

The Future of Airports

A Vision of 2040 and 2070

Topic No. 4: Security Threats and Unlawful Activities

White Paper

ENAC Alumni – Airport Think Tank

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Foreword



In February 2019, ENAC Alumni – the alumni association of the National University of Civil Aviation (ENAC) – organized a day of discussion and education on the current and future challenges in air transportation: **The State of the Air (“Les Etats de l’Air”)**. This event, held at the headquarter of the French General Directorate for Civil Aviation (DGAC), was part of a broader effort to fulfill some of our primary missions toward our 24,000 members: to maintain their knowledge up to date, to provide them platforms where to express and exchange ideas, and to promote excellence in aviation & space.

In addition to master classes on Airports, Aircraft and Systems, Design & Certification, Airline Operations, Air Traffic Management, Aircraft Maintenance, Pilots & Flight Operations, Safety & Compliance, and Entrepreneurship, **the State of the Air** featured a series of roundtables bringing together key leaders of the industry in the sectors of air transportation, tourism and general aviation who presented their vision of the future.

Following the large success of the State of the Air, and considering the dedication and expertise of our alumni, it has been decided to take the momentum and invite our think tanks to launch projects on the future of aviation. These think tanks reflect the diversity and excellence of our alumni community: air traffic management, airline operations, airports, digital innovation, and sustainable development.

The Airport Think Tank chaired by Gaël Le Brissonne of the most active of our research groups. The Future of Airports is an important study that brings a significant value added to help us foresee future challenges and prepare our industry for the changes to come. The participants of The Future of Airports have provided remarkable work. The output of the working sessions and the research findings are being released as white papers and other practice-ready materials that will be shared and brought to decision makers and leaders of both the public and private sectors worldwide. I am confident that the outcome of this Think Tank will be a huge move forward for the promotion and recognition of the ENAC Alumni.

Marc Houalla, President of ENAC Alumni

Introduction



From March 2019 to April 2020, the Airport Think Tank of ENAC Alumni conducted a research project on the long-term future of the airport industry: “The Future of Airports”. The project involved thought aviation leaders from diverse backgrounds and affiliations who looked at the trends and potentially disruptive changes, emerging transformational innovations, their impact on practice and their challenges for air transportation, and the needs in research, education, and policies for anticipating and facilitating these changes.

The future of airports cannot be envisioned without considering the future of our societies. At the 2040 and 2070 horizons of our study, we will count more fellow human beings than ever. Overall, we will be wealthier and more educated, and have a longer life expectancy. However, we will all face increased impacts from climate change that will put pressure on resources and communities, and might increase inequalities. We will have different social expectations. How can aviation address these new paradigms and continue to provide mobility?

First and foremost, we shall never forget that safety always comes first. As we are making air transportation increasingly automated and connected, we shall remember that our top priority must be to safeguard life, health, and property, and to promote the public welfare.

Human-induced climate change is the most formidable threat to our civilization. Transportation must become greener if we want to sustain the development of our societies without degrading our well-being and endangering public health at a horizon increasingly visible. Aviation shall keep pioneering green policies.

As aviation professionals, we are on the front line to tackle the fundamental issues arising and still continue to interconnect people and move freight. Aviation shall remain a world of opportunities and “create and preserve friendship and understanding among the nations and peoples of the world” as stated in the Convention of Chicago of 1947.

By 2040 and 2070, it is likely that unforeseeable groundbreaking technological innovations, scientific discoveries, and social and political changes will occur and deeply impact our world. When reading these pages, remember that we conducted our work and prepared these materials with our eyes of 2019.

We are all part of this future, and we can make a difference individually if we make ethical and sustainable decisions. Aviator and writer Antoine de Saint-Exupéry said that when it comes to the future, “it is not about foreseeing it, but about making it possible”. Let’s make a bright aviation future possible together.

Gaël Le Bris, Chair of the Airport Think Tank of ENAC Alumni

Topic No. 4: Security Threats and Unlawful Activities

Existing Patterns of Terror Will Remain the Main Threat of Tomorrow

In 2017, then U.S. TSA Administrator Peter V. Nuffenger declared that “there is a spectacular nature to attacking aviation. First of all, it says something about you as a terrorist group if you are able to get through all the systems designed to prevent damage. But it also has a huge psychological impact and a very large economic impact”. This was true in 2017 and will still be applicable in 2040 and 2070.

The most common patterns have remained unchanged since the years 1970. Bombing the check-in counters or baggage claim and attacks with firearms by armed groups in the public area of passenger terminals have been used on multiple occasions. These modes of action maximize damages, casualties, and mediatic impact while they are difficult to prevent unless these efforts are identified prior to their action via intelligence and police investigation.

