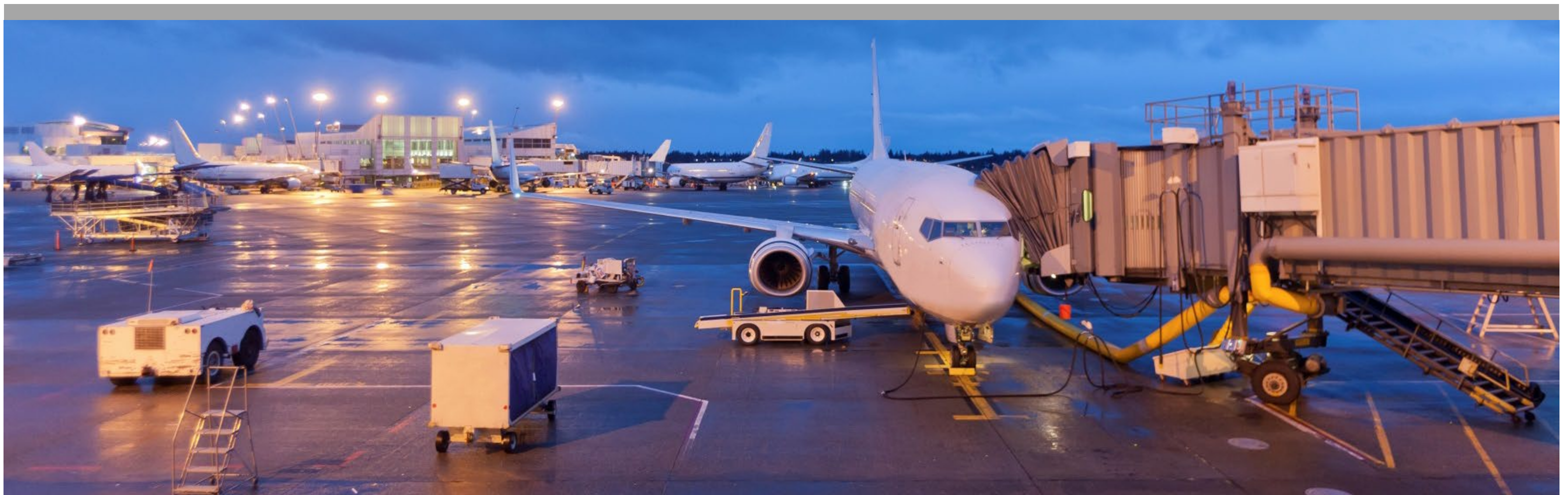
PARAS PROGRAM FOR APPLIED RESEARCH IN AIRPORT SECURITY



PARAS 0023 February 2021

Exit Lane Strategies and Technology Applications

National Safe Skies Alliance, Inc.

Sponsored by the Federal Aviation Administration

Gloria Bender
Andy Entrekin
Jessica Gafford
TransSolutions
Fort Worth, TX

Christian Samlaska
Seattle, Washington

NATIONAL SAFE SKIES ALLIANCE, INC.

National Safe Skies Alliance (Safe Skies) is a non-profit organization that works with airports, government, and industry to maintain a safe and effective aviation security system. Safe Skies' core services focus on helping airport operators make informed decisions about their perimeter and access control security.

Through the ASSIST (Airport Security Systems Integrated Support Testing) Program, Safe Skies conducts independent, impartial evaluations of security equipment, systems, and processes at airports throughout the nation. Individual airports use the results to make informed decisions when deploying security technologies and procedures.

Through the POST (Performance and Operational System Testing) Program, Safe Skies conducts long-term evaluations of airport-owned equipment to track and document a device or system's performance continuously over its life cycle.

Through PARAS (Program for Applied Research in Airport Security), Safe Skies provides a forum for addressing security problems identified by the aviation industry.

A Board of Directors and an Oversight Committee oversee Safe Skies' policies and activities. The Board of Directors focuses on organizational structure and corporate development; the Oversight Committee approves PARAS projects and sets ASSIST Program priorities.

Funding for our programs is provided by the Federal Aviation Administration.

PROGRAM FOR APPLIED RESEARCH IN AIRPORT SECURITY

The Program for Applied Research in Airport Security (PARAS) is an industry-driven program that develops near-term practical solutions to security problems faced by airport operators. PARAS is managed by Safe Skies, funded by the Federal Aviation Administration, and modeled after the Airport Cooperative Research Program of the Transportation Research Board.

Problem Statements, which are descriptions of security problems or questions for which airports need guidance, form the basis of PARAS projects. Submitted Problem Statements are reviewed once yearly by the Safe Skies Oversight Committee, but can be submitted at any time.

A project panel is formed for each funded problem statement. Project panel members are selected by Safe Skies, and generally consist of airport professionals, industry consultants, technology providers, and members of academia—all with knowledge and experience specific to the project topic. The project panel develops a request of proposals based on the Problem Statement, selects a contractor, provides technical guidance and counsel throughout the project, and reviews project deliverables.

The results of PARAS projects are available to the industry at no charge. All deliverables are electronic, and most can be accessed directly at www.sskies.org/paras.

PARAS PROGRAM OFFICER

Jessica Grizzle *Safe Skies PARAS Program Manager*

PARAS 0023 PROJECT PANEL

Lori Anderson *National Safe Skies Alliance*
Ethan Barske *Portland International Airport*
Ryan Clements *Easterwood Airport*
Bryan Diekman *Jacksonville Aviation Authority*
Mark Inzana *Denver International Airport*
Bill Marrison *National Safe Skies Alliance*
Richard Roth *CTI Consulting*
Lisa Rousseau *Port of Seattle*
Christer Wilkinson *AECOM*

AUTHOR ACKNOWLEDGMENTS

The research conducted for this guidebook was performed under PARAS 0023 by TransSolutions, LLC. with the assistance of subject matter expert, Christian Samlaska.

Gloria Bender of TransSolutions was the Principal Investigator for the project and primary author of the guidebook. Christian Samlaska, Andy Entrekin, and Jessica Gafford assisted with the research and data collection.

The research team would like to acknowledge the airports who took time out of their busy schedules to help make this document robust and useful to all sized airports. It is only through the support of airports that Safe Skies is able to continue to provide the aviation industry with valuable research on practical airport-related topics. Finally, the research team wants to thank the panel of volunteers who lent their expertise and time to ensuring the guidebook would be useful and applicable.

CONTENTS

TABLES & FIGURES

SUMMARY

There are currently numerous exit lane security solutions deployed at airports throughout the United States consisting of a mix of staffing, technology, and prefabricated devices.

Many airports continue to maintain security guards as their primary method of exit lane protection and security, but are interested in deploying more innovative solutions to improve the security posture of the airport and reduce costs. However, there has not been a consolidated source of information that discusses available solutions and their capabilities, as well as the factors that airports should consider when choosing between them.

Many elements need to be considered in the design, procurement, and deployment of a technology-based exit lane protection system. This document is designed to assist airports in all stages of deploying exit lane solutions and includes discussions on:

- Planning considerations
- Operational factors
- Testing and auditing
- Maintenance requirements
- Training
- Potential configurations and layouts
- Compliance with health and safety codes
- Comparison and discussion of the capabilities of available technology types

PARAS ACRONYMS

ACRP	Airport Cooperative Research Project
AIP	Airport Improvement Program
AOA	Air Operations Area
ARFF	Aircraft Rescue & Firefighting
CCTV	Closed Circuit Television
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
COO	Chief Operating Officer
DHS	Department of Homeland Security
DOT	Department of Transportation
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
FSD	Federal Security Director
GPS	Global Positioning System
IED	Improvised Explosive Device
IP	Internet Protocol
IT	Information Technology
MOU	Memorandum of Understanding
RFP	Request for Proposals
ROI	Return on Investment
SIDA	Security Identification Display Area
SOP	Standard Operating Procedure
SSI	Sensitive Security Information
TSA	Transportation Security Administration

ABBREVIATIONS, ACRONYMS, INITIALISMS, AND SYMBOLS

ADA	Americans with Disabilities Act
ADPM	Average Day Peak Month
ASP	Airport Security Program
ELBC	Exit Lane Breach Control
FAST	Find Airport Security Technologies
KCM	Known Crew Member
LEO	Law Enforcement Officer
RFI	Request for Information
RFQ	Request for Qualifications
RFx	RFI/RFQ/RFP
SSCP	Security Screening Checkpoint

DEFINITIONS

Breach	Unauthorized entry to a Sterile Area by an unscreened individual.
Breach Control System	Integrated security devices that provide access control to prevent wrong way movement through an airport exit lane by unauthorized personnel or objects, which would allow access into the Sterile Area.
Exit Lane	The passageway through which personnel and passengers exit the Sterile Area of an airport terminal or concourse.
Exit Lane Breach Control	Devices utilized at airport exit lanes that detect unauthorized access or attempted entry of people or objects into a Sterile Area.
Exit Lane Breach	Unauthorized access of people or objects into the Sterile Area via an exit lane.
Public Area	Areas of an airport that do not require personnel or passenger screening.
Sterile Area	That portion of an airport defined in the Airport Security Program that provides passengers access to boarding aircraft, and for which access generally is controlled by the TSA, or by an aircraft operator under Part 1544 of 49 CFR Chapter XII or a foreign air carrier under Part 1546 of said chapter, through the screening of persons and property.

SECTION 1: INTRODUCTION

There are currently numerous exit lane solutions deployed at airports throughout the United States, consisting of a mix of staffing, technology, and prefabricated devices. In the years since TSA began approving the use of unmanned, automated exit lanes, the airport community has seen the long-term operational benefits of upgrading their exit lane solutions and reducing the personnel resources needed.

Many elements need to be considered in the design, procurement, and deployment of a technology-based exit lane protection system. This document outlines and discusses many of the factors that airports should consider in exit lane system design and operation. It also examines why some systems have failed to meet expectations, and provides cautionary tips for managing the pitfalls associated with exit lane management. Finally, this document contains helpful templates and worksheets to aid airport security planners as they prepare to address exit lane protection.

1.1 Purpose

Many airports continue to maintain guards as their primary method of exit lane protection and security, but are interested in deploying more innovative solutions to improve the security posture of the airport and reduce costs. However, there has not been a consolidated source of information that discusses available solutions and their capabilities, and the factors that airports should consider when choosing between them.

The primary purpose of this document is to assist airports in researching, designing, procuring, and installing exit lane technology. This includes exit lane configuration discussions and the comparison and discussion of the capabilities of available technologies.

1.2 Scope

This document consolidates the information, recommendations, solutions, and lessons learned found during an in-depth literature review and dozens of interviews with airport operators and vendors. The product is designed to assist airports in all stages of deploying exit lane solutions, and includes discussions on:

- Planning considerations
- Operational factors
- Testing and auditing
- Maintenance requirements
- Training
- Potential configurations and layouts
- Compliance with health and safety codes
- Comparison and discussion of the capabilities of available technology types

1.3 Navigation

This document is designed to provide airports with a resource to help them research, design, procure, and deploy exit lane solutions. We recommend reading the document from beginning to end to fully understand the elements and factors necessary to help choose the solution that fits the airport's needs and requirements.

The first five sections are dedicated to researching exit lane solutions. These sections discuss exit lane solution characteristics and capabilities, as well as factors airports should keep in mind when choosing a solution to fit their needs and requirements.

Section 6 discusses the advantages and disadvantages of the available solution types. While it is not necessary to have read the rest of the document, this section is the culmination of the previous sections and refers to several elements from those sections.

Section 7 discusses procurement considerations, including formal and informal procurement options, ROI, funding, and project timelines.

SECTION 2: DESIGN CHARACTERISTICS

When researching exit lane solutions, airports should consider:

- How their exit lane configuration(s) would function most effectively with the various types of systems
- Which systems are the most cost effective for their operations
- Which solutions provide a reasonable ROI and have an acceptable life cycle
- Operational, maintenance, infrastructure requirements and issues
- Compliance with federal, state, and local requirements (Americans with Disabilities Act [ADA], Fire and Life Safety codes, SAFETY Act, etc.)

2.1 Functionalities

The TSA has stated that the effectiveness of a technological solution should be based on the technology's ability to detect, in real time, unauthorized persons enter a certain location; alert, in real time, appropriate authorities of unauthorized ingress of persons or items; and prevent or mitigate a breach of the Sterile Area by unauthorized persons or items.

In order to securely replace exit lane guard staff, a complete technology system should be able to monitor for and deter potential breach attempts, detect the breaches when they occur, notify the authorities to the breach, and isolate the person or object until the authorities can contain the situation.

2.1.1 Monitor

Monitoring includes observing the areas in and around an exit lane, with expanded means to identify and track a potential intruder. This also includes the ability to quickly capture images and video of the breach incident to facilitate apprehension and, if warranted, prosecution.

While human guards are the most common means for airports to monitor their exit lanes, CCTV, sensors, and video analytics are often used in conjunction with a guard or as a replacement. Some systems have the capability to record and report events within the exit lane, which can be monitored by the Communications or Security Operations Center for real-time resolution and reporting.

Some systems can push video and photographs to mobile devices or remote computers, which accelerates the information flow to Law Enforcement Officers (LEO) and/or operational staff who are responding to potential breaches. Standalone systems often enable the responder to access a computer terminal at the exit lane and view or print pictures. If the system is integrated with the Communications or Security Operations Center, the staff can then push the information out to the relevant authorities.

2.1.2 Deter

Systems designed for deterrence will warn an intruder or potential intruder by audible and/or visual means. The system alarms when triggered by specific events, such as venturing into predefined alarm zones. Warning situation examples include:

- When an individual approaches the exit lane from the public area
- When an individual's movements within the lane appear inconsistent with normal pedestrian flow (stopping, pausing, turning, or changing direction within the exit lane)
- When an individual does not respond an initial warning and proceeds into the exit lane from the public area (in this situation, an alert or alarm should also be issued)

In addition, physical structures like doors, barriers, and contained corridors may have a greater deterrent factor than open lanes with no overt security.

