# Present and potential security threats posed to civil aviation

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*Abstract: Aircraft presents ideal object for terrorist attack. Apart from the risks posed by possible terrorist attacks on airborne aircraft, air terrorism includes the threats to general aviation on the ground, including airports and surrounding infrastructure. Air oriented terrorism in all of its forms can undermine public confidence in the safety of air travel, which could result in negative effects for certain airlines and other firms in aviation industry due to decline in passenger travel and cargo shipment. This article is giving an overview about the redoubtable present and potential future threats posed to in-flight security, and possibilities and solutions how to mitigate the risks on acceptable level.*

*Key Words: aircraft, threat, security, aviation, risk*

*„In a free and open society, we simply cannot protect every person against every risk at every moment in every place. There is no perfect security."*
*Michael Chertoff, former U.S. Secretary of Homeland Security*

## 1. INTRODUCTION

Security is more and more a strong social demand in the new world environment, not excluding air transport. Aviation security is concerned as a one of the main global challenges of this centu-ry. Fear of the aviation terrorism in all of its forms is spreading worldwide and touching almost all passengers. Civil aviation is an attractive target for terrorists due to considerable media interest, with tremendous potential human victims, material damages and psychological impact on community. Terrorists are using asymmetric methods which are difficult to reveal and defend against them.

The morning of September 11, 2011 entered into history as a time that changed the way we live for many years to come. Although terrorists have targeted aviation many times in the past, prior to 9/11 hijacked airplanes had not been used as a weapons against ground targets with such a vast consequences. The terrorist attacks demonstrated vulnerability of the commercial aviation and pointed out that the protection of aviation should be the international and national priority.

## 2. IN-FLIGHT SECURITY BEGINS ON THE GROUND

In a response to the 9/11 attacks, the Transportation Security Administration (TSA) was established by the Aviation and Transportation Security Act of November 2001 in the subordination of the U.S. Department of Homeland Security agency. TSA has developed

twenty layers of security as a general prevention against any kind of terrorism directed towards air transport. These layers form a complex system which plays a role in preventing or detecting terrorist attack or attempt in any stages to occur and is being applied not only on passengers but also on all people associated within the airport secured area. This security measures/approach was generally adopted in other countries taking into account local conditions, type, size and financial possibilities of an airport.

Briefly, these layers comprise various security officers specially trained for work in aircraft and on airport, random employee screening, task forces, several check-in and passenger screening procedures. Also all cargo and passenger luggage have to undergo an explosive trace and x-ray screening. Important that only three out of twenty layers are connected with an aircraft, while all others are associated with the airport. These three layers are:

- Hardened cockpit doors as an extra level of prevention of terrorism,
- Federal Air Marshal/ Federal Flight Deck Official specially trained for work in an aircraft in undercover,
- Flight Crew with self defence training in case of assault.

Each of these layers alone is able to inhibit or stop a terrorist attack. In combination their security value is multiplied, creating a much stronger, formidable system. A terrorist who has to overcome multiple security layers in order to carry out an attack is more likely to be pre-empted, deterred, or to fail during the attempt. Once the threat is detected at the airport, the chances of threat occurrence during the flight is reduced. Airports are closely working together with airlines toward the highest level of security in the area. New technology is playing an important part in airport security in maximising the overwhelmed ideas from terrorism. The following  equipment for baggage and passenger screening are examples of how  high innovative technology is or should be implemented as part of airport security system:

- Dual energy X-ray automatic explosive detection,
- Ion mobility spectrometer,
- Beams of radio frequency (RF) energy in the millimetre wave spectrum to construct a three-dimensional image,
- Direct high energy X-ray at passenger and uses the reflected beam (or backscatter) and highly sophisticated software to display both organic and inorganic objects on passenger,
- New mobile units being developed for liquid identification (identifies inflammable, corrosive and explosive liquids and triacetone triperoxide (TATP) precursors).

Although the advantages of layered security were described above, disadvantages are sometimes outbalancing the benefits. Due to the extremely costly machines and lack of government funds on the developments and implementations, many airports and airlines rather use the available resources on innovations, product developments, services and training as security does not appeal as significant as these factors, especially at times of economic crisis. Also some layers are objects of criticism for unbalanced or inadequate security standards and procedures across the countries. Overpriced machines unable to detect all forms of threat, frequent false alarms, time delays or under-trained personnel are only some them. As for the layers concerning the aircraft e.g. Federal Air Marshal Program has been criticised as the most useless and most expensive among the other security layers. The demand of trained on board air marshals is perpetually high, therefore the training level has

been reduced in order to accommodate the required numbers, so many of them are unable to detect a terrorist hiding among the passengers.

### 3. TYPES OF THREAT

While the greatest threat is perceived to be from potential bombings of aircraft, suicide hijackings and attacks using aircraft as weapons against ground targets (9/11 attacks) remain a risk not only for commercial passenger and all cargo aircraft, but for General Aviation (GA) operators as well. Additionally, faced with enhanced security measures surrounding passenger airline operations, terrorists may resort to the use of specific threat to aircraft from shoulder-fired Man Portable Air Defence Systems (MANPADS) discharged beyond perimeter fence of airport or other stand off weapons to target passenger aircraft. Leaders of G8 countries at the summit in Evian in 2003 approved a MANPADS action plan and in the same year the Wassenaar Arrangement – multilateral guidelines adopted for control of MANPADS transfer was signed. Organisation for Security and Cooperation in Europe adopt these guidelines in 2004.