Early checkpoints filtering the access to the airport landside greatly perturb the flow of passengers, greeters, and workers without addressing the threat as they create bottlenecks that provide an easy target to terrorists. They are not relevant countermeasures. Vigilance from the airport community and awareness of passengers form the first natural barrier. Canine patrols specially trained for detecting explosives are an efficient deterrent inside the terminals at the most exposed airports as long as both the dog and the handler are adequately trained and comply with standard operating procedures.³ The next evolution could be walk-through sensors at the entrances of terminal facilities. Microwave radars with machine learning are already in use at some casinos and banks. Strategically located at terminal accesses, they might constitute an early warning system for detecting weapons and explosives without slowing downflows.

In the years 2000, radicalized individuals started increasingly ramming cars into the public. Used for the first time against an airport in 2007 in Glasgow (GLA), it has then been involved in multiple non-airport mass murders such as in Nice, France in 2016. The most efficient strategy is the protection of the terminal curbside with reinforced bollards or blocks. Current bollards are typically able to stop 1.5 to 7-ton vehicles (midsize cars to medium trucks) at 50-80 km/h (30-50 mph).¹ Systems capable of stopping heavier trucks exist too.

While they are not an airport-specific phenomenon, active shooters are an emerging threat at airports. The first mass shooting by an active shooter at an airport occurred in January 2017 at Fort Lauderdale-Hollywood International Airport, Florida (FLL). They are perpetrated by mentally unstable or radicalized individuals (FLL, schizophrenia; ORY, under influence with suspicion of radicalization). These are the most difficult to detect as they are committed by motivated individuals who can stay “under the radars” of counter-terrorism and law enforcement until they commit their crimes.

The Risk-Based Approach is the Future

Airports shall never again be the access door to aircraft for terror organizations. The 1994 hijacking of the Algiers-Paris flight AFR 8969 by the Armed Islamic Group (GIA) can be seen as a prelude of the September 11 attacks seven years later. In the period immediately following 9/11, the countries the most targeted by jihadist groups and their followers took exceptional measures to prevent aircraft hijacking and bombing. Adjusted multiple times afterwards, these standards provide an efficient security

³ As long as both the dog and the handler are adequately trained and follow standard operating procedures. Research in the U.S. demonstrated that inadequate training or non-standard practices deeply degrade the performance of canine patrols.

net today. The number of hijacking from departing countries where they are implemented has plunged, and the aviation community is now better prepared to counter in-flight attempts.

As in aviation safety, the Reason’s model applies in security. Adding layers of different measures and policies reduces the likelihood of an attack to be successful. Because terrorists – unlike safety issues – adapt to countermeasures and innovate as well, these security layers shall be versatile and evolutive. While they are already not the same from a region to another depending on local activities and global targeting of terrorists, they might not use the same layers from airport to airport in the future – depending on the reality of the threat. This risk-based approach is now promoted by ICAO. Per the Global Aviation Security Plan (GASep) roadmap², nations should conduct their own security risk assessment, elaborate a national security plan from this assessment, and then refine locally and implement at the airports. We are moving toward a similar framework than in safety, with an international framework, national safety objectives, and certifications based on local specificities.