2.1.3 Detect

Detection identifies the improper entry into or movement within an exit lane, and passed or abandoned objects. Typical capabilities include detecting the following:

- An individual who enters the exit lane from the public area
- An individual whose movements within the lane appear inconsistent with normal pedestrian flow, such as traveling in the wrong direction or within a moving crowd, or loitering in the area for too long
- An unattended or abandoned object in the exit lane, or an object tossed into the lane from the public area
- An individual loitering in areas adjacent to the device
- Forced door movement

Many technology solutions are deployed with these capabilities, which are typically performed using sensors or video analytics; however, some systems cannot provide object detection if the object is thrown or moving at more than eight miles per hour.

2.1.4 Alert and Alarm

Alerts and alarms provide sensory feedback to both intruders and authorities. Alerts are meant to deter potential intruders or indicate a potential issue. Alarms are meant to notify authorities that a triggering event has occurred (such as a breach) and a response is necessary. Which triggering events listed in the Deter and Detect sections above activate an alert or an alarm will depend on the airport's protocols and the solution deployed.

Airports that use staff to control the exit lane typically have a podium within or near the lane at which the individual can monitor the exit lane's camera feed(s). These usually have an alarm/breach button that can be pressed to notify airport security, the TSA, and LEOs, as well as a phone and/or radio to communicate. At some airports, pressing the breach button triggers an all-stop to the intra-airport rail system. If exit lanes are monitored in a central Communications or Security Operations Center, an alarm can be set up to notify and dispatch the responsible staff to intervene.

Ideally, the exit lane solution should be capable of multiple alert and alarm levels. Airports utilizing systems that have multiple alert and alarm levels see fewer breaches that may result in major disturbances. The type of alert/alarm and triggering event for each should be determined by the airport with input from stakeholders and the system vendor. It is not uncommon for the airport to reconfigure these levels and triggering events multiple times before finding the best response level for the specific exit lane.

Most airports with a technology solution use sensors or cameras to create invisible alert/alarm zones within the exit lane and extending into the public area. Typically, there are one to three alarm zones within the corridor area and a pre-alarm/warning zone in the public space. Each of these zones is usually about 10 feet long, but may vary depending on the corridor length and camera capabilities. Airports should configure zones to match the length of the exit lane corridor and the system's capabilities.

In a typical installation, the pre-alarm/warning zone cautions individuals in the area not to enter the exit lane from the public area. Some airports elect to have the pre-alarm/warning zone notify staff in the Communications or Security Operations Center, but many only have a local verbal message meant to alert the person that they are too close to the exit lane. The next alert or alarm will trigger if the individual continues the wrong way into the exit lane, and will then set off the alarm to the Communications or Security Operations center so a LEO or operational staff can make an appropriate response.

> One airport interviewed for this guidebook has distinct carpet extending into public area. If an individual steps within its boundaries, a restricted area warning alert is activated.

Alerts and alarms can include an audible local alarm, a verbal message, flashing lights, camera call-ups, and/or a direct video feed and notifications to the Communication or Security Operations Center. Some systems allow the notification to be sent to a local computer adjacent to the exit lane to notify the individual staffing the lane. Some also have the ability to send the notification directly to specified users' cell phones or computers via email or text message.

Local audible alerts and alarms are the most prevalent type used at United States airports. Physically smaller airports often choose to increase the alert/alarm volume to be heard across the entire terminal to notify nearby personnel, LEOs, and TSOs to respond. Larger airports often set the alert/alarm volume lower to keep it localized to the exit lane and possibly a co-located checkpoint. Generally, these airports integrate the local audible alerts/alarms with an alert sent to the Communications/Security Operations center to dispatch LEOs.

Some systems have the ability to program multiple verbal warning announcements that may correspond to the exit lane's alert/alarm zones. While verbal warnings are good for redundancy, they are not recommended for use on their own and should always be paired with audible and visual alarms. This will allow airports to reach passengers with hearing or sight limitations, or passengers who do not speak the language(s) of the verbal warning.

False and nuisance alarms are common at airports, regardless of the solution deployed. A false alarm is one set off due to a system or technical error; a nuisance alarm is one that is set off unnecessarily because of passenger behaviors or environmental elements (e.g., a swinging bag or shadows generated by lighting). Airports should be conscientious to design a system that results in a low false or nuisance alarm rate, since high levels may lead to personnel responding too slowly or ignoring the alarm. Nuisance and false alarms may also negatively affect the exiting queue and inconvenience passengers. However, airports need to configure the system carefully to ensure the overall sensitivity level is not so low that it misses valid alarm trigger events. More information on system calibration can be found in Section 4.1.2.

2.1.5 Isolate

Isolation is the use of physical impediments—the most common being doors—that limit passage or confine an intruder to facilitate apprehension until a LEO, TSO, or operations/security staff member can respond. True isolation consists of two layers: a prevention layer composed of a physical barrier at the lane exit to prevent unauthorized access into the lane from the public area, and a containment layer composed of one or more physical barriers located elsewhere in the lane and/or in adjacent corridors. However, not all solutions offer both layers.

Many systems that offer interlock capabilities, such as portal systems, have breach control doors on the Sterile side of the exit lane that are programmed to close automatically when the system detects a breach attempt. The doors on the public side remain open for passengers, as well as the intruder, to exit into the public area.

2.2 Life and Safety Codes and Accessibility

Technology systems must comply with all local, state, and federal regulations pertaining to safety, health, fire, ADA, etc. While most technology solutions are designed specifically to ensure they meet these requirements, European-based technologies may be designed to meet European regulations, which do not always comply with U.S. regulations. For instance, European exit lanes tend to be narrower than those designed in the United States, as Europe does not have the same ADA requirements.

> Implementation of European systems in the U.S. has presented some challenges. One airport that installed larger doors on a prefabricated European system to comply with ADA requirements experienced multiple drive belt burnouts due to the increased weight of the larger doors.

It is important to ensure that solutions featuring a physical barrier meet ADA requirements and fire codes. Some solutions can create unnecessary difficulties for people with disabilities, small children, or the elderly. For instance, push-bar/self-closing doors may be heavy and difficult to open; automatic door opening mechanisms should be considered for these doors. Additionally, revolving doors may be challenging to fit users of wheelchairs and their attendants, strollers, animals, and small children.

Working with the local fire marshal and, when possible, life safety professionals prior to and during the initial procurement and design stages can help identify potential code compliance issues before the system is procured and installed.

Some airports have discovered after installation that their exit lanes are considered emergency egress points by their local fire marshal. This may mean that the chosen solution is not appropriate for that area, or that alternate emergency egress paths need to be defined to alleviate the stress on the exit system. Often the local fire code will recommend using the Security Screening Checkpoint (SSCP) as an emergency egress if it is close to the exit lane. Many airports require permits to change emergency egress points, which necessitate the involvement of the local fire marshal.

If the exit lane system has doors, the airport, with input from the fire marshal, must decide if it should be connected to the airport fire alarm system, which may be required by code. If the doors are programmed to automatically self-release and open, then the airport can be vulnerable if someone initiates a fire alarm in the terminal, although many of the exit lane systems require multiple alarms to activate.

> One airport that wanted to use the exit lane as emergency egress originally installed crash bars on the doors, but passengers impatient for the exit doors to open simply pushed them open using the crash bars, which set off exit lane alarms.

Changes made to the exit lane may affect the airport's Life Safety evacuation plans. These plans should be reviewed with the local fire marshal during the design and procurement stages, and be updated as necessary as part of the post-deployment document review process.

> The National Fire Protection Association (NFPA) has published hundreds of codes and standards on maintaining the health and safety of individuals due to the possibility and effects of fire and other risks. Many federal, state, and local rules and regulations are based on the NFPA codes, which are available free of charge at https://nfpa.org.
>
> Guidelines for complying with ADA requirements are outlined in 28 CFR §§ 35 (title II) and 36 (title III). More in-depth discussions on implementing these requirements can be found at ada.gov.
>
> Some states have ADA requirements that exceed federal regulations. Airports should work with their local fire marshal and legal counsel to ensure they meet any additional requirements.

2.3 Redundancy

There is no perfect solution that prevents breaches 100% of the time, even if it was custom-made for the airport. Successful deployment of any exit lane solution requires a layered approach to security, which relies heavily on redundancy. Carefully configured controls and alarms, paired with a practiced security response, are critical to creating a secure airport and preventing breaches. Use of several independent systems helps create layers of security that cannot be breached by one single method.

While technical solutions are useful and may provide high levels of security during routine operations, consideration should be given to what should happen in the event of a power outage, system failure, or other unplanned event that could interrupt service. Downtime of the exit lanes can result in lower levels of customer service, and may require the use of personnel to redirect exiting passenger traffic to the nearest available exit. The longer the exit lane is not functional, the higher the cost of downtime for the airport.

Some of this downtime can be mitigated with the use of redundant equipment such as an Uninterruptable Power Supply (UPS), a backup generator, or an extra set of one-way doors. Installing two or more portals (sets of doors, turnstiles, etc.) would help control the exiting passengers should one of the portals fail due to a maintenance issue or some other reason.

Some systems have the capability to provide reports and information on the status of the system, as well as resolve breach issues. However, complete reliance on the system's notifications is not ideal and should be complemented with regular system testing and monitoring.

Airports should consider conducting threat/risk assessments of the exit lane area before procuring new equipment or technology. Knowing the potential threats specific to the airport and the area around the exit lane will allow the airport to develop strategies to mitigate certain security risks, while also balancing resources effectively.

Aviation industry groups have published several resources that discuss conducting threat/risk assessments for individual airports. Airports may also find PARAS 0016 – Airport Security Vulnerability Assessments and its supplemental tools a valuable resource for conducting these assessments.

SECTION 3: TECHNOLOGY CONSIDERATIONS

The Implementing Recommendations of the 9/11 Commission Act of 2007 required the TSA to conduct a pilot program identifying Exit Lane Breach Control (ELBC) technologies. The pilot was conducted in 2010 at Dallas/Fort Worth International Airport and Seattle-Tacoma International Airport. The TSA was directed to identify ELBC technology that could minimize the risk of unauthorized access, reduce resource requirements (staff) at the exit lane, and maintain or exceed the existing level of security.

To date, the TSA has not approved any form of ELBC technology for widespread use at airports. However, local TSA representatives have the authority to accept exit lane technology solutions on a case-by-case basis at individual airports. Many of these solutions have the ability to monitor, deter, detect, alert/alarm, and/or isolate on their own or in conjunction with posted guard staff.

3.1 Cameras and Video Analytics

Some systems have the capability to record and report the events leading up to and during a detected breach. Typically, tracking is confined to the immediate area of the exit lane, as most systems do not monitor the Sterile Area beyond the exit lane.

All airports use some type of CCTV system for the purpose of monitoring and/or recording activity in or around the exit lane for real-time or forensic analysis. Typically, the cameras are positioned to capture a specific line of sight. Multiple cameras can be used to overlap lines of sight and eliminate blind spots within the corridor.

When deploying a new exit lane security solution, many airports choose to also upgrade their camera systems at the same time or, in some cases, eliminate them entirely to be replaced by the deployed exit lane solution. Depending on the type of exit lane system technology deployed, various types of cameras and video technologies can be utilized. Common camera types include:

- Megapixel cameras – high resolution cameras often used for video surveillance and/or video analytics
- Analog cameras – high resolution cameras often used for video surveillance in conjunction with a video encoder and/or video analytics
- Infrared cameras – often utilized in applications where visible light is an issue due to environmental elements

Regardless of the type of camera or sensor, they will need to be periodically recalibrated as they may get bumped or misaligned during normal use, especially if located at floor level or designed to swivel for multiple angles. Many airports must recalibrate their cameras every few months to account for significant changes in ambient lighting as the seasons change.

Systems using sensors and cameras may need to be calibrated several times during and after installation. Often, false and nuisance alarms occur after the system is installed that require slight adjustments to the system.

Many airports relying on sensors or video analytics choose to test the system several times a day, often immediately after the changing of the guard on duty. Several airports have noticed that their system may work properly in the morning but may fail the same test later in the day. This type of failure could result from several factors, such as environmental conditions, camera model, life span, and configuration.

Some types of camera systems tend to produce more false alarms during the time immediately after the system is brought back online.

Airports upgrading their camera systems or deploying systems with the ability to track a breach within the exit lane corridor will need to consider digital storage space for the information. The amount of digital storage needed will depend on several factors, including:

- Video and image quality (higher quality videos take up more storage space)
- Number of cameras recording
- Frequency at which video/images are taken
- Data retention time required for video/images (some states require information to be retained for longer periods than others)
- Data compression options (compressing the data can save space but typically at the cost of lower video/image quality)
- Data backup frequency

Some airports have needed to purchase additional hard drives and servers to handle the video data. Occasionally, this also equates to additional physical storage for the hardware.

3.1.1 Environmental Conditions

Solutions using sensors and cameras require a stable lighting environment; this means that the light levels should remain constant and should not dim or brighten throughout the day. Many airports have glass windows and skylights to take advantage of the sunlight, but the constantly changing light levels can make the sensors and camera analytics less effective. Sunlight, reflective surfaces, and shadows can also impact the system and cause nuisance alarms (shadows can fool analytics into thinking there is movement).

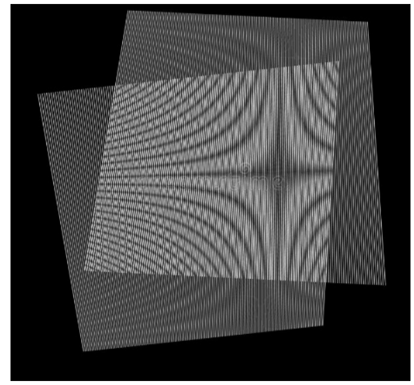
Use of walls, frosted glass, and other architectural features can help create and maintain a stable lighting environment. Some systems have self-contained lighting elements, which can minimize or eliminate common issues caused by ambient lighting.

