statutory requirement for TSA screening of passengers, no such requirement exists for airport worker screening, so this function could be conducted by private screening vendors. In any case, system-wide implementation of 100% airport worker physical screening may require tens of thousands of new screener personnel, whether they be TSA screeners or private screeners.

The TSA maintains that through a layered security approach – relying on extensive background checks, access controls, surveillance, and law enforcement presence at airports – adequate security can be established and no specific need for 100% screening of all airport workers has been identified. The TSA believes that stepped up random screening of workers can provide an additional layer of security to augment these other longstanding layers of airport security.

In addition to random selection techniques, additional steps are under consideration, including the use of behavioral profiling techniques for targeting physical inspections of airport workers.[80] For example, at several Florida airports and in San Juan, Puerto Rico, the TSA has augmented the ADASP program with Saturation Security Teams (SSTs) that rove through sterile and secure areas of airports using behavioral observation techniques to evaluate and select airport workers for on-the-spot random inspections.

The TSA has also been mulling the idea of creating a voluntary program, allowing certain "certified employees" that undergo more extensive background checks to be exempt from routine, but not random, inspections. Some familiar with airport operations observe that certain categories of workers, such as maintenance workers, who must routinely pass into and out of sterile and secured areas, often carrying tools, knives, and other dual-use items that could be used as a deadly weapon. Repeatedly screening such individuals throughout the day may be labor intensive and arguably ineffective against preventing certain kinds of weapons from being carried into sterile and secured areas. Additional background checks and vetting of these workers may provide an option for exempting them from routine screening every time they access sterile and secured areas of airports.

Screening and Vetting of Airline Crews

While the TSA has been testing various procedures for screening airport employees, it has also moved forward to develop a system for validating the identity of airline crews as a means for sterile area access in lieu of physical screening at security checkpoints. The 9/11 Act (P.L. 110-53) required the TSA to assess the feasibility of creating a credentialing and identity verification system to allow airline flight crews access to the sterile areas of airports, and if feasible, initiate implementation of such system.

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[79] "New Screening Program Begins Test At Logan," The Boston Globe, May 7, 2008.

[80] Ibid.

Since the 9/11 attacks, flight and cabin crews have been required to undergo physical screening at airport checkpoints, largely over concerns that terrorists or criminals could gain access to secured areas of airports or to air carrier aircraft by impersonating airline crew members, particularly pilots. Pilots and flights attendants and organizations representing these groups have complained that while they were required to pass through screening checkpoints whenever accessing sterile areas of airports, other airport and airline workers have been allowed to bypass screening, pointing out that pilots and flight attendants were subject to the same background checks as airline workers.[81] Nonetheless, the TSA had expressed specific concerns about the level of access pilots, as well as flight attendants, had to aircraft and cockpits, fearing that an imposter dressed as an airline crew member could gain access allowing them to sabotage or hijack an aircraft if such an individual were allowed to bypass screening checkpoints.

Similar concerns had also been raised about allowing crew members from other airlines from riding on the cockpit jumpseat. Prior to the 9/11 attacks, it had been a longstanding industry practice to allow flight crew personnel from other airlines to ride in the cockpit as a means of transportation to position pilots, and sometimes flight attendants, for their flight assignments. Most major airlines had reciprocal agreements with the other airlines to allow for this. However, after the 9/11 attacks, the practice was terminated because there was no industry-wide system to authenticate the credentials of flight crews from other airlines. Airline crews were, therefore, often required to fly standby on a space-available basis to commute to and from their flight assignments.

As a result of an industry need to provide jumpseat access privileges on other airlines' aircraft in order to maintain efficient crew positioning, an industry-wide database called the Cockpit Access Security System (CASS) was developed. It was field tested beginning in 2003 and received TSA approval for full operational deployment in September 2005. This database is maintained by ARINC, Inc. using human resources data provided by the individual airlines. The system provides gate agents identity verification of flight crew members by transmitting an up-to-date photograph and background information to compare to employee credentials using a secure Internet-based interface.

For the sterile access area testing, the TSA has leveraged the investment in the development of CASS. For flight crew sterile area access, called crewPASS, the system relies on secure Internet access to the CASS database via TSA checkpoint computer terminals positioned at exit lanes to validate the identity of airline flight crew members. The testing is being conducted at BWI, Pittsburgh International Airport, and Columbia (S.C.) Metropolitan Airport, and it is currently limited in participation to uniformed flight crew members. Further evaluation of the program, including whether to extend participation to cabin crew members, is to be made based on the results of this testing.

The TSA is continuing to study ways to further enhance airline crew identity validation, and is assessing how this program may be able to enhance security by reducing the number of individuals requiring physical screening, allowing screeners and behavioral detection officers to better focus their efforts on detecting suspicious items and suspicious behaviors.[82] Nonetheless,

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[81] See the Transportation Security Administration's Screening of Airline Pilots: Sound Security Practice or Waste of Scarce Resources, Hearing Before the Subcommittee on Economic Security, Infrastructure Protection, and Cybersecurity of the Committee on Homeland Security, House of Representatives, One Hundred Ninth Congress, First Session, May 13, 2005. Serial No. 109–13, U. S. Government Printing Office, Washington, DC: 2005.

[82] See Transportation Security Administration, "TSA Announces Launch of Expedited Screening for Flight Deck Crew (continued...)

flight crew members participating in crewPASS are subject to random screening and behavioral observation.

Additionally, in September 2008, the TSA launched a separate test of a biometrics-based access control system for flight crews.[83] The system, known as SecureScreen, is being tested on about 200 Southwest Airlines pilots based at BWI airport. The pilots participating in the testing are being issued biometric identity cards that store fingerprint, digital photograph, and personally identifiable security information. Card readers have been installed at TSA security checkpoints at BWI to verify pilot identities, allowing pilots to bypass routine security screening. However, pilots participating in the test may still be subject to random or targeted screening as a secondary layer of security.

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Members," Press Release, July 17, 2008.

[83] Kathleen Hickey, "TSA Tests Biometrics for Pilots," *Government Computer News*, September 18, 2008.