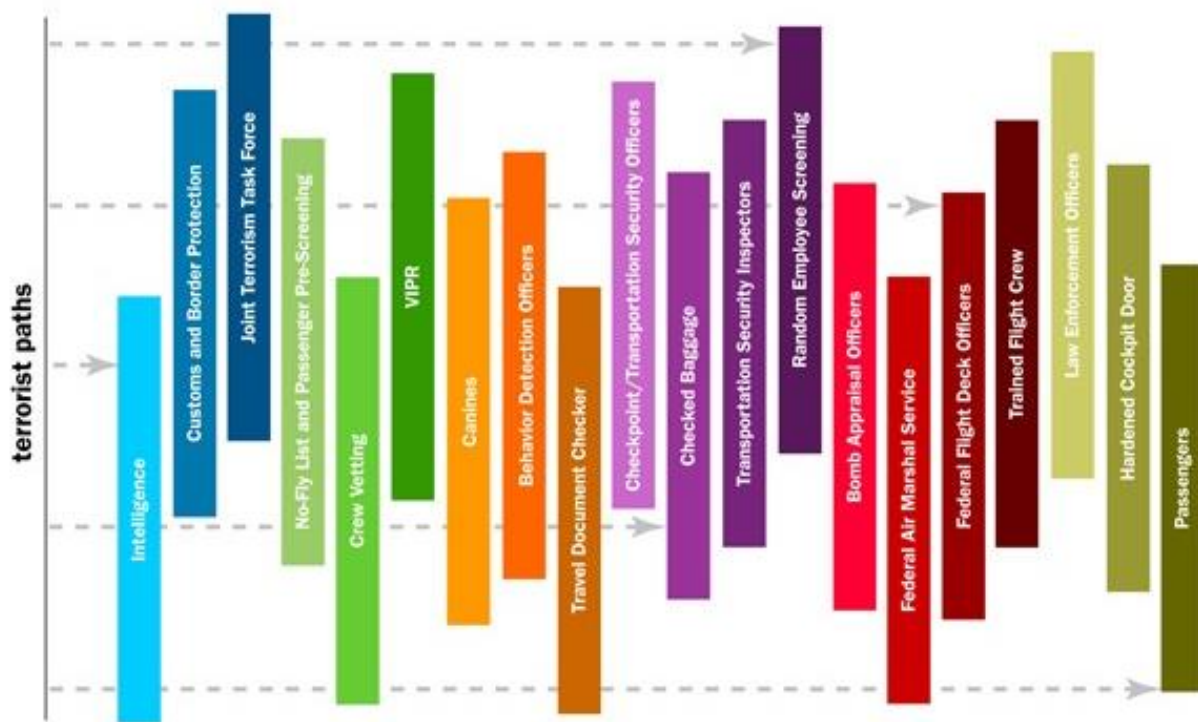


Figure 4-1 - Layered Security Approach in the United States

Source: U.S. Transportation Security Administration

While the post-9/11 measures intended to implement the same restrictive standards at all airports, it is now time – nearly two decades after the September 11 attacks – to reassess the threat and revise standards meet to future, long-term challenges. In the United States, the Transportation Security Administration (TSA) is designing the checkpoints of the future. TSA is considering introducing more pre-clearance levels to its Pre-Check program. Processes would range from the existing full-screening methods for the non-cleared passengers to a sensor-based walk-through concept with shoes and bag closed. Identification control could be expedited via biometrics. The goal of switching from a “100% screening” approach to smart and adaptive concept of operations is to increase capacity, lower operating costs, and reduce intrusion into the passenger journey.

Emerging Threats Require New, Specific Approach

Man-Portable Air-Defense Systems (MANPAD) have been used sporadically against civil aviation since the years 1970. Radical movements continue seeking their acquisition. Recently, the proliferation of limited but consistent stockpiles of these systems happened consecutively the 2003 war in Iraq and the 2011 Libyan civil war. These systems can be stored for long periods of time (up to 20 years) and reactivate them. Today, several hundreds of MANPAD units might be under the control of militias and terrorist groups. More than 50 strikes against civilian aircraft have been perpetrated, with about 30 of them accounting for about 1,000 fatalities. Since 2000, at least three civilian aircraft have been targeted in Eastern Africa and the Middle East. Such threats have cost these airports a delay in the development of air services. A 2005 study from RAND Corporation evaluated the potential economic damage beyond 16 billion USD if an attack was conducted in the United States. While airports are not currently equipped with active counter-measures, some airlines have decided to equip aircraft flying exposed destinations with flares (Arkia, El Al). As anti-surface-to-air missile (SAM) defensive lasers are being developed, the most exposed airports could be equipped with such systems in the future.

A Body Cavity Bomb (BCB) or Surgically Implanted Improvised Explosive Device (SIIED) was detonated at least once in a tentative assassination of a member of the Saudi nobility in 2009. BCBs are detectable by canine patrols and explosive trace detectors, but they are not by current body scanners. SIIED are not detectable by current systems unless the bomb holder takes an X-ray. However, because of the logistics required for implanting the device and limited blast yield, such weapons are primarily anti-personal bombs rather than massive destruction weapons. The target of the 2009 aggression was only lightly injured. However, this threat should not be underestimated.

After 9/11, western governments feared that extremist Islamic groups might have access to radioactive and fissile materials and try to manufacture nuclear devices or “dirty bombs”. While it seems that Al-Qaeda did explore such an option, it has not been established that any terrorist groups have ever secured significant quantities or even pursued the acquisition of materials – even ISIS that was in possession of exceptional means. They are expensive to procure, complex to manipulate, and require specific expertise to turn into an actual weapon.

As it is of bioterrorism. However, recent progress in bioengineering raises the question of easier access to these technologies and knowledge in the short-term. CRISPR genome editing was the AAAS 2015 Breakthrough of the Year. Compared to previous methods, it allows a highly efficient and selective editing of genomes. Could terrorist organizations, rogue governments or mentally unstable but skilled individuals^b create and spread enhanced diseases? Air transportation is a major vector of contagious disease and can contribute to creating a pandemic within weeks specifically by displacing subjects across borders (SARS, 2002-2003; COVID-19, 2019-2020). Spreading at the airport is as much as a concern than in any other public place. Some airports have designed their ventilation systems in anticipation of a potential pandemic to minimize transmission, filter the air of the airport with hospital-grade filters, and renew the air of the terminal. Emerging post-COVID-19 procedures may also make aviation more resilient to this threat.