Some airports reported other environmental factors that impacted their cameras' performance and generated nuisance alarms. Common elements at airports that affect a camera's ability to perform its core functions include:

- Dust particles
- Carpet color (e.g., individuals wearing colors similar to the carpet colors may appear "invisible" to the sensors)
- Reflective material in the corridor (e.g., metals and glass)
- Window blinds (which can create shifting shadows)
- Shadows on the other side of glass partitions and doors (especially when co-located to the checkpoint)
- Low ceiling heights (optimal height is 9–10 feet; anything lower can restrict camera angles and create blind spots)
- Reflective clothing (e.g., reflective vests, wet rain jackets)

- Direct lighting on the camera, which causes blooming and "blinds" the camera
- Wheelchair, stroller, and walker wheels, which are often reflective
- *Moiré* patterns

Figure 1. Moiré Pattern



Source: dreamstime.com

Moiré patterns occur when a scene or an object being photographed or recorded contains repetitive details—such as lines, dots, or squares—that exceed the sensor's resolution. This often creates wavy lines and curves in the image that seem to move. Figure 1 is an example of overlapping straight lines to create a moiré pattern. This is typically a bigger issue with digital cameras and recorders (especially single-lens reflex [SLR]-type) due to the method of scanning used to produce a high-quality image.

> At one airport interviewed, the exit lane emptied into a vertical transportation core consisting of a stairwell, elevators, and escalators moving down to the lower level. The airport had video analytic capabilities on the camera pointing toward this area and noticed higher nuisance alarm rates. The cause was eventually determined to be the steps of the escalator moving at consistent intervals away from the digital camera's location, which created a moiré pattern.

3.1.2 Video Analytics

Video analytics use algorithms to process real-time video to detect triggering events, such as wrong-way movement, unattended objects, crowding, scene changes, and loitering. More advanced systems can go as far as identifying the difference between a piece of litter and a dropped bag left within the corridor. Many video analytic systems are camera agnostic, so airports will not necessarily need to purchase new cameras to integrate the new software.

Not every exit lane solution has included video analytic capabilities, but many offer wrong-way detection. Independent video analytic systems can be added to most exit lane solutions, although discussions with potential vendors should include methods for calibrating to account for factors such as swinging doors or escalators.

Airport operators should include their IT department in discussions of video analytic processing to ensure the best fit for their current system, capabilities, and needs.

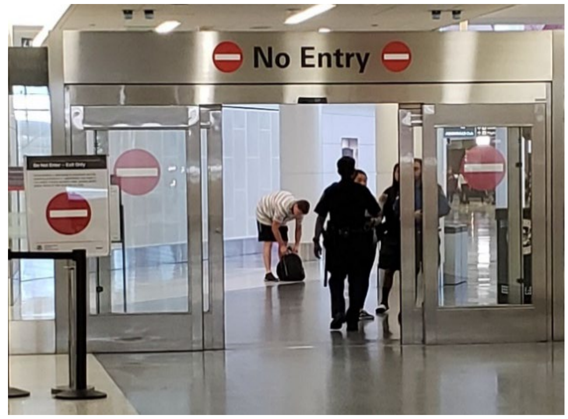
3.2 Access Control

Many airports use their exit lanes as an authorized bypass for airport personnel, Known Crew Members (KCM), and LEOs. Access control may include a badge verification reader, integrated biometric card reader, or a person monitoring the public side door.

Lanes that are monitored by personnel can be open (no doors or gates), or have doors/barriers as shown in Figure 2. The person guarding the lane typically swipes the bypassing individual's ID on a card reader at the podium and performs any inspections required by the airport. Using the exit lane for authorized entry typically sets off any sensor alert/alarms within the exit lane. Some airports have local alarm reset buttons for this purpose.

Some airports have unmanned lanes with barriers that can also be used for authorized bypass. These typically have keypads or card-swipe pads on or near the door that allow airport personnel to use their ID media to access the lane. These are rarely used as KCM entrances or access for non-badged LEOs (such as air marshals).

Figure 2. LEO Using the Exit Lane for Authorized Bypass



Airports considering the use of the exit lane as an authorized bypass should determine the procedures and response to alerts and alarms that may result from legitimate bypass use.

Information on utilizing a bypass hallway as an alternative to the exit lane can be found in Section 5.3, and should be considered in conjunction with the access control elements discussed here.

3.3 Infrastructure Elements

Several infrastructure elements may need to be addressed, depending on the type of solution and specific system being considered. Architectural and structural elements that may need to be altered include:

- Width and length of exit lane corridors/area
- Turns and curves within the corridor
- Load capacity of the floor for heavier items (especially if the exit lane is on an upper floor)
- Column sizes and locations within the corridor
- Ceiling height
- Floor slope
- Wheelchair, walker, and stroller accessibility and related allowances (e.g., tall poles on the back of wheelchairs)
- Wall locations
- Doorway locations and sizes
- Egress barriers

Electrical, IT, and telecommunication elements that may need to be altered include:

- Ambient lighting
- Power and cabling connections
- Normal, emergency, and backup power supply
- Telecommunication infrastructure
- Ethernet network cabling
- Audio/visual alerting systems (speakers, strobes, etc.)
- Heating, ventilation, and air conditioning
- Sprinkler and fire alarm system connections

Access elements that may need to be altered include:

- Access for operational equipment such as electric carts and Segway-type equipment
- Access for maintenance/cleaning and repair equipment (e.g., scissor lifts)
- Authorized bypass (e.g., first responders, LEOs, KCM, air marshals, etc.)
- Rerouting traffic patterns

Procedures for the control of equipment access panels must be considered both on the public and Sterile side. Failure to properly secure access panels could result in a breach.

3.3.1 Legacy Equipment

Depending upon the airport's needs, the exit lane location, and the chosen technology, consideration should be given to the level of integration of the exit lane system with the airport's existing legacy security systems. These may include legacy access control systems, CCTV, or physical barriers such as doors. Features to consider for integration include:

- Alarms and associated notifications to the Communications/Security Operations Center or LEOs
- Remote alarm reset
- Video call-up and replay
- Video analytics that track individuals during a breach
- Ability to push video and images to cell phones and computers via text or email
- Access control systems
- ADA compliant door opening systems

> One airport using an ADA door opener experienced frequent alarms due to a wiring issue between the door opener, access control device, and the exit lane alarm system. The entire system needed to be rewired twice to resolve the issue.

Software integration between the new system and the airport's existing system may require a software upgrade or new software development, which may be costly. Airports should work with their chosen vendor and their IT department to facilitate the integration of legacy technology.

Typically, the costs of annual recurring software license renewal and maintenance are specified in a 1 to 3-year software maintenance agreement. The duration of the agreement is often based on the project budget and what is allowed by the funding source.

Removing and storing or disposing of legacy technology and equipment takes additional effort and possibly additional funding. Unless the legacy equipment will interfere with the new equipment, it may be more cost effective to leave the legacy elements in place, even if they are no longer actively working. If the elements are still in working order, these may be leveraged to provide additional security.

> One airport chose to keep the set of doors at the public end of the exit lane despite installing a three-door portal system in the corridor. They stated that removing the doors would have resulted in unnecessary removal and disposal expenses, and the doors provide one more set of barriers.

SECTION 4: TESTING AND TRAINING

4.1 Testing and Audits

One of the keys to the successful implementation of an exit lane system is the proper testing and commissioning of the system. Steps should be followed throughout all phases of the project to ensure proper system installation and operation. The execution of all required activities by factory-certified and technically trained staff will establish a "check and balance" process throughout the project. This will ensure any issues are discovered and resolved in an efficient and timely manner. All testing activities should be properly documented to ensure execution, completion, and acceptance.

4.1.1 Initial Testing

The system's design stage should include the development of testing and commissioning requirements, quality assurance measures, and quality control requirements for the installation vendor, contractor, or integrator. The manufacturer's certification process and lessons learned gathered from previous installations of similar systems should also be considered at this stage. The required commissioning tests should be clearly documented and test results recorded.

During the system acceptance stage, the inspection and execution of all required installation and commissioning activities, including all system operations and functionality, should be performed to ensure installation of a physically complete and fully operational exit lane system. This is an iterative process with adjustments made as needed based on various test results. Airport stakeholders, including but not limited to local TSA, airport operations, and maintenance staff, should participate in this stage. This typically lasts only a few days, with the vendor often remaining at the airport to oversee necessary adjustments.

Final user-acceptance testing of the exit lane solution should be conducted to ensure the system has been installed and commissioned properly, and that it meets all functional, operational, and code requirements. Assuming the system meets all the requirements laid out in the contracts, the system can be formally accepted by the airport's designated authority to begin normal operations. (Note that TSA's testing and acceptance of the system for use in an unmanned capacity may or may not be included in the final acceptance testing described above. Each airport should coordinate with their local TSA representative to determine their acceptance process.)

Below is a template that can be used by airports to complete initial testing of their system. This can also be used for regular testing and auditing. Airport operators should customize the table to fit their system's individual requirements.

LOCATION & PERSONNEL	
Location:	
Individual(s) Conducting Tests:	
Date(s):	
TESTING	
Test Objects Used	
☐ Golf ball	☐ Baggage tubs
☐ Baseball	☐ Boxes

- ☐ Knife
- ☐ Gun or gun parts
- ☐ Airport ID media
- ☐ Cell phone
- ☐ Coins (quarters are the most common)
- ☐ Sheet explosives
- ☐ Other

DATE	TESTS PERFORMED	PASS	FAIL	COMMENTS
	Human – without crowd			
	Walking			
	Running			
	Crawling			
	Jumping Turnstile			
	Human – with crowd			
	Walking			
	Running			
	Crawling			
	Jumping Turnstile			
	Object – without crowd			
	Varying Speeds			
	Varying Trajectories			
	Left Object			
	Object – with crowd			
	Varying Speeds			
	Varying Trajectories			
	Left Object			
	Record/Report			
	Did the system record the individuals and/or objects that breached the exit lane?			
	Did the system record the events of a detected breach so that data can be forwarded to response personnel?			
	Did the data recorded provide enough information to adequately be able to resolve a breach situation?			

	Alert/Alarm			
	Did the system provide an audible pre-alarm that an individual and/or object has breached the exit lane?			
	Did the system provide a visual pre-alarm alert that an individual and/or object has breached the exit lane?			
	Did the system provide an audible alarm than an individual and/or object has breached the exit lane?			
	Did the system provide a visual alert that an individual and/or object has breached the exit lane?			
	Did the system detect a maintenance panel tamper test?			

4.1.2 Calibration

The airport needs to calibrate the new system to ensure the technology is functioning correctly for their environment. This is best done during or immediately after the initial installation and testing, while the vendor/manufacturer is still at the airport. Many airports experience calibration issues when first installing the system, but it is not uncommon for airports to identify post-installation issues during the first year of system deployment.

> One airport's optical barrier was recalibrated multiple times before it was discovered that the posts were installed six inches higher than those at the manufacturer's test site.

Occasionally, airports are required to recalibrate their systems seasonally if the light levels change or passenger flows change dramatically. The ability for the system to save and recall settings can be helpful when seasonal adjustments must be made.

In addition to the elements listed in Section 3.1.1, the most common elements that trigger false and nuisance alarms and require minor adjustments include:

- Dog leashes, especially long leashes, which tend to sway and drag (or allow a door to close with the dog on one side and the owner on the other)
- Multiple wheelchairs (e.g., an attendant pushing one and pulling another)
- Concessionaire carts, especially if long and/or tall
- Discrepancy in the system's mounted height (e.g., turnstiles that are tested at one height in the factory may need to be installed at the same height in the airport)

- Speed of revolving doors for multiple situations (wheelchairs, strollers, children, luggage, etc.)
- Speed of doors shutting behind an exiting passenger (typically for portal lanes)
- Pedestrian walking speeds (a slow pace and pedestrians using assisted walking devices often trigger left-object alarms)

4.1.3 Recurring Audits

Performing regular breach audits will test the equipment, staff, and security response and highlight any areas that need maintenance or training. The frequency of the audits depends largely on the exit lane solution, airport traffic, and frequency of breaches or nuisance alarms occurring.

Testing included in the audits can be categorized into four areas: human breach, object breach, false and nuisance alarms, and measures to defeat. Each category should be tested regularly, but not necessarily at the same time. Frequent response testing should be considered; however, most airports noted that the number of false and nuisance alarms during daily operations made additional response testing unnecessary.

A testing plan should be developed by the airport to ensure the system continues to meet the criteria that the airport and local TSA have defined. A variety of testing scenarios should be explored and documented, with the results kept on file for future reference or audits. These scenarios and situations should reflect common local activity as well as less common activity. The template included in 4.1.1 can be modified for this purpose.

Including airport stakeholders with multiple perspectives in the testing—such as airport security, local LEOs, the TSA, and airport communications and operations—can help identify potential breach opportunities.

Some systems are capable of detecting attempts to defeat them or reduce their effectiveness through altering or tampering with system components. Regular audits should also include attempts to access maintenance panels and other components that are accessible to passengers and the public.

4.2 Training

Most vendors provide some form of training to airport staff. This is typically basic operational training that takes only a few hours long after the system has been deployed, but it can also take as long as one or two days. At a minimum, airport operators should be able to perform basic troubleshooting and act as first responders to system error alerts.

Airports should discuss training options and costs with the vendor during the procurement phase to ensure personnel will receive the desired level of training. This may include preventative maintenance training, custodial maintenance training, IT training, or other department training, which may range from a few hours to a week duration. Airports should also confirm what costs are associated with operator training as this can vary significantly, with some vendors not charging at all.

> One airport sent a staff member to be trained at the vendor’s headquarters in Germany for several days. This person returned with complete training and was prepared to train other personnel at the airport.

Vendors may also offer training courses online or via video conference services. Airports should discuss potential training options with their chosen vendor or manufacturer.

Another consideration should be user manuals. Many vendors are headquartered in other countries, and some airports noted that the manuals provided to them by the vendors were not written in English. Airports should confirm that all manuals are written clearly in English or other preferred languages.

4.2.1 Maintenance

Most vendors offer training options for airport maintenance staff to address first-response repair issues. However, there may be additional charges for the training. Airports that provide training for their maintenance staff should consider train-the-trainer style instruction for their department managers and as many staff as possible to enable the training of new staff members in the future.

Additionally, the IT department should be trained on supporting the system's network or software application requirements. Many airports also add training for their IT department to perform minor issue maintenance on the device itself.

Ideally, the vendor or manufacturer's representative should be present to perform the maintenance or supervise in the event of a major issue.

4.2.2 Custodial Maintenance

Many prefabricated systems require specific cleaning methods to avoid disrupting the sensors or equipment. The vendors should document these requirements and train custodial staff on the appropriate methods and cleaning products. Coordination between operations and the custodial department is often required to disarm the alarms and lock the doors during the cleaning process. There should also be a system reset and test when the work is completed.

Some systems have a cleaning mode designed specifically for custodial tasks. It requires using a key or a code that locks the Sterile side door and allows the custodian to enter one lane from the public side to clean. The cleaning mode has a timer that provides a limited time to complete the cleaning tasks before the public side door closes and the normal security mode restarts. This avoids any possibility of the lane remaining open and unattended if the cleaner forgets to re-engage the normal operating mode.

4.2.3 Preventative Maintenance

Airports should create a regular preventative maintenance schedule. This may be coordinated with regular testing and auditing schedules, or may be performed on an independent schedule. Failure to conduct preventative maintenance appropriately could lead to larger issues that impact operations and may require assistance from the vendor or manufacturer.

4.3 SOPs and ASP Updates

SOPS

Airports must ensure that SOPs and contingency plans are in place for exit lane systems. However, airports should wait a short period after deploying the solution before finalizing procedures and plans to allow time to determine the best workflows. This will help minimize the number of document revisions.

Elements to consider when developing or updating SOPs include:

- Alarm response
- What constitutes a breach
- False and nuisance alarm response
- Emergency egress
- Points of egress other than the exit lane
- Preventative (planned) maintenance
- Responsive (unplanned) maintenance
- Cleaning procedures
- Authorized bypass
- System testing
- Recalibration procedure and individuals authorized to recalibrate

SOPs and contingency plans should be exercised periodically to ensure response staff remains familiar with all aspects of the system.

Chain of command during a breach incident is often dictated by the ASP, but procedures for alerting authorities to a breach incident should be written in an SOP to be used for training. Contact information for the airport's Operations/Communications Center and local law enforcement should be readily available to exit lane staff, LEOs, and TSA personnel, as well as any other relevant stakeholders.

AIRPORT SECURITY PROGRAMS (ASP)

The TSA does not "approve" the method for controlling exit lanes they no longer staff in airports—they only accept or do not accept the solution. However, the TSA can levy penalties or open a Letter of Investigation for breaches and any incidents that occur. As a result, it is in the airport's best interest to work closely with local TSA during the design and procurement stages and to update the ASP as appropriate.

Airports are required to address exit lane protection in the ASP, but there is no requirement for the level of detail. Many airports choose to keep discussions of the exit lane solution vague or provide a high-level overview of the solution. This is often due to the difficulties of making changes to the ASP, as any alterations require approval of the TSA.

Many airports that use personnel to guard the exit lane simply state that the lane is staffed and provide the hours that it is staffed. Airports using a technology-based system often state that the exit lane is protected with the type of technology and whether it is also staffed.

Some airports describe each alarm type (Breach, Thrown Object, Left Object, etc.) and the responses to each of these alarms in their ASP. Descriptions of contingency measures that will be implemented if the exit lane corridors fail to function properly or if alarms are not working in the access control system are also common additions to the ASP.

The ASP should include guidelines for what constitutes a breach. This typically means delineating a boundary (either physical or imaginary) that divides the public area from the Sterile Area. Other areas, such as the pre-alarm zone, can also be discussed if desired.

More detailed ASPs may include a description of how the system works and the responsibilities of the police and airport. Below is example language from an ASP addressing the alarm system in place at the exit lane:

> Beacon Alarms - used when an individual has breached (without proper screening) the entrance or exit lane of a checkpoint and whose obvious intention is to continue within the sterile without obeying recall instructions from TSA, law enforcement, or Airport Security personnel.
>
> Beacon alarms are reported by the Access Control System but should include a follow-up call by TSA to the SOC [Security Operations Center] with pertinent information about the subject.
>
> Beacon alarms are visual in nature and are designed to make air carrier personnel aware of the situation so that action can be taken to secure jetway and aircraft access doors. Additionally, an audio tone will accompany the beacon alarms along with a verbal announcement in the affected area(s).

Other airport operators utilizing the same or similar solutions may be able to share their SOPs and ASP language to help with creating the processes and procedures.

SECTION 5: OPERATIONAL CONSIDERATIONS

5.1 Configurations

In general, the design of an exit lane system will be dictated by the configuration of the exit lane. Compatibility of the technologies, exit lane configurations, and architectural surroundings should be carefully considered to ensure the exit lane maintains the needed security without creating high nuisance alarm rates.

Exit lanes generally fall into four lane/corridor configurations:

1. Simple door/abrupt exit
2. Corridor less than 20 feet
3. Corridor greater than 20 feet
4. Escalators and stairs

Each configuration has advantages and disadvantages for preventing breaches, and some exit lane control solutions will not work for all configurations.

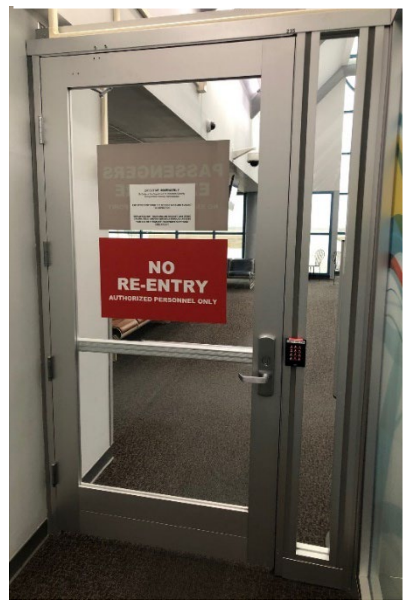
5.1.1 Simple Door/Abrupt Exit

Physically smaller airports or those with lower passenger volume often have simple door/abrupt exits, as shown in Figure 3. These can include:

- Single doors
- Double doors
- Automatically opening doors
- Authorized key opening doors
- Push-bar opening doors
- Sliding doors
- Glass doors
- Solid doors

These configurations typically need some sort of staffing to maintain security, although doors that need to be manually unlocked would not need continuous monitoring.

Figure 3. Example of a Simple Exit Door Layout



5.1.2 Corridors Less than 20 Feet

Airports with short corridors (less than 20 feet) do not have the space to implement several 10-foot alarm zones within the corridor, and may not be able to install certain types of systems (such as portal types) require longer corridors. However, there may be enough space to install revolving doors, “mantrap” portals, or two sets of doors to create a sally-port style exit lane. Some airports with short corridors have an open lane to maximize throughput, as physical barriers may result in passengers bunching and triggering nuisance alarms. Depending on the solution, it is possible that short corridors will need someone to staff the exit.

5.1.3 Corridors Greater than 20 Feet

Long corridors (longer than 20 feet) have the benefit of being able to support several 10-foot alarm zones and nearly any type of system, if the corridor is straight and level. Some longer corridors have turns or curves and a sloped floor, which is good for preventing sprinters from the public side, but will limit the types of systems that can be installed.

5.1.4 Escalators and Stairs

Airports with escalators or stairs within or near the exit lane are extremely limited in the options available. Some airports with this configuration add a door (revolving or automatic) at the public side to mitigate passengers entering the exit lane. However, this depends heavily on the space available at the top and bottom of the escalator. Adding a door or vestibule at the escalator's drop-off point could potentially create a back-flow issue if the doors cannot meet throughput needs. Often, airports with vertical cores within or near the exit lane choose to maintain an open lane with staff.

It is also important to note that the width of the corridor will have some bearing on the solution selection. Most portal-style solutions have limited width options. Airports installing a physical barrier will need to determine if the solution is too wide, or if a wall will need to be constructed or removed to ensure the system fits appropriately.

Escalators near the exit lane may cause some video interference in CCTV cameras (refer to Section 3.1.2).

Figure 7. Example of a Wide Corridor with an Automatic Sliding Door

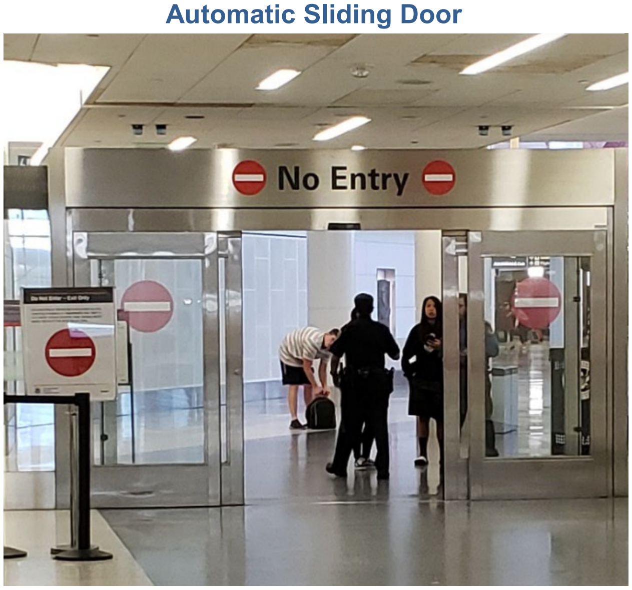


Figure 4. Sliding Exit Doors at the Bottom of Escalator

Figure 5. Example of Escalators Leading to Revolving Doors

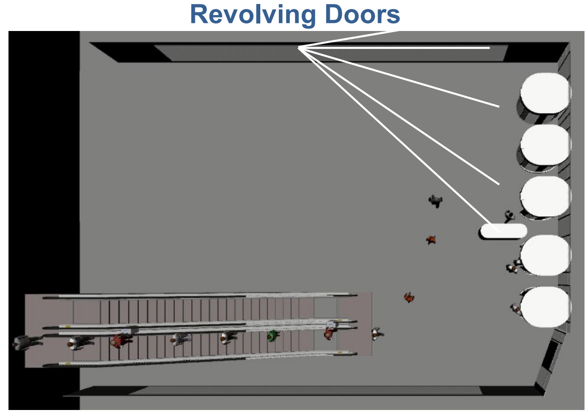


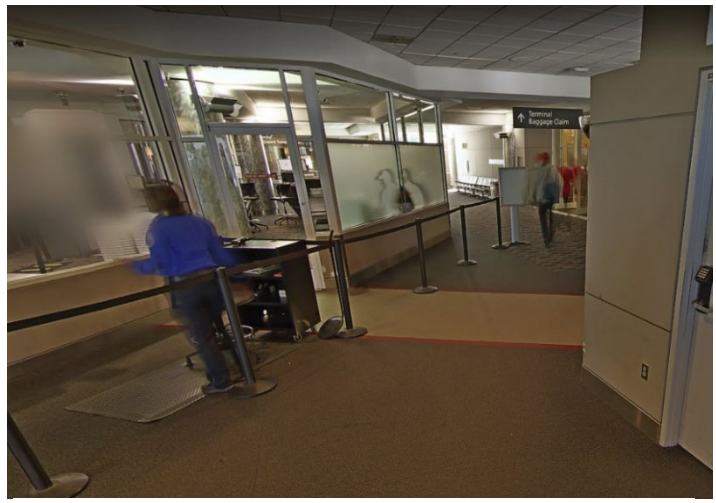
Figure 6. Example of a Narrow Corridor with Doors at Either End

One airport installed a motion detection system in the elevators at the end of their exit lane to detect persons in the car. The system allows the car to go down to the public area without issue, but prevents it from returning to the upper level with a person in the car unless an authorized airport ID badge is swiped on the access control panel.

5.1.5 Curves and Turns in the Corridor

Sharp turns or multiple turns would require sprinters from the public side to slow down, and could help prevent a full breach without impeding the flow of passengers exiting. However, turns and corners could limit solution options, as many prefabricated physical barriers require a specific length of straight corridor for installation.

Figure 8. Example of a Short Corridor with a Curve



Source: Google Maps

5.1.6 Tall and Curved Ceilings

Airports with tall ceilings in the exit lane have experienced some difficulties implementing technology systems. The height means that cameras at or near the ceiling need to be carefully positioned and able to capture high levels of detail for any form of video analytics. Standard-sized doors may leave gaps at the top, which could allow items to be thrown over them. The same is true of portal systems, which are designed at a specific height.

Airports with high ceilings often view the aesthetics of the terminal as a high priority. As a result, open lanes with a guard are the most common method for securing these exit lanes. However, depending on the ceiling height, some airports with tall ceilings have installed barriers and then added glass walls or netting above them to prevent objects being thrown into the corridor while maintaining the general aesthetics of the terminal.

Curved ceilings often have the same issues as tall ceilings but with the additional challenge of working around a non-flat surface. Cameras may need to hang from the ceiling or be mounted on wall brackets instead of being embedded to account for the angles created by the ceiling. Even low curved ceilings may require additional walls or netting to secure the area above the doors or devices.