Small Unmanned Aerial Systems (sUAS) are opening a new world of cost-efficient solutions in several domains. They are also available to the general public with very affordable pricing (US\$50-US\$200). Multiple airports, mainly in Europe and North America, have reported drone seeing and encounters that have endangered or perturbed air operations. In 2019, London airports faced characterized, repeated incursions of sUAS that were obviously intentional. While the objective might have been to disturb flight operations rather than constituting a real threat to aircraft integrity, these flights are still violating safety

^b In 2001, anthrax spores were disseminated by letters. The attacks, killed 5 people and infected 17 others, was perpetrated by a researcher seeking to revive interest in his anthrax vaccine program.

regulations and are a threat against flight safety. The potential damage of an encounter between an aircraft and a small UAS is comparable, for the aircraft, to a collision with a large bird.^c Commercial aircraft are by design able to survive such collisions, while general aviation aircraft and helicopters are more vulnerable and can be lost consecutively to bird strikes.

Technologies have recently been developed for countering sUAS incursions. They typically consist of portable GPS jammer or “canon” sending an electromagnetic impulse (EMI) to the drone that will make it fall or be forced to land. Recent efforts in research and development have focused on automated detection and identification as well. Systems have been tested or in the process of being tested at airports in the United States, the United Kingdom, France, and Israel. At the 2025 horizon, automated or semi-automated sUAS counter-measures might be part of the typical security equipment of hub airports with operators at the Airport Operations Center.

As discussed in the previous chapter, intelligent airports and connected passengers are a growing target for cyberterrorism. According to the 2019 Threat Intelligence Index, transportation currently accounts for 13% of cyberattacks. Airport public Wi-Fi is regularly the target of cyber hackers seeking personal information or cyber-ransoming of travelers. Sensitive airport systems require hardening regarding the evolution of the cyberthreat to prevent intrusions. Security systems themselves are exposed as they become increasingly connected. In this domain, a collaboration between the stakeholders of information technologies is vital beyond aviation. Initiative for sharing experience and responses are important. Locally, Computer Security Incident Response Teams (CSIRT) can organize exercises to raise awareness and stress-test systems and procedures – including at non-hub airports. But cybersecurity is neither a local or industry-specific issue, and broader initiatives are needed as well. We can mention the ATT&CK initiative of MITRE corp. with an online library and an annual conference.

Table 4-1 - Long-Term Threats to Airport Security

Threats	Recent Events	Long-term global risk	Prevention & Mitigation at Airports
Active shooter	FLL	High	Airport community awareness
Terminal bombing	BRU, ISL	High	Airport community awareness Canine patrols Sensors (future)
Cyberterrorism	Various	High	Hardening sensitive systems Best practices
Firearm attacks in terminals	KDH, KHI	High	Airport community awareness Sensors (future)
Hijacking airliners	9/11, ALG-MRS	High	Airport community awareness Screening process
Vehicles ramming into public	GLA	High	Bollards and other reinforced obstacles
Hijacking GA aircraft	N/A	Low	GA community awareness Airport watch programs
MANPADs	MGQ, BGW	Low	Laser defense (future)
UAS	LHR, LGW	Medium	Active counter-measures
Bioterrorism	None	Unknown	Ventilation systems

^c In most countries, sUAS regulations were designed based on the weight and density of drones.

Security Education and Stakeholders Outreach are Vital

Education and training of the greater airport community are vital for raising awareness on security threats. Airport professionals are on the front line and are the best people for identifying suspicious activities and recognizing threats. Facing shooters, every second count, and the action of each individual can save lives. An open gate can be the sign of an intrusion into the aircraft operating area. Recent events show that a lot can still be done in this domain. A widely disseminated awareness culture is also of a significantly helps in detecting and containing non-terrorist, non-criminal security offenses such as accidental intrusions that can degenerate into serious safety threats.

Security awareness should not be limited to a yearly recurrent session for badge holders. Joint training between the different stakeholders of the same area of the airport should be implemented. This outreach should include all the stakeholders potentially exposed to or able to provide early warning against terrorism and active shooters. Taxicab drivers in London now receive training for identifying and reporting suspicious customers, following the Brussels attacks. At least one large hub airport in Europe involves spotters in delivering them authorization, and in return constituting a small community active along the airport perimeter that can report suspicious activities and “fake” photographers.

While the potential use of General Aviation aircraft has been mentioned as a threat after 9/11, the reality of the field shows that such a tactic is not cost-efficient and effective. It requires a logistics involving pilot training and highly-explosive device preparation when these aircraft are slow and with a limited payload. The 2009 tentative suicide strikes by the Tamil Tigers (LTTE) using light aircraft demonstrates the difficulty of this modus operandum. Moreover, there is now a better security awareness of the general aviation community after 9/11, reducing the likelihood of a light aircraft being hijacked without being reported.

The Good, The Bad and The Ugly

The threat assessment that is the basis of the risk-based approach shall be revised periodically and triggered by alerts from the intelligence community, security events, or geopolitical evolutions. For instance, international terrorism threat is variable and is highly dependent on the results of the global war against terror and local actions for dismantling groups. As this paper is being finalized, terrorist attacks worldwide are dramatically decreasing with ISIS losing ground in Syria and Iraq. As long as poverty, violence, and political instability plague certain parts of the world, new “ISIS” could and will rise.

New movements and motives might also appear. After the “Golden Age” of nationalist and political terrorism in 1970-1980, jihadism took the lead in the years 2000. In 2014, Iraq and Nigeria accounted for more terrorist violence than the rest of the world. This peak of terror is dramatically decreasing with ISIS and its affiliates losing physical control over territories. Between 2013 and 2018, the majority of attacks in North America and Western Europe were carried out by individuals with far-right, white nationalist or anti-Muslim motives. Mass shootings in Norway and Christchurch by isolated but mutually inspired far-right extremists should raise concerns over potential white supremacist aggressions at airports – in particular when they welcome a diverse population of passengers such as pilgrims flying for the Hajj. On the longer term, eco-and social-terrorism could revive on the frustration of the most radical factions of green activism and radical anarchism. Aviation is increasingly in the spotlight and denounced by some for its impact on the environment. In 1982, an eco-terrorist group fired an anti-tank rocket at the construction of the Superphenix nuclear powerplant in France. Between 1978 and 1995, anarchist terrorist “Unabomber” had targeted persons and entities involved with technologies, including airlines – and at least one commercial flight.

State-sponsored cyberterrorism is a growing threat too. Over the past decade, mass cyberattacks with a strong suspicion of State-sponsorship have skyrocketed. Statewide power or internet outages have occurred in Estonia (2007) and Ukraine (2015). Dictators and rogue factions could go further and try to attempt to destroy the integrity of air transportation. Moreover, viruses targeting specific information system infrastructure could get out of control and contaminate critical networks and systems (e.g., Stuxnet, 2010).

Active shooters and suicidal individuals rejecting our society might be a major threat of the future – not only for aviation. Contemporary urban societies that aim at connecting many have created deep isolation of some. Suicides have been historically high within the youngest members of the community in Japan, while attacks with knives against school pupils have multiplied these past two years in P. R. of China. The United States struggles with mass shootings. Mental illness is growing by the number and can be exacerbated in countries and “cultures” of tight social control with a lack of solidarity. This pandemic is not yet fully recognized by governments, and is susceptible to creating new Unabombers and active shooters.

Criminality Must Be Fought Too

While these activities are not necessarily a direct threat against aviation security, criminality at airports exist as these facilities are doors to the world and large communities where goods and people live and transit. While Central America, Southern, and Southeast Asia are major centers of production for drugs, products are changing and their flows as well. Central Africa is now a major hub for drug trafficking. Criminal organizations are adaptive and seize short term opportunities, with for instance, a dramatic increase of smuggling from Venezuela as the political and economic structure of the country is falling apart. The current strategy against smuggling – a blend of police intelligence, canine patrols, profiling, and selected in-depth inspections of passengers and freight – might continue to be the most efficient.

According to the U.S. State Department, 600,000 to 800,000 people are trafficked across international borders every year, of which 80% are female and half are children. While there are no aviation-specific figures available, the use of air transportation for trafficking people worldwide is documented with long-term records.³ In 2016, the U.S. Congress made mandatory for air carriers to provide human trafficking awareness training to the cabin crews. Other countries have or are working on introducing similar legislation. Several airports have programs of human trafficking awareness, including to the public.

Some specific larcenies and scams such as fake taxis might target airports because of travelers and more specifically foreign tourists carrying valuables making them easy targets. However, strategies and best practices exist to prevent them. The organization of taxi pickups, the rise of app-based transactions, and broader information of passengers make it harder for fake taxis to proliferate. At Paris-CDG, driver unions have organized red-vest squads of volunteers to provide orientation to passengers exiting the sterile area and looking for taxis. At several commercial airports, pickup is extremely regulated, limited to licensed operators with specifically labeled vehicles, and ride fares to downtown or business districts are fixed or capped.