5.1.7 Co-located vs. Independent Exit Lanes

There are two categories of exit lane configurations: exit lanes that are co-located and exit lanes that are independent of the SSCP. Independent exit lanes have no formal guidelines to follow, although any solution deployed must be accepted by the local TSA representative. On the other hand, co-located exit lanes have specific physical requirements, which can be found in the *TSA Checkpoint Requirements and Planning Guide*. For example, co-located exit lanes must be separated from the SSCP by, at a minimum, an 8-foot wall. Airports with co-located lanes should coordinate closely with their local TSA representatives to protect the exit lane.

Many exit lanes are staffed by TSA personnel as a result of the Bipartisan Act of 2013, which required the TSA to permanently maintain exit lane staffing at all 155 airports (mostly Cat I and X) at which the agency already performed those duties. Partly due to this, many co-located exit lanes use an open lane solution with TSA guards during flight hours and third-party guards after hours. However, airports with co-located exit lanes are not required to utilize TSA personnel, and may choose to deploy other solutions that meet the needs and requirements of their airport.

5.2 Throughput

An airport's exit lane system must match the exiting passenger rate (or "demand") to the system throughput capabilities. Demand is the quantity of exiting passengers per minute that must be served by the exit lane solution. The service rate of the system is throughput, typically quantified as a number of passengers per hour. Ideally, exiting passenger demand and the service rate of the system should be approximately equal, or the service rate of the system should be slightly greater than the demand. If the exiting passenger rate exceeds the service rate of the system, queues for the system will grow quickly during peak passenger times.

Throughput of the exit lane system is one of the most important decision factors for airports researching exit lane solutions. The throughput capacity may greatly affect customer service perception and emergency egress capabilities. The peak throughput should be determined for each exit lane as it can vary widely based on lane location within the terminal, number of arrivals at gates near the lane, and other factors.

Vendors will provide throughput numbers for each of their products; however, many vendors will quote the throughput rate of the system based on the cycle time of one of its key components (e.g., a door). In an operational environment, throughput is not that simple. Most systems are composed of a number of elements and, although many of these elements operate very quickly, the throughput of the solution is typically governed by its slowest element. Throughput is also determined by how quickly passengers access, are processed by, and exit the solution. Many vendors determine their throughput in a laboratory setting with users who may not accurately represent the airport's typical passenger.

Human factors have a major impact on throughput rates, especially when technology is used. Examples include:

- How quickly passengers understand use of the technology (e.g., do they understand the automatic door will open without pushing and may even stop if it is pushed)
- How quickly passengers move into and out of the technology (e.g., some passengers hesitate before entering revolving doors or mantrap systems)
- Number of strangers that passengers are willing to share space with (e.g., joining other passengers in a revolving door or tunnel system)
- Number and type of bags passengers possess (e.g., roller bags versus duffel bags)
- Bulky items such as wheelchairs, walkers, and strollers
- Animals on leashes and in carriers
- Walking speeds (e.g., elderly passengers and adults with children)
- Passenger behavioral patterns (e.g., most people in the United States travel to the right side and follow the person in front of them)
- Passenger demographics (age, travel frequency, mobility level, technology competence, etc.)

All of these human factors can be mitigated to a certain extent through appropriate messaging, and as passengers become familiar with the technology through its use at an individual airport or at various airports.

When reviewing throughput capabilities, airports should ask for the vendor’s testing methods; tests done in a factory setting or with test subjects who do not represent typical travelers may not accurately represent the throughput that can be achieved in the airport environment. It would also be beneficial to reach out to other airports using the technology to get an estimate of their throughput.

Typically, airports use an Average Day Peak Month (ADPM) standard for planning. This means that the technology solution must accommodate the demand of the average day of the peak month, accounting for the demand experienced on 85% of all days in the year. This means that up to 15% of the days may be busier and some congestion may occur as a result. Airports always have the option to plan for a higher demand level, but over-planning may result in unnecessary costs. Conducting time studies is the most effective way of determining the throughput need for each lane. Elements used to calculate the ADPM include:

- The flight schedule for the ADPM, which includes the arrival time to the gate, aircraft size (single or double aisle), seating capacity, and number of jet bridges used
- Load factor for the ADPM
- Percent of passengers terminating their travel at the airport
- Aircraft gate assignment by time of day (airline-exclusive or preferential gate-use policies should be considered)
- Number of gates served by the exit lane
- Any special-use exits that may pull additional passengers (e.g., exits to the parking garage or intra-airport rail systems)
- Arrival rate calculated on a minute-by-minute basis
- Passengers arriving on an intra-airport train system (must consider number of exits served by the train exits, train arrival schedule, and debarking rate of passengers)

Performing time and motion studies is especially important for airports that experience regular surges in passengers as a result of situations such as intra-airport rail stops.

Simulation modeling can offer airports the opportunity to “test” how technology can be expected to affect throughput for a fraction of the cost of deploying and configuring the technology. Such a model can be configured to test multiple system options, strategies, operational modes, and demand scenarios to find the solution that best meets the airport’s needs. Planning scenarios should consider operation of the system under special circumstances, such as emergency situations, and accommodating passengers with special needs.

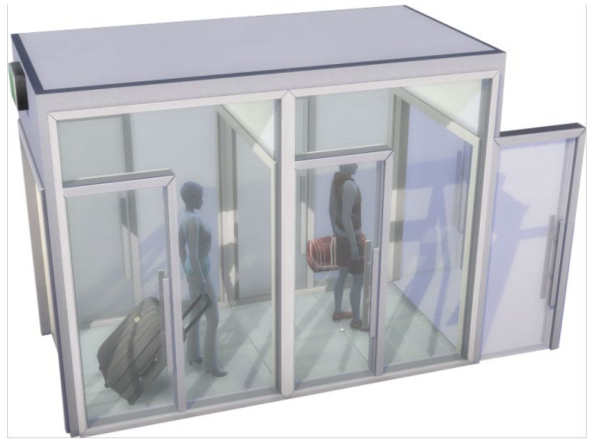
When analyzing demand and throughput requirements for the system, local airport policies, local fire codes, and ADA requirements must also be evaluated. It is important to ensure that the solution is capable of handling emergency egress demand.

5.2.1 Flow vs. Interlock

Airports choosing systems with isolation capabilities should consider which operational mode will meet their throughput and security requirements. There are two mode options that need to be considered:

- **Flow mode** – The exit lane system's entry and exit doors are both closed when there are no exiting passengers. The doors open as passengers approach the door, and remain open until no exiting passengers are detected. Flow mode allows for a much higher throughput because the Sterile side doors and public side doors are open at the same time in most instances. However, having both doors open at the same time provides opportunity for a breach. Flow mode still allows for monitoring, detecting, alerting, and isolating requirements, but may require staffing to maintain security.

Figure 9. Flow Mode



- **Interlock mode** – The public side doors only open when the Sterile side doors are closed. The public side doors open to let out the passengers while the Sterile side doors remain locked. This is sometimes called mantrap mode and is not favored by fire marshals for fire and safety reasons. The devices can be designed as straight or circular chambers (revolving doors). This mode is the most successful at preventing breaches, but also lowers throughput and may delay or impede exiting passengers. Airports considering interlock mode should plan on several rounds of testing and configuration to determine the optimal amount of time both doors remain locked.

Figure 10. Interlock Mode

Some systems have the capability to automatically change between flow mode and interlock mode based on a set schedule or detected passenger throughput. Some airports develop operational strategies that include a combination of these modes depending on threat levels. This often results in the system operating in flow mode during peak times and in interlock mode during off-peak times. This type of strategy could allow for a reduction or elimination of staff at certain times.

5.3 Authorized Bypass

Many airports have a need for an alternate access/bypass lane for authorized personnel. Some airports have authorized bypass through the exit lane while others have bypass access independent of the exit lane. Authorized bypass lanes are often used for access by KCMs, employees, first responders, LEOs, and large equipment (such as scissor lifts). Some of these authorized bypass types may not be compatible with all types of exit lane systems.

Many airports have chosen to add an authorized bypass hallway next to the exit lane when installing a new exit lane system. Often, this is a fortuitous circumstance resulting from extra space in the lane after installing the system. For instance, if the system is 10 feet wide but the existing corridor is 20 feet wide, an airport could add a wall down the length of the corridor to create a bypass hallway with access controlled doors at either end. Airports that add a bypass hallway in this way often include the cost of the wall in the contract with the exit lane system provider or as part of the larger scope of work for terminal projects.

Bypass hallways with only one door (regardless of whether it is closer to the public or Sterile side) may create spaces where individuals can hide. Two doors, one on either end, with access control is the most security-effective solution.

Airports intending to use the authorized bypass to transport large equipment between the public area and Sterile Area should carefully consider the width and the height of the door(s) and corridor. For example, a scissor lift may not fit through a standard door frame. Additionally, emergency personnel may experience some difficulty maneuvering stretchers through a narrow or curved corridor.

More on integrating access control technology into the bypass hallway can be found in Section 3.2.

5.4 Signage and Wayfinding

The space in the Sterile Area immediately before the exit lane, within the corridor, and immediately outside the exit in the public space should utilize wayfinding techniques that keep passengers moving, discourage stopping, and identify alert/alarm zones in the public space. Carefully designed wayfinding can help reduce nuisance alarms.

Signage decisions should be considered carefully and implemented to reflect the needs of the public and the design of the exit lane. Insufficient signage can lead to confusion and stopping or turning around within the exit lane, which may cause nuisance alarms. However, excessive signage can cause passengers to experience signage overload and "sign blindness," negating the effectiveness of the signage. It may take several attempts to find the most effective amount and placement of signage for each individual airport.

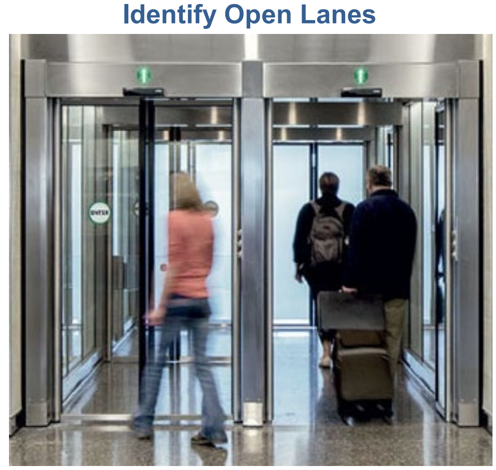
Typically, airports place signage at the public side of the exit lane advising individuals to stand back or not to enter the pre-alarm area. These signs can be placed on stanchions, overhead signage, on doors, or even on the floor, and often use TSA's recommended language or signage. Some airports choose to include signs advising of possible fines for violating the exit lane.

Some airports place signs within the exit lane or play an audible recorded statement that encourages passengers to continue moving to avoid setting off alarms.

5.4.1 Human Factors

Human behavior studies have shown that travelers in the United States tend to follow the person in front of them and stay to the right side of a corridor. For an exit corridor that has multiple lanes, doors, or portals, this often means that a line can form behind one or two of the units while the others remain nearly empty. Sometimes this bunching is caused by a staggering of the units within the exit lane, which unintentionally encourages passengers to choose one exit portal over another. This bottlenecking could be mitigated with signage either on the floor using carpet or stickers, above the individual units using colored lights, or using temporary stanchions to help define the lanes.

Figure 11. Example of Lights Used to Identify Open Lanes



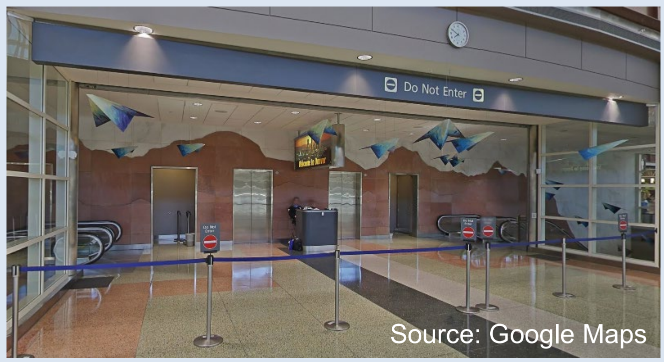
Source: Dormakaba

Figure 12. Example of Floor Signage

Some systems have built-in traffic flow indicators on the Sterile side that indicate which lanes are available to enter; these are typically seen above systems using an Interlock mode. The most common symbols are a solid red X to indicate that the lane is already in use or out-of-service, and a green arrow pointing to a lane that is available for use, such as in the picture above.

Many passengers look down at their phone while passing through the exit lane (scheduling ride shares, messaging family, etc.) Stickers on the floor or arrows in the carpet or floor pattern directing traffic may be useful for these passengers, but will encounter more wear and tear than elements on the walls or hanging from the ceiling. Some airports with carpeted lanes use different colored carpet indicating a path from sterile to public.

Denver International Airport is known for its paper airplane art, which serves a dual purpose by being both aesthetically pleasing and guiding exiting passengers from the intra-airport train stop at the bottom of a set of escalators to the main terminal hall upstairs.



Source: Google Maps

When performing construction at or near the exit lane, the airport should ensure there is enough signage to guide exiting passengers around the construction area and to the exit location.

Airports should also consider whether elements of their selected system may require instructional signage in order for passengers to navigate without incurring alerts or alarms. For example, a system that has the capability to isolate individuals who continue the wrong way down the lane may be triggered by an excited child, potentially resulting in the child being isolated from their family. To mitigate this risk, signage or an audible recorded statement could be added to the lane to remind families to remain together, or to warn of the consequences of moving in the wrong direction.

5.4.2 Meeters and Greeters

Meeters and greeters often wait near the public side of the exit lane for arriving passengers. At some airports—especially where the exit lanes are straight, the doors use clear glass, and/or arrival gates can be seen—these meeters and greeters will move toward the exit lane when they see their arriving passenger, potentially entering the pre-alarm/alert zone. When possible, the view of exiting passengers should be restricted until they are within the public area. This can be done in several ways, including restricting the area where meeters and greeters can wait, implementing turns or columns in the corridor design, or using frosted glass or film over glass doors.