Appendix 4-1 - Selection of Physical Attacks Against Airports

Year	Airport	Description	Pattern
1975	SGN	MANPADs hit a Douglas C-54D-5-DC in Vietnam flying from Vientiane to Saigon. Six crew members and 20 passengers were killed in the crash	MANPAD
1978	<i>Enroute</i> VFA - SBY	MANPADs hit an Air Rhodesia Vickers 782D Viscount passenger airline by the Zimbabwe Peoples Revolution Army. Four crew members and 34 of the 56 passengers were killed in the crash.	MANPAD
1979	IAD	Bomb planted by Unabomber in the cargo hold of Boeing 727, operated by American Airlines, exploded forcing an emergency landing. 12 passengers were injured.	Bombing
1982	ESB	Bombing and shooting in the middle of a check-in area at Ankara Esenboğa Airport. The attack killed 9 people and injured 72 others.	Firearm attack in terminal
1983	ORY	Bombing of Turkish Airlines Check-in counters at Orly Airport by Armenian militants. The explosion killed 8 people and injured 55.	Terminal bombing
1984	LHR	Bombing at baggage claim of Terminal 2. 22 out of the 60 people present were injured.	Terminal bombing
1985	FRA	Bombing at the international departure lounge in Frankfurt Airport by Palestinian group with Libya complicit. The attack killed 3 people and wounded 74 other others.	Terminal bombing
1985	NRT	Bomb planted by Sikh separatists intended for Air India Flight 301 exploded during baggage handling ops. 2 baggage handlers were killed, and four of them were injured.	Terminal bombing
1985	FCO	Detonated hand grenades and opened fire at people queuing in front of the check-in of El-Al airlines (Palestinian-nationalists). 16 people were killed and 99 wounded.	Firearm attack in terminal
1985	VIE	Detonated hand grenades and opened fire at people queuing in front of the check-in of El-Al airlines. (Palestinian-nationalists) 2 people were killed and 39 wounded.	Firearm attack in terminal
1986	GMP	Bomb explosion outside a terminal building at Kimpo International Airport by North Korea. Five people were killed and 36, injured.	Terminal bombing
1988	AGA	MANPADS hit two Douglas DC-7 from Senegal to Morocco by POLISARIO militants in the Western Sahara on approach to Morocco. One DC-7 crashed killing all 5 crew members. The other DC-7 landed safely in Morocco.	MANPAD
1993	SUI	MANPADs hit a Tupolev 154B operated by Transair Georgia by Abkhazian separatist forces as it was approaching Sukhumi-Babusheri Airport. It crashed onto the runway and caught fire, killing 108.	MANPAD
1994	ALG-MRS	Air France Flight 8969 was hijacked by Armed Islamic Group of Algeria (GIA). Three passengers were murdered.	Hijacking airliner
1994	KGL	MANPADs hit a Dassault Mystère-Falcon 50 executive jet on final approach to Kigali. Aboard the jet were the Presidents of Rwanda and Burundi and its French flight crew. The attack killed all aboard and sparked massive ethnic violence and regional conflict.	MANPAD
1996	REU	Euskadi Ta Askatasuna planted two bombs in a rubbish bin that detonated in the passenger terminals. 35 people were injured.	Terminal bombing
1998	KND	MANPADs hit a Boeing 727-30 Lignes Aeriennes Congolaises airliner just after take-off from Kindu Airport by Tutsi militia. The attack killed all 3 crew members and 38 passengers.	MANPAD

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1998	JAF	MANPADs shot by Liberation Tigers of Tamil Eelam terrorists hit an Antonov An-24RV, operated by Lionair, off the coast of Sri Lanka after take-off from Jaffna-Palaly Air Base. The attack killed all 7 crew members and 48 passengers.	MANPAD
1998	NOV	MANPADs hit a United Nations-chartered Lockheed C-130 Hercules transport over Angola flying from Huambo to Saurimo by UNITA forces, killing 14.	MANPAD
1999	NOV	MANPADs shot by UNITA forces hit a United Nations-chartered Lockheed C-130 Hercules transport a few minutes after take-off from Huambo. All 4 crew members and 5 passengers were killed.	MANPAD
2001	USA	A series of four coordinated terrorist attacks by Al-Qaeda. Four passenger planes were hijacked. Two of the planes crashed into the World Trade Center complex, the third crashed into the Pentagon and the last crashed into a field in Stony Creek Township. 2,996 people were killed and over 6,000 were injured.	Hijacking airliner
2001	<i>Enroute</i> CDG-MIA	A failed bomb attempt (AQ) to detonate explosives hidden in his sneakers on American Airlines Flight 63. Passengers thwarted his plan, and the plane landed safely in Boston. No casualties.	Plane bombing
2001	CMB	Tamil Tigers attacked air force planes. All 14 attackers were killed, along with six Sri Lankan air force personnel and one. Twelve soldiers were injured, along with three Sri Lankan civilians and a Russian engineer. No tourists were harmed during the attack. Five SriLankan Airlines aircraft were destroyed.	Firearm attack
2002	MBA	MANPADs hit an Arkia Airlines Boeing 757-3E7 with 271 passengers and crew as it took off from Mombasa, Kenya by terrorists. Both missiles missed.	MANPAD
2002	LAX	Radicalized individual (Palestinian-nationalists) active shooter opens fire at the EI Al ticket counters. Two people were killed and four others were injured.	Active shooter
2003	BGW	MANPAD hit a DHL Airbus A300B4 cargo jet transporting mail shortly after take-off from Baghdad International airport. Though hit in the left fuel tank, the plane was able to return to Baghdad airport and land safely.	MANPAD
2006	MAD	Van bomb explosion in Terminal 4 parking area (ETA). The attack damaged the airport terminal and destroyed the entire parking structure and killed two people and injured 52 others.	Parking bombing
2007	MGQ	MANPADs hit an Ilyushin 76TD cargo plane shortly after take-off from Mogadishu International. The attack killed the crew of 11.	MANPAD
2007	GLA	Car loaded with propane canisters was driven at the glass doors of the Glasgow Airport terminal and set ablaze. It rammed into passengers. Five people were injured and 1 of the perpetrators died.	Vehicles ramming
2007	JFK	Aborted Islamic Terrorist plot for bombing a system of jet fuel supply tanks and pipelines that feed fuel to JFK. No casualties.	Airport bombing
2009	<i>Non-Airport</i>	Body Cavity Bomb (BCB) attack against bin Nayef (SIIED), who was injured.	Active shooter
2009	CMB	Air attack with GA aircraft used as flying bombs by Tamil Tigers targeting military facilities in and around Colombo, Sri Lanka. Two people died and over 50 were injured.	Aerial attack with GA
2011	FRA	Active shooter opened fire at USAF bus parked outside a terminal building. Radicalized individual (AQ). Two people were killed and two other injured.	Active shooter
2011	DME	Suicide bombing by North Caucasus groups in the international arrival hall of Moscow's Domodedovo International Airport. 37 people were killed and 173 injured.	Terminal bombing

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2012	PEW	At least five rockets were fired towards the airport by Taliban extremists. Three of those landed within the facility and two hit nearby residential areas. Militants then rammed a car bomb into the perimeter wall, sparking a fire with troops posted nearby. Nine people were killed.	Firearm attacks
2013	PEK	Individual tries to kill himself with explosives. The explosion only injured the bomber.	Terrorism
2013	ICT	Failed bombing attack by radicalized individual (AQ) with the intention of detonating a car bomb. No casualties.	Terminal bombing
2014	KHI	Ten Taliban extremists attacked the cargo terminal of the Jinnah International Airport with automatic weapons, hand grenades, rocket-propelled grenades, and other explosives. 36 people were killed and 18 injured.	Firearm attack
2014	DOK	Destruction by civil war. Pro-Russian separatist insurgents captured the terminal building of Donetsk International Airport. Paratroopers launched an assault on the airport, accompanied by airstrikes against insurgent positions	Act of War
2015	SAW	Bombing by Kurdish nationalists in the apron area of Sabiha Gökçen International Airport. One person was killed, and one was injured.	Terminal bombing
2015	KDH	Attack and bombing by Taliban extremists at Kandahar Airfield (joint-use airport). 61 people (11 attackers) died and at least 35 wounded.	Firearm attack and bombing
2016	BRU	Two suicide bombers (ISIS) attacked a departure hall at Brussels Airport. The attack killed 32 civilians and three terrorists, and more than 300 people were injured.	Terminal bombing
2016	ISL	Two assailants (ISIS) approached a security checkpoint and opened fire before detonating the bombs they were carrying. 3 attackers and 45 people were killed. More than 230 people were injured.	Firearm attack and bombing
2017	FNT	Radicalized individual (AQ) stabbed a police agent in the neck at Bishop International Airport. Police agent survived the attack.	Terrorist attack
2017	FLL	Active shooter opened fire near the baggage claim in Terminal 2. Five people were killed while six others were injured.	Active shooter
2017	ORY	Radicalized individual fails seizing weapon from a soldier of the Sentinelle operations. The individual was killed.	Firearm attack
2017	KUL	Kim Jong-Nam (brother of Korean dictator Kim Jong-Un) was attacked by two women with VX nerve agent near an airport self-check-in kiosk. Assassination was said to be ordered by the DPRK regime.	Chemical weapon
2019	AHB	Houthi rebels launched drone and missile attacks on a touristic Saudi civilian airport. One person was killed and several others were wounded.	Act of War