5.4.3 Advertisements and Art

Most airports display advertisements and local art throughout the terminal, but these distractions should be kept out of exit hallways. The goal is to move the passengers from the Sterile side to the public area as quickly as possible and keep them from turning around within the space. Adding ads and art could cause exiting passengers to stop or to walk in the wrong direction, causing traffic blockages and setting off alerts/alarms.

Some airports have "Welcome to [Destination]" on the public side of the exit lane. While these signs indicate the correct exiting direction and location, some airports have seen individuals blocking traffic in order to take pictures in front of the sign.

5.4.4 Frosted Glass

The *TSA Checkpoint Requirements and Planning Guide* recommends using clear glass panels to separate co-located exit lanes from the checkpoint; this may deter breaches as the intruder can see TSOs monitoring the lane. However, adding frosted glass or frosted film to all or some of the glass partitions can also protect SSI and passenger privacy in the security checkpoint, as well as prevent potential bad actors from viewing operations and movement occurring in the Sterile Area and exit lane.

Frosted glass also prevents glare and shadows off the glass, which can set off nuisance alarms in some sensors and cameras . Additionally, some airports noticed that exiting passengers would often wave to waiting meeters and greeters through clear glass, which can set off the wrong-way alert/alarms. Frosted glass could help mitigate this problem.

However, some airports have noticed that frosted glass can cause confusion for exiting passengers who are unsure if they are exiting through the right portal. Frosted glass should always be paired with exit signage to minimize confusion.

For some airports, a combination of frosted and unfrosted glass may work best to allow TSOs to maintain visual contact with the activity in the exit lane while accommodating the needs of the system's sensors.

5.4.5 Courtesy Phones and Phone Numbers

The most common cause of breach incidents at airports is passengers who forget a personal item on the plane and then try to return to the gate through the exit lane. Providing a courtesy phone on the public side for passengers to reach someone who can help them retrieve the forgotten item could mitigate these types of incidents.

If courtesy phones are not an option, airports could consider adding signage that directs them to an information booth or provides numbers to call to connect with airport and air carrier customer service. This signage should be located so that it is obvious to those who need it, but does not result in passengers stopping and blocking the exit lane.

5.4.6 Digital Wayfinding

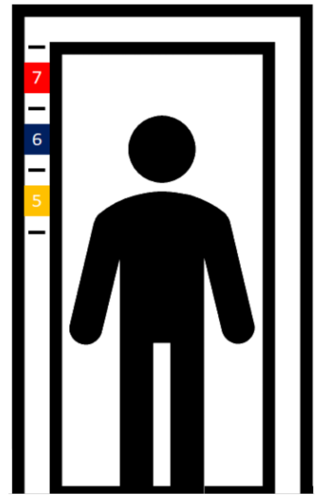
Exit lane locations should be clearly marked on all digital forms of terminal maps, such as on the airport website and signage throughout the terminal.

If the airport is in the process of moving exit lanes to another part of the terminal, or if construction temporarily moves or blocks the exit lane, ensure that websites, wayfinding applications, digital signage, and any other maps are updated to reflect the changes to prevent lost and confused passengers.

5.4.7 Identification Markers

Adding a height measurement sticker to each door provides forensic evidence to help locate and identify someone who has successfully breached the system. These stickers are commonly seen at retailers and have a relatively inconspicuous footprint.

Figure 13. Example of a Height Measurement Sticker



5.5 Maintenance and Reliability

Maintenance requirements and system reliability are major elements that airports should consider when choosing their exit lane solution. It is important that the system be able to function properly during routine and emergency operations with minimal downtime.

However, all solutions will need occasional preventative maintenance and minor repairs, as well as more frequent custodial maintenance. Airports should make plans and have contingencies in place for periods when the exit lane is non-operational.

Most technology solutions have some degree of self-diagnosis capability. This means that if a fault or error occurs in one of more of the operational components, the system will perform a self-diagnosis and a non-audible notification will be sent to the appropriate department for further review.

5.5.1 Custodial Maintenance

Most airports clean the exit lane corridor at least daily. Incorrect cleaning of the exit lane and its components can cause the system to consistently issue alerts/alarms.

Dust and debris can trigger nuisance alarms in floor sensors, or can prevent them from detecting legitimate breaches. The area around these sensors must be kept clean and free of debris, which requires frequent spot checks. Using water to clean around the sensors may also cause issues as water droplets or drying streaks can interfere with the sensor’s capabilities. Dry floor mops are typically the best option for sweeping around the sensors. If the sensors get dirty, they need to be carefully cleaned, often with a cotton swab and rubbing alcohol. Some airports may task maintenance staff with cleaning the more sensitive equipment while using custodial staff for general cleaning.

It is important to obtain proper cleaning products and equipment as specified by the manufacturer. This will ensure that cleaning products do not interfere with any of the components or analytic technology. Airports should also ensure their custodial staff is properly trained on how to clean the equipment (see Section 4.2.2 for more on Custodial Training).

Note that many airports install their new system during a terminal renovation project, and sometimes the system is put in place before construction is completed. By blocking off the sensors and cameras with plastic or temporary walls, the airport can prevent excess dust from the construction from disrupting the sensors’ functions.

5.5.2 Preventative Maintenance

Preventative maintenance will vary depending on the type of exit lane solution installed and level of traffic. Systems that rely on cameras, sensors, and video analytics require lower levels of preventative maintenance than systems that rely on mechanical elements, such as doors. However, most mechanical elements should not need more maintenance than a standard door at the same airport. Some systems have sophisticated programming that requires preventative maintenance along with the doors and sensors.

It is not uncommon for sensors, especially near the floor, to get bumped and misaligned through normal use and custodial maintenance. Regular preventative maintenance checks of the different system elements should be scheduled to avoid performance issues and failures.

Airports using any form of technology in the exit lane (including cameras) should create a preventative maintenance schedule and checklist as part of their regular audit and testing functions.

5.5.3 Irregular Operations

Planning for system downtime during irregular operations (such as construction or system failure) will enable the airport to minimize the total system downtime.

The SOPs should include designated roles and responsibilities for the different types of downtime and all relevant departments and stakeholders, such as operations/security, custodial personnel, IT, TSA, LEOs, nearby air carriers, and nearby concessionaires. Some of these stakeholders will be the first to encounter confused and lost exiting passengers.

Airports should make plans and SOPs for periods when the system may fail partially or entirely. These plans should designate an alternative route for passengers. If a minor element has failed, it may be possible for passengers to continue using the corridor or device. If this is not possible, airports should create signage that directs the exiting passengers to the next closest usable exit location.

For system failures, airports should have information for the appropriate vendor or manufacturer point of contact readily available. This information should be documented during the deployment of the system, and needs to be confirmed on a regular basis so that outdated information is not used in the event of a failure. A good time to confirm this information is during the airport's regular preventative maintenance schedule.

During contract negotiations, airports should ask vendors/manufacturers who will be performing the actual maintenance and repairs. In some cases, the vendor or manufacturer may outsource maintenance and repair tasks to authorized third-parties who are trained on the system; up-to-date contact information will also need to be maintained for these representatives. Airports should also work with their vendor/manufacturer to determine what is an appropriate and acceptable response time.

Airports not located within the continental U.S. (such as Alaska and Hawaii) may experience longer response times from vendors/manufacturers and their authorized representatives, as most have headquarters on the mainland but not in outlying areas.

5.5.4 Spare Parts

Most airports do not keep spare parts on hand for their system. If they do, their inventory is often limited to minor elements such as lightbulbs or replacement cameras, and they are stored with spare parts for other airport equipment.

Spare parts are most often ordered as needed from the vendor or manufacturer. This may cause some downtime, especially if it is an element of the system that prevents the entire solution from functioning, such as a door or mechanical belt. However, most airports that have needed to order spare parts received them within a couple of days, though some saw delays as long as a week.

> One airport noticed that their door was burning out belts more than they felt appropriate. They worked with their vendor to adjust the mechanical elements, reducing future burn outs.

Some airports have encountered difficulties when ordering replacement parts from their system vendor or manufacturer. This may be partly due to where the parts are shipped from; proprietary elements may need to be shipped from the factory, which may cause delays if the factory is overseas.

Discuss spare parts availability and ordering with providers during contract negotiations. A parts list and life cycle estimate for each part should be included as well.

SECTION 6: CHOOSING A SOLUTION

Some exit lanes are more compatible with certain types of technology. Table 1 indicates which configurations and technologies are compatible.

Table 1. Compatibility of Exit Lane Configurations with Technology Types

Configuration	Open Lane	Camera-based Systems	Portal Systems	Revolving Doors	Optical Turnstiles
Simple Door/Abrupt	✓	✓		✓	✓
Exit Lane <20 Feet	✓	✓		✓	✓
Exit Lane >20 Feet	✓	✓	✓		✓
Escalator/Stairs	✓	✓			✓

Table 2 shows the capabilities of the various exit lane technology types and their compatibility with some features.

Table 2. Exit Lane Technology Capabilities and Compatibility

Capability	Open Lane	Camera-based Systems	Portal Systems	Revolving Doors	Optical Turnstiles
Monitor	✓	✓	✓	✓	✓
Detect	✓	✓	✓	✓	✓
Deter			✓	✓	
Isolate			✓	✓	
Flow Mode	✓	✓	✓	✓	✓
Interlock Mode			✓		
Authorized Bypass	✓	✓			✓
Self-Diagnosis Capability		✓	✓	✓	✓

When considering different solutions and providers, airports should give more weight to practical, industry-proven technologies that have been deployed effectively at United States airports. These solutions are more likely to be accepted by TSA, comply with U.S. regulations, and have fewer unforeseen issues. The use of “cutting-edge” technologies should be carefully researched and reviewed before implementation and preceded by a smaller pilot or trial implementation.

Additionally, technology that has been deployed previously will give the most accurate estimate of the technology and equipment life cycle. This can be used as one factor to determine ROI.

6.1.1 Manned vs. Unmanned

Despite the many technology options available, staffing is still the primary method of exit lane protection. The lane may be staffed by TSA personnel, a contracted guard force, airport staff, or some combination of these. Airports with exit lanes staffed by TSA during flight hours often require contract guards or airport personnel to staff the lane after the checkpoint is closed or the last passenger on the last arrival leaves the Sterile Area.

If possible, the exit lane may be locked for the night. This might mean locking the doors or another physical barrier, such as a gate. Airports with terminals that remain open and have no physical barrier to secure will need the exit lane to remain operational or at least staffed all night.

Airports utilizing third-party guard staff typically rely on the use of post orders to outline the guards' schedules and responsibilities. Some airports require the terminal's exclusive air carrier to provide appropriate staff for the exit lane.

For airports with manned open lanes (no barriers), a two-person (or more) schedule is the most desirable. This allows one person to go on a break or lunch while the other remains at the exit. It also allows one person to handle any incident while the exit lane remains guarded. A two-guard schedule may not be necessary for co-located exit lanes or lanes near LEO stations, as TSA personnel or LEOs would most likely be close enough for a fast response.

Exit lane staff can be prone to distraction and boredom due to the monotony of the job, and exiting passengers often ask them questions. These factors can create an opportunity for a potentially bad actor to attempt to breach the exit lane.

While some exit lane solutions will not completely eliminate the need for staffing, adding solutions with at least one (preferably more than one) method to supplement the staffing will often allow for the reduction of staff, which will result in cost-savings. This may be a physical barrier such as a door or set of doors (such as a sally port), or sensors and cameras with wrong-way alarm capabilities.

If an airport chooses to operate the exit lane unstaffed, response protocols and SOPs should be instituted that clearly define lines of communication and response measures for alerts and alarms. These should then be practiced periodically to ensure ongoing readiness should an event occur.

VOLUNTEER STAFF

Some airports choose to utilize volunteer staff to assist with monitoring the exit lane. A number of airports use volunteers from the local government, such as the Chamber of Commerce or Tourism Board. The primary duty of these volunteers is to help exiting passengers by directing them to locations within the airport, putting them in contact with airport or airline customer service, or offering travel tips for the local area. These volunteers prevent the guards stationed in the exit lane from being distracted by questions from lost or confused exiting passengers. They can also help keep the flow of exiting passengers moving. These volunteers are typically stationed in the public area to eliminate the need for badging this population.

Because they are unpaid, the airport will often offer premium parking or other benefits to the volunteers in return for their service. Airports with any passenger volume can utilize volunteers in this way.

6.1.2 Open Lane

Open lanes are exit lanes without physical barriers. These types of lanes are staffed out of necessity and TSA requirement, but are very often paired with cameras, sensors, and/or video analytics to provide detection capabilities. These types of exit lanes are not well equipped to prevent breaches, but many airports choose them because they offer the highest throughput rates and are more aesthetically pleasing for their customers.

Most open lane configurations include a podium where the person guarding the exit lane can sit and monitor activity within the corridor. These podiums are often equipped with a computer monitor showing camera feeds from CCTV units in the vicinity, as well as a breach or alarm button that the guard can push to set off an alarm to get the attention of nearby TSA or LEOs, or to notify the Communications or Security Operations Center of a problem.

This lane configuration typically uses one or more of the camera technologies listed in Section 3.1 for detection purposes, with sensors positioned to create alert/alarm zones within the exit lane. Adding video analytic capabilities to an open lane configuration will not deter or prevent a breach, but could offer the airport real-time alerts that may minimize the effects of a breach or near-breach. This may be useful for authorities attempting to locate and detain the intruder, as many systems can transmit images and videos as text and email push notifications.

6.1.3 Portal Systems

Figure 14. Example of a Portal Style System

Portal systems, sometimes called tunnel systems, are prefabricated devices with two to three doors or barriers, with the ability to operate in flow mode or interlock mode (see Section 5.2.1 for more information). The system specifications and physical footprint vary by vendor and manufacturer, as well as model.

These devices have fixed physical specifications, which limits the airport configurations where they can be installed. According to vendors of these devices, layouts with short corridor lengths, sloped floors, or corridors with turns or curves may not be compatible. Because the portal's length and width are determined by the manufacturer, airports looking to use these systems may have to alter their exit lane in order to fit the devices within the corridor.

While not required, multiple portal devices can be deployed side-by-side, as shown in Figure 14, to meet throughput needs and provide redundancy in case of device failure.

Many portal systems include alerting and alarming technology, as well as lighting and video capability.

6.1.4 Simple Doors and Turnstiles

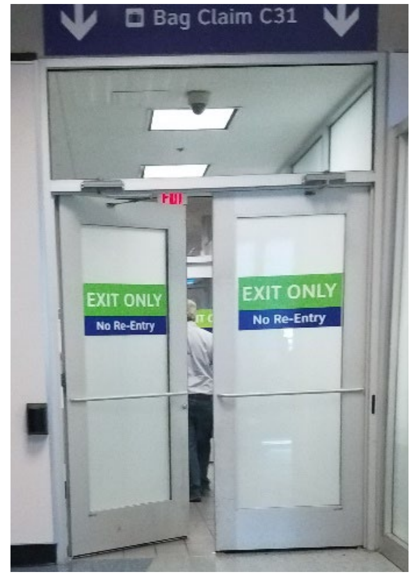
The use of doors as part of or exclusively as an exit lane system can significantly reduce the risk of unauthorized entry, though not eliminate it. Door breaches are commonly caused by unauthorized behavior such as passengers running through the doors, jumping over turnstiles, or holding the exit door open for someone entering the wrong way. Most simple door solutions require staffing or monitoring to prevent these behaviors; physical barriers (doors, turnstiles, portals, etc.) do not exempt airports from staffing lanes.

Sliding or hinged doors are often the most durable option. Airports choosing this option can expect similar maintenance requirements as other simple doors within their terminal areas. The hinges typically fail before anything else but, in general, these doors have a long life span. Airports should consider having them installed by a local company and requiring them to meet the same specifications of other doors installed at the airport. This will provide uniformity for maintenance staff and repairs.

Half-door or half-height turnstiles are not good at preventing breaches as they can be easily jumped over. Airports using these barriers should pair them with additional, full-height barriers and/or staff to help prevent barrier jumping.

6.1.5 Sally Ports

Figure 15. Example of a Sally Port Exit Lane



Not all portal solutions are pre-manufactured devices. Many airports use a sally-port style exit, often paired with a guard. These systems consist of two sets of simple doors, one at the Sterile side and one at the public side, which creates a vestibule.

Some airports station guards within this vestibule to monitor exiting passengers. If the doors are clear glass, nearby TSA personnel or LEOs may be able to monitor the exit lane from the Sterile side. Doors with frosted or opaque glass (as shown in Figure 15) would make it more difficult for nearby personnel to monitor the activity within the corridor, but also shield it from view of a potential breacher attempting to time a sprint through while doors on both sides are open.

6.1.6 Revolving Doors

Revolving doors (Figure 16) are a viable option for airports with short corridors, no corridor, or lower throughput demands. They are more effective for isolation than many barrier solutions, since the revolving door is capable of containing a breach simply by locking in place. Some revolving door systems have additional security features designed to detect objects that have been left behind, and to prevent objects from entering from the public side.

However, revolving doors are typically wider than a standard sliding door, to enable several passengers to exit at once. They also have a much lower throughput than a standard push door, and may be designed to slow down or stop completely if the doors are pushed on.

Many airports identified revolving doors as the least desirable option due to the lower throughput and resulting customer service issues. Only a handful of airports interviewed used revolving doors, and those airports did not view the doors favorably.

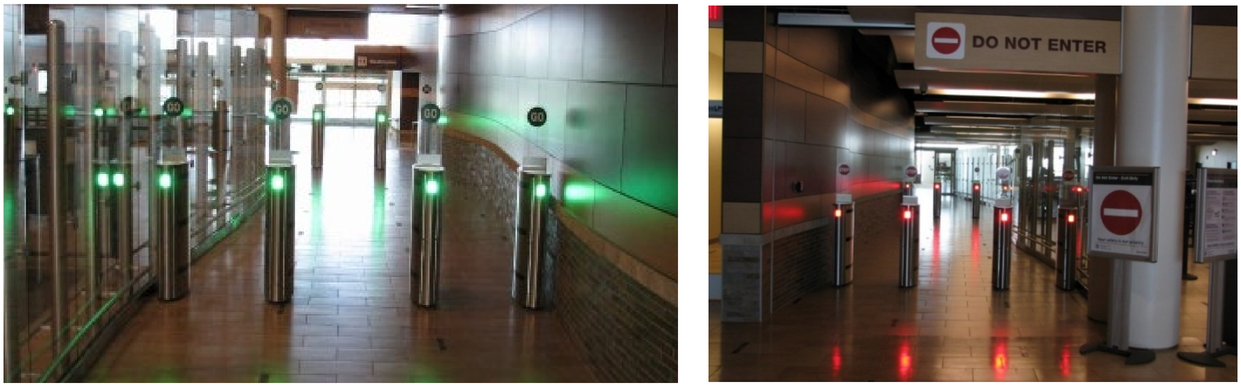
Figure 16. Example of a Revolving Door System

Source: Geoff Mulvihill/AP – NBCnews.com

6.1.7 Optical Turnstiles

Exit lane systems with optical turnstiles use two or more adjacent pedestals equipped with active infrared beams to create an invisible electronic field to monitor the passage of exiting passengers. The sensors also detect wrong way movements, which trigger alerts or alarms. These pedestals often have colored lights to indicate wrong-way flow, as shown in Figure 17.

Figure 17. Example of Optical Barriers



Source: Metropolitan Airport Authority of Peoria

Optical turnstiles can be used by airports with nearly any lane configuration, so long as the pedestals can be installed at the same height and at the optimal distance from each other, which will vary by vendor/manufacturer and model. However, these devices operate under similar conditions as an open lane configuration, and offer no means to deter or prevent a breach attempt. Some airports using this technology choose to also staff the exit lane, while others monitor the corridor with nearby TSA personnel or LEOs.

Some optical turnstile systems offer barrier options such as half-height glass doors or metal bars attached to the turnstile units. Airports with this setup have noted that it is easy for people to leap over these barriers and get closer to a breach. Pairing these devices with full-height doors at either or both ends could help deter and prevent sprinters, but may lower the throughput of the exit lane.

6.1.8 Engineered Solutions

Some airports have chosen to create a customized exit lane solution consisting of multiple technologies from several vendors, sometimes called "engineered solutions." While this enables the airport to create a solution that works specifically for their needs, there are also several factors that need to be considered.

- Multiple warranties to negotiate and manage
- Integration of several technologies, new and legacy
- Preventative and reparative maintenance responsibility
- Training time and cost for each element
- Installation/deployment scheduling and cost of all the elements

Airports that have created customized solutions typically worked with a consultant to coordinate the procurement and deployment of the technologies. However, some airports worked with specific vendors or had qualified personnel available at their airport.

The following factors should be considered when planning to implement a system with multiple integrated technologies:

- Project Manager / integrator experience and qualifications
- Selection of mechanical elements (doors, barriers, etc.)
- Selection of software elements (video analytics, access control, etc.)
- Ability of the integrated system to be operational continuously or for several hours every day during flight hours
- Warranty concerns with the integration of multiple systems
- Preventative and reparative maintenance responsibilities

SECTION 7: PROCUREMENT CONSIDERATIONS

Procurement of new technology and equipment is often an extended process that requires the airport to consider many factors before the chosen solution can be deployed. As with most things, the process for procuring the new solution may vary greatly from airport to airport.

Some airports may have planned terminal work that allows them to alter the exit lane during the construction. Some may develop the exit lane renovation project separately in order to upgrade or transition to an unstaffed solution. Others may be more interested in understanding what is available to them as they plan for a future project.

The following sections are designed to help airports in various stages of the procurement process navigate the factors they need to consider when looking at exit lane solutions.

> Safe Skies maintains a database of technology vendors and systems called FAST (Find Airport Security Technologies). This is a good resource for airports looking for vendors who provide the technologies discussed in this document, and can be found at fast.sskies.org.

7.1 Formal Procurement Options (RFP/RFI/RFQ)

In general, airports have three formal options to obtain information from potential vendors about their solutions. If the airport wants to begin gathering information but is not immediately committed to procurement, a Request for Information (RFI) or Request for Qualifications (RFQ) is often the best choice. Some airport procurement practices allow the airport to issue an RFI/RFQ and then invite qualified responders to reply to an RFP, or to procure directly with the most qualified company.

Directly contacting vendors for a one-on-one consultation is a less formal method of obtaining the same information and is discussed in the next section.

When developed properly, an RFP/RFI/RFQ (RFx) can save the airport an enormous amount of time identifying potential vendors or manufacturers. When developing the RFx, airports should include as many requirements and parameters as possible to ensure the submitted proposals provide concise information. Examples include:

- Minimum vendor qualifications
- Installation experience at airports, particularly integration with other systems if applicable
- General solution capability requirements
- Facility constraints worth noting
- Airport IT standards and existing architecture
- Applicable legacy hardware and software, including versions
- Hardware and software requirements, including initial licensing, any recurring licensing costs, and upgrade costs
- Applicable operational policies, including acceptable work hours, security requirements, etc.
- Preventative maintenance requirements
- Required throughput

- Vendor support requirements (business hours, phone, on-site, etc.)
- Training required
- Project schedule
- Cost per unit, lane, etc.
- Warranty and maintenance agreement options and support
- SSI requirements

It is not recommended that airports include testing requirements, to avoid making the RFx SSI. Instead, consider providing these requirements in writing to vendors for response and follow-up during the interview stage of the process. Many airports already have a process that defines what items will be considered SSI during the project. Most airports require the following assurances from the vendor:

- Non-Disclosure Agreement for the handling of SSI
- Any sensitive plans or materials provided during the bidding process will be controlled and either returned or destroyed
- A log accounting for all SSI in their possession, including documents related to the project in the future, drawings, etc.

Many airports installing new systems during a new terminal or renovation project place the burden of procurement on the contracted architect/engineer. However, the airport still has the responsibility to define the parameters of the solution, suggest vendors or manufacturers that it believes will meet its needs, and approve or accept the final solution.

7.1.1 Informal Procurement Options

Some airports prefer an informal approach to gathering information on vendors or manufacturers. There are a couple of options for gathering this information.

ONLINE RESEARCH

Safe Skies' FAST resource (fast.sskies.org) offers a list of technology manufacturers their products. This database is most useful to airports that know the type of technology they want to consider, but need help identifying vendors who provide the technology. This document, while vendor agnostic, offers discussions on different types of technologies and solutions and factors that may help an airport determine which option is best for their specific needs and requirements.

OTHER AIRPORTS

After airports narrow down the type of technology that is most compatible with their exit lane configuration, they may want to talk with other airports that have that technology. Airport conferences and industry events offer opportunities to talk to multiple airport operators at once. These events often feature vendor exhibits as well.

Airports should reach out to other airport operators to schedule visits to view and discuss their exit lane solutions, especially those that are using the solution under consideration. Also, make note of solutions when traveling; many airports receive suggestions from their management team members who have seen or used exit lane solutions during trips.

Below is a list of questions an airport may want to discuss with airports utilizing the solutions they are considering:

- What is the product or system’s expected life cycle?
- What is the cost per unit (both purchase and operational costs)?
- How much money/resources do you expect to save with the solution?
- What training was included and how long did the training take?
- What are common issues you have seen with the product or system?
- Have you experienced any downtime from the system?
- How is the company’s customer support (hours of operation, response time, etc.)?
- Who performs the repairs?
- What spare parts do you keep on hand?
- What warranties did you include?
- How often do you need to perform audits/tests and preventative maintenance?
- How long did it take to install and configure?
- How did you fund the project?

VENDOR CONSULTATIONS

Once the airport has narrowed down the type of technology they believe works for them, it is advisable to bring in vendors for a one-on-one consultation within the exit lane space. This allows the airport to interview the vendor, as well as enable the vendor to evaluate the site to determine if the solution would work within the constraints of the airport.

The vendor will need some information during the consultation to understand the airport’s needs and requirements. Having this information ready for the consultation will save time and allow for a more open dialog between the airport and vendor. This information may include, but is not limited to:

- What problem is the airport trying to solve?
    - Eliminate or reduce need for personnel
    - Replace existing solutions
    - Improve security, perhaps due to a specific type of threat
    - Increase throughput
    - Decrease false or nuisance alarms
- Is the airport going through a master plan or terminal construction project? Is this a stand-alone project?
- Is there an important deadline that must be met?
- Are there important metrics that the product/system should or must meet?
    - Throughput
    - False alarm rates
- What architectural features they need to know about? (many of these can be addressed with a site visit)
    - Ceiling height
    - Slope of floors
    - Floor weight-bearing capacity
    - Width of corridor

  - Length of corridor
  - Turns or angles within the corridor
  - Carpet or tile flooring
  - Glass walls or partitions
  - Vertical core systems (elevators, stairs, escalators) at the entrance or exit of corridor
  - Existing doors at the entrance or exit of corridor
  - IT infrastructure
  - Electrical infrastructure

- What important factors must the finished product or system meet (other than local or federal regulatory requirements)?
  - Aesthetic features
  - Open-area concept
- Is authorized bypass necessary? Would a specific hallway need to be created for bypass?
- Is location of authorized vendor repair technicians important?
- Is a train-the-trainer option important?

Airports should always obtain references from the vendors and confirm those references. This gives the airport a more complete understanding of the product they may end up procuring.

Below is a template that can be used by airports to gather information from potential vendors and manufacturers. The questions presented are common among all airport sizes, but are in no way comprehensive. Airport operators should customize the template to suit their airport's individual needs and wants.