Appendix 4-2 - Selection of Cyberattacks Against Airports

Year	Airport	Description	Target(s)
2013	ISL	Access to the passport control system used at the international departure checkpoint was blocked by an alleged cyber-attack on July 26. Passengers stood in lines for hours and plane departures were delayed.	Passport Control System
2015	WAW	Around 1,400 passengers of the Polish airline LOT were grounded at Warsaw's Chopin airport on Sunday after hackers attacked the airline ground computer systems used to issue flight plans	Airline System
2016	BKP	Malware used to attack 3 Ukrainian energy providers was detected in a computer of the IT network of Kyiv's main airport (Boryspil). This network connects to air traffic control systems as well.	Energy Management
2016	HAN/SGN	Hackers successfully pulled-off cyberattacks against Vietnam's two largest airports and Vietnam Airlines. The attacks were attributed to a Chinese hacking group known as 1937CN. The govt. reported that hackers failed to cause any significant security issues or air traffic control problems.	Flight information Screens
2018	ATL	Hartsfield-Jackson Atlanta International Airport shut off its internal Wi-Fi network as a security measure as the City of Atlanta's network underwent a ransomware attack. ATL switched off the Wi-Fi service to avoid any malicious ransomware spreading to airport authority computers, airline computers, and possibly customers' computers.	IT systems Airport Wi-Fi
2018	BRS	A cyberattack caused flight information screens to fail for two days. A spokesman said the displays were ultimately taken offline as a precautionary measure to contain the attack, which has been described as similar to a ransomware. The airport temporarily displayed departure times to passengers off whiteboards.	Flight Information System
2018	MHD	Monitors at an airport in Iran were reportedly hacked in protest of the Iranian government. The messages on the screens at Mashhad's airport denounced Iranian casualties in regional conflicts.	Flight Information System

Abbreviations

AAI	Airports Authority of India
AAJ	Airport Authority of Jamaica
A-CDM	Airport Collaborative Decision Making
ACSA	Airports Company South Africa
ADAC	Abu Dhabi Airport Company
ADM	Aéroports de Montréal
ADR	Aeroporti di Roma
AENA	Aeropuertos Españoles y Navegación Aérea
AFIS	Aerodrome Flight Information Service
AI	Artificial Intelligence
ANN	Artificial Neural Network
APOC	Airport Operations Center
ASEAN-SAM	ASEAN Single Aviation Market
ASUR	Grupo Aeroportuario del Sureste, S.A.B. de C.V.
ATL	Hartsfield-Jackson Atlanta International Airport
ATM	Air Traffic Management
BCB	Body Cavity Bomb
BKG	Branson Airport
BNDES	Banco Nacional de Desenvolvimento Econômico e Social
CAAC	Civil Aviation Administration of China
CAG	Changi Airport Group
CAH	Capital Airport Holding
CDG	Paris-Charles de Gaulle Airport
CDM	Collaborative Decision Making
CNS	Communication, Navigation and Surveillance
CSIRT	Computer Security Incident Response Team
DAC	Dubai Airports Company
DAESP	Departamento Aeroviário do Estado de São Paulo
DFW	Dallas-Fort Worth International Airport
DOK	Donetsk Airport
ECAA	European Common Aviation Area
EGSA	Etablissement de Gestion de Services Aéroportuaires
EHCAAN	Egyptian Holding Company for Airports and Air Navigation
EMI	Electromagnetic Impulse
ENAC	Ecole Nationale de l'Aviation Civile
ENANA-EP	Empresa Nacional de Exploração de Aeroportos e Navegação Aérea E.P.
ERAU	Embry-Riddle Aeronautical University
FIT	Florida Institute of Technology
GACA	General Authority of Civil Aviation
GANP	Global Air Navigation Plan
GASeP	Global Aviation Security Plan
GMF	Global Market Forecast
GMR Group	Grandhi Mallikarjuna Rao Group
GTAA	Greater Toronto Airport Authority
HCC	Hub Control Center
IATA	International Air Transport Association

ICAO	International Civil Aviation Organisation
Infraero	Empresa Brasileira de Infraestrutura Aeroportuária
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IST	Istanbul Airport
KUL	Kuala Lumpur International Airport
LAWA	Los Angeles Airport World
LGP	LaGuardia Gateway Partners
LHR	London-Heathrow
MANPAD	Man-Portable Air-Defense System
MDAD	Miami-Dade Aviation Department
MIA	Miami International Airport
ML	Machine Learning
MRS	Marseille-Provence International Airport
MWAA	Metropolitan Washington Airports Authority
NEXTT	New Experience Travel Technologies
NFC	Near-Field Communication
O&C	Ownership & Control
OCC	Operations Control Center
OER	Örnsköldsvik Airport
ONDA	Office National Des Aéroports
ORD	Chicago-O'Hare International Airport
ORY	Paris-Orly International Airport
PPP	Public-Private Partnership
PPP	Purchasing Power Parity
PKX	Beijing Daxing International Airport
RPA	Regional Plan Association
RTC	Remote Tower Center
rTWR	Remote Tower
RVA	Régie des Voies Aériennes de la République Démocratique du Congo
SAAS	San Antonio Airport System
SAATM	Single African Air Transport Market
SAT	San Antonio International
SDL	Sundsvall-Timrå Airport
SFB	Orlando Sanford International Airport
SIIED	Surgically Implanted Improvised Explosive Device
SIN	Singapore-Changi International Airport
SJU	San Juan Luis Muñoz Marín International Airport
SWIM	System Wide Information Management
TAM	Total Airport Management
TIP	Tripoli International Airport
TNC	Transportation Network Companies
TRT	Turnaround Time
UAM	Urban Air Mobility
UATM	Urban Air Traffic Management

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