COMPANY INFORMATION
Company Name:
Contact:
Email Address:
Telephone Number:
SYSTEM OVERVIEW
Provide an overview of how the system works
Is the system manufactured or assembled in the U.S.?
Does the system use commercial-off-the-shelf equipment for the hardware and electronic components?
What is the system's throughput and how are the numbers calculated?
Does the system have built-in ambient lighting?

Does the system have the ability to self-diagnose and reset itself (if it malfunctions) without human intervention?
Can the system be integrated into the existing legacy hardware and CCTV?
How much battery time does the system provide in the event of a power failure?
What ADA or fire codes does your system meet?
What facility challenges do you think the airport will experience at this airport in order to deploy your solution?
What are the main installation challenges the airport should anticipate (facility and operational)?
Is the system capable of object detection? Are there speed limits to how fast or slow an object must travel to be detected? What is the smallest size object the system is able to detect?
What is the system's estimated lifespan?
What is the cost of a single unit?
OPERATIONAL
Does the system offer the ability to operate in flow mode, interlock mode, or a combination of the two?
What types of signage are recommended to help passengers keep moving through the exit lane?
What types of adverse reaction to this system have you seen from passengers or the media?
Does the system offer alternative or bypass access?
Does the system push video or other data to smartphones or other devices/services?
What are common issues with the product or system?

MAINTENANCE
What warranties are available? How much do extended warranties cost? What do they cover?
What are the requirements for preventative maintenance? Who would perform this and how often would it be necessary?
Will the airport need to keep spare parts on hand? Where can spare parts be obtained and how long would it take to get them shipped to the airport?
Will the airport incur additional costs if we require your company to train our maintenance staff to conduct preventative maintenance for this system?
How frequently does your system require calibration or alignment?
What are the potential upgrades or software licenses that may be needed?
What training is included and how long will the training take? How many employees may attend training? Do all trainees have to attend the same training at the same time? How much will additional training cost?

INSTALLATION
How wide is your network of approved installation vendors in the U.S.? Where are they located in our city and/or state?
How long does it typically take to install each device?
What kind of testing is completed during installation?
Where has this system been installed previously?

CLIENT REFERENCES
Contact:
Email Address:
Phone Number:
Contact:
Email Address:
Telephone Number:

7.2 Return on Investment (ROI)

ROI is an important factor when choosing an exit lane solution. A solution may not have the same ROI at another airport. Factors that may impact the airport's calculations include:

- Current operational costs
- Current staffing costs
- Anticipated operational costs
- Anticipated staffing costs/savings
- Total project cost
- Procurement direct costs
- Airport indirect costs
- Annual utility costs
- Life cycle of the solution
- Routine maintenance costs
- Equipment reliability
- Cost of downtime
- Operational impacts of the technology

An important part of determining the ROI of an exit lane solution is considering the number of years the solution is expected to provide an acceptable level of service. This is usually expressed as a number of years beyond the date of beneficial use. The vendor or manufacturer will provide their estimate of the device's life cycle, but airports should also reach out to other airports using the same technology to help determine how long they believe the device will service their needs and requirements.

In some cases, airports may need to justify to air carriers, an airport authority, or others why the technology should be procured. The potential exit lane breach impacts outlined in Table 3 are for discussion only, but can be used to craft a scenario specific to the airport.

Table 3. Potential Impacts of Exit Lane Breach

Passenger Issues	Concessionaires	Airports	Air Carriers	Airspace Network
Long security lines, passengers stuck in the public terminal, missed connecting flights	Concessions on concourses/terminals lose significant revenues	Airports conduct recovery operations instead of normal operations	Takes days to recover	Exponential effect on entire country
Passengers holding reservations may face multi-day delays due to lack of capacity	Passengers will wait in public areas to be rescreened and then rush to catch their flights once they are in the Sterile Area, bypassing concessions	Negative media coverage	Millions per day lost by air carriers	Hub airports hit the worst

Too many inquiries to handle, phone lines jammed, customer complaints on Twitter and other social media skyrocket			Negative media coverage	
Local hotel accommodation may be difficult to obtain if many flights are canceled				

7.3 Funding

Exit lane system costs vary depending on which technology an airport chooses to purchase, as well as the specifics of the system installation and operation. When planning a budget, airports should ensure they include installation costs, maintenance, training, spare parts, extended warranties, and any new software licenses needed. The cost of installation will vary depending on whether the system is being installed in a new terminal or terminal renovation project, or into an existing facility.

When planning a budget, airports need to consider:

- Installation costs
  - Into a new terminal or existing facility
  - During a terminal renovation project or as a standalone project
  - As replacement of existing equipment
- Training
  - Types of training
  - Number of people trained
  - Hours to train
  - Location and mode of training
- Spare parts
  - Cost
  - Availability (including lead time)
- Extended warranties
  - Most vendors only offer a 1-year warranty with optional 1–3 year extensions
- Software licenses or upgrades
- Media storage
  - On-premises solutions may require purchase and installation of new hardware
  - Cloud solutions may require additional service costs

The most common funding source for exit lane technology is airport project funds. Some airports planned the installation of their technologies to coincide with new terminal or renovation projects, and funded the costs through those projects.

Many airports have on-call contracts with architects and engineers already in place. Airports should work with these contractors to find appropriate solutions for the airport's needs and to fill in gaps that exit lane solution vendors may not be able to provide (e.g., building walls to fill space or adding partitions).

Some airports that serve as a hub for a major air carrier received funding from the air carrier for procurement of the exit lane solution to be used in their exclusive terminal. Airports with an air carrier occupying an entire terminal may consider working with the affected air carrier to fund and procure solutions for exit lanes within that space.

7.4 Project Timeline

The project timeline can be divided into two major phases: the procurement phase and the deployment phase. Within each phase are multiple stages and steps that most airports will need to take.

Some airports reported as little as three months to fully deploy the solution (both procurement and deployment phases), while others took almost a year. Five to six months seems to be the average amount of time for full solution deployment.

7.4.1 Procurement Phase

STAGES

The procurement phase includes the following stages. Not all airports will need to go through each stage and may not go through the stages in the same order; this will vary by airport and airport authority.

- Research stage
  - RFI/RFQ/RFP
  - Determine product type
  - Determine product vendor or manufacturer
- Design stage
  - Determine product model
  - Determine installation location
  - Determine architectural changes
- Approval/acceptance stage
  - Meets all federal, state, and local codes and requirements
  - Confirm all functional/operational requirements are addressed
- Contract stage
  - Sign contracts
  - Purchase system and system add-ons (warranties, training, etc.)

DURATION

The type of procurement impact will how long it takes, as well as the requirements of the airport and the airport authority.

- Is it a contract for just the solution or is it part of a larger project such as a terminal redevelopment program?
- Is it an RFP/RFI/RFQ or is an on-call contract being used?

This phase also includes finalizing and signing contracts after a solution and vendor have been chosen. While this will vary greatly depending on the airport, it is common to assume at least three months to finalize contracts.

STAKEHOLDERS

Airports should include all relevant stakeholders in the procurement phase, especially during the design and approval/acceptance stages when changes can still be made with relative ease and at lower cost. Procuring a system without fully coordinating with other airport departments and stakeholders has the risk of failing to identify and understand operational impacts, overrunning operational budgets, and underutilization of the system.

Many stakeholders, such as security/operations, maintenance, custodial, and IT, may use staffed exit lanes for "emergency" bypass in certain circumstances. Implementing some types of technology may affect that ability, and should be discussed with those stakeholders.

Solutions that were accepted by TSA to be unstaffed at one airport will not necessarily be accepted to be unstaffed at another. For this reason, airports should work with TSA during the procurement phase—especially the design stage—to help alleviate their concerns and gain their support for the solution before the equipment is purchased and installed.

The fire marshal and other life and safety authorities should also be consulted during this phase to ensure the proposed solution meets all relevant codes and regulations. Many airports have had to make significant changes to their solutions, including adding guards, because the design of the solution did not meet the proper codes and regulations as interpreted by the relevant authorities.

Airports should discuss plans to move exit lanes with concessionaires, airlines, and other non-airport stakeholders who will be affected. Relocation of the exit lane may affect their sales as exiting passengers are directed to another area in the terminal. Additionally, many utilize carts to move product and supplies from the Sterile to public side. It is critical to address any questions about the size of carts and procedures that will be required.

7.4.2 Deployment Phase

STAGES

The deployment phase includes the following stages. Not all airports will need to go through each stage and may not go through the stages in the same order, as this will vary by the technology/solution chosen.

- Installation stage
  - Delivery of parts
  - Staging of partial systems
  - Integration with facility
- Configuration stage
  - Facility/infrastructure changes
  - Configuration of device(s)
  - Testing throughput and detection
- Training stage
  - Training all departments
  - Creating SOPs
  - Rewriting ASP language
- System acceptance stage
  - TSA testing and acceptance
  - Final system approvals
  - Device(s) fully functional for public use

DURATION

The type of solution procured will drive the installation, testing, and full implementation of the technology.

Shipment of the parts is determined by the manufacturer's location, which is often overseas. Most manufacturers have devices prepared for shipment before the final contracts are signed so delivery can take as little as 1–2 days, but may take up to a month if the device needs to be built or modified at the factory.

> One airport recently deployed a portal system in their exit lane. The equipment traveled directly from Europe, partially assembled, in large crates. The vendor assumed that the shipment would arrive directly at the airport via plane, but the airport does not have FedEx or UPS service. As a result, the shipment arrived at a nearby airport where it had to be offloaded from the international flight, loaded on trucks, driven to the airport, and offloaded again. This unanticipated process took about one week.

Device installation typically lasts 1–5 days per lane/device, and even less for simple door installation. This does not include the time to configure the device for the location, which can often take 2–5 days after installation. Occasionally, the configuration and testing stages last up to 2 weeks if the device(s) need further changes.

Terminal renovation projects may create a specific timeline that needs to be considered. The project manager for the construction project should be consulted to help determine the best time to receive the device(s) as well as timing to install them, especially if the exit lane space needs to be physically altered (temporarily or permanently) for the system installation.

STAKEHOLDERS

Airports should allow security/operations, maintenance, custodial, and IT to participate in the installation process. This enables them to ask questions of the vendors and receive informal training in addition to any formal training they receive. It also allows the stakeholders to work with the vendors to help configure the system.

The TSA typically requires testing of the system before accepting the solution. In most cases, this includes thrown objects, but often includes human breaches as well. Sometimes these tests require that the device be reconfigured if a potential security gap is discovered. Once the TSA has accepted the solution, the airport may need to update the ASP and receive final approval of the document from TSA.

The fire marshal will need to confirm that the facility still meets the required fire and safety codes. If they have been involved in the process up to the deployment phase, this should essentially be a formality for the airport.

BIBLIOGRAPHY

"Atlantic City Int'l Provisions for Scheduled International Service." Airport Improvement Magazine, March–April 2013.

Aratani, Lori. "A man walked through the wrong door at an airport, causing an hours-long shutdown and the cancellation of nearly 200 flights." The Washington Post, August 2019.

ASSIST CRP: Evaluation Report, Horton Automatics Secure Exit Lane System. National Safe Skies Alliance, January 2020.

ASSIST FAI: Exit Lane Breach Control System Evaluation Report – Phase I, Comtrol Restricted Area Automated Security System. National Safe Skies Alliance, February 2017.

ASSIST SNA: Exit Lane Breach Control System Evaluation Report, Aimetis Symphony™ 7 Video Management System. National Safe Skies Alliance, October 2017.

Aviation Security Consulting. Airport Guide to Exit Lane Protection. National Safe Skies Alliance, March 2014.

Chamberlain, Colleen. "Airports Oppose TSA Plan to Shift Exit Lane Responsibility." Airport Magazine, August/September 2013.

"Exit Lane Breach Control." Dormakaba.

"ExitSentry." CheckVideo, 2018.

FAA Reauthorization Act of 2018. H.R. 302 § 1920.

Faith Group. PARAS 0011: Guidance for Airport Security Master Planning. National Safe Skies Alliance, January 2019.

Garrett, Ronnie. "Portland Int'l Installs Automated Exit Lane Breach Control System." Airport Improvement Magazine, May–June 2017.

"Gateway Airport 1st in Southwest to install fully-automated exit lane." MyNewsMesa.com, 19 February 2018.

Gigandet, Dale. "An Introduction to Security Mantraps." 14 December 2018.

Implementing Recommendations of the 9/11 Commission Act of 2007. Pub. L. 110-53. 121 Stat. 266. 3 August 2007.

Jansen, Bart. "Airports worry about cost of guarding exit lanes." USA Today, 18 October 2013.

Lockheed Martin System Integration Team. Checkpoint Design Guide (CDG), Revision 6.1. Transportation Security Administration, 01 June 2016.

"Privacy Impact Assessment for Exit Lane Breach Control (ELBC) System." US Department of Homeland Security, December 2010.

Samlaska, Christian. "SEA-TAC Opts for Exit Lane Control Technology." Airport Magazine, August/September 2013.

Security Technology. “Solicitation HSTS04-08-R-ST1058.” May 2009.

Stevens, Kim. “AAAE Thanks Congress for Maintaining TSA Exit Lane Staffing at Airports.” State Aviation Journal, 22 December 2013.

Thompson, Carolyn and John Kekis. “Glass exit portals: Security to leave the airport.” NBCNews.com, 2 December 2013.

Transportation Security Administration. Checkpoint Requirements and Planning Guide (CRPG). December 2018.

TransSecure. PARAS 0004: Recommended Security Guidelines for Airport Planning, Design, and Construction. National Safe Skies Alliance, April 2017.

“TSA Modernization: Improvements to Aviation Security.” Senate Commerce Subcommittee on Aviation Operations, Safety, and Security, Statement of Brian C. Weiler. 28 September 2017.

Ward, Carol. “Airports, Trade Groups Fight New TSA Exit-Lane Policy.” Airport Experience News, 6 December 2013.

Wysocky, Ken. “Airports Boost Security & Reduce Operating Expenses with Automated Exit Lanes.” Airport Improvement, January–February 2016.