Present-day aviation policy and security must fully consider this broad array of potential terrorist attack scenarios to assess the overall risk picture and determine the most appropriate course of action.

### 3.1 Bomb attack

Bomb attacks on aircraft are proliferating in present world conditions. As for other types of threat, protection against bomb warning lies mainly on shoulders of ground (airport) security. An effective and relatively inexpensive protection of passengers and aircraft against potential harm from luggage-borne bombs is critical. Only consistent, multilevel monitoring and scanning of passengers and cargo, including banning of all dangerous, suspected and unaccompanied freight shipments could reduce the risk of further such events. Intelligence is also one of the key factors and way how to discover something doubtful. It can discourage the use of bombs in addition to protecting passengers and aircraft. Solutions to date have included bomb-detection systems and explosion-containment systems.

An luggage container with explosive-absorptive or explosive-resistant construction could be a right option as an aircraft protection. Several successful tests have been made which confirmed that a potential in-flight luggage bomb explosion will not have negative impact on passengers or aircraft. The question remains the costs of this construction and airline`s interest to invest into this protection.

### 3.2 MANPADS

Shoulder fired MANPADS are light, easy to transport and fast to unfold surface to air anti-aircraft missiles. They can use 3 types of guidance: infrared, CLOS (command line of site) and laser beam. Wide spread of these weapon systems is dated back to seventies of the last century. Up to 1 million MANPADS were manufactured by now. They soon proved deadly effectiveness by shooting down or damaging military and civilian aircraft. Although the threat of civilian aircraft shootings has historically been confined to civil aviation operations in war regions of the world, there is growing concern among some aviation security and counter terrorism experts that there is an emerging worldwide threat to civil aircraft from shoulder fired weapons and perhaps other stand off weapons. Many aviation security experts have speculated that, in the post 9/11 environment, increased security measures at airports (which become more effective against other methods of attack like hijackings and bombings)

may logically lead terrorists to contemplate such attacks, allowing them to target aircraft, passenger airliners in particular, from far beyond the airport perimeter and its associated security enhancements.

Civilian aircraft remain quite vulnerable to an attack from MANPADS. They fly at low altitudes within range of shoulder-fired weapons for extended distances during take off, departure and approach to landing. Commercial aircraft, unlike the military ones, do not carry any special countermeasures to repulse a missile attack. Also, large commercial aircraft are not agile or maneuverable enough to effectively evade a missile attack. Since 1970s, 40 civilian aircraft hit with 600 deaths (source: US Department of State).

There is no single general solution to effectively mitigate the threat to airliners posed by the stand off weapons that are available to terrorist groups. Only a risk-based, multi-layered approach involving an assortment of options for preventing terrorist acquisition of these weapons, disrupting terrorists activities during their planning and preparation of an attack and reducing the risk of such an attack through enhanced airport and flight operational security measures offers the best solutions to mitigate the risk to the flying activity posed by MANPADS to acceptable level.

### 3.3 Hijack

Hijacking an airplane is one of the most effective means for terrorists to achieve their intended goals for several reasons. Every act of air terrorism is widely broadcast by the global media, which is the main goal of the terrorists. There is no need for significant financial or technological resources. The risk to the perpetrators is quite low in comparison with the danger to the passengers and crew of the plane. In case of airliner crash, it is virtually certain that every person on board will perish and the death of the perpetrators in such a manner guarantees them anonymity, thus increasing public fear.

There are generally two main motives for terrorists for hijacking. First one is an escape from a particular country, when a hijacker forces the crew of an aircraft to alter the direction of a flight in order to land in another state. The second reason for aircraft hijacking is extortion, when hijacker essentially holds an aircraft, its crew and passengers for ransom. However, the fulfillment of these demands depends completely on the government, not on the crew members or owners of individual aircraft. Furthermore, some acts of air piracy are carried out by individuals wanting to protest against the policy of particular country.

### 3.4 „9/11" Hijack

Large passenger plane with travellers on board destroying important civilian, military, or governmental targets on the ground. A small civilian aircraft used for a suicide mid-air collision, to ram a jetliner during take-off or landing, or used to destroy an airport terminal, causing a huge number of fatalities and tremendous infrastructure damage. These are only some examples of potential scenarios when hijacked aircraft is used as a „manned missile".

NATO developed a new concept called "Renegade" for dealing with such a threat. Officially, NATO defines renegade as an aircraft operating in such a manner as to raise suspicion that it might be used as a weapon to perpetrate a terrorist attack. Important to know that renegade is legislatively considered as civil threat, not the military. Hence, not NATO, but the Nation itself is responsible for determining the best way of action against renegade. Of course, the decision to launch the quick reaction alert interceptor (QRA/I) is always made by appropriated NATO agency, but after successful interception and identification of a suspected aircraft the authority is given to national command and control centre. Thus, the

decision to use of weapons and engaging the aircraft lies on the national authorities. This is because each country has a different law system, which can differ in such a sensitive issues.

### 3.5 Renegade procedure

There is no uniform procedure regarding the renegade. Each situation is assessed on individual basis and civil just like military controllers are trained to identify suspicious behavior and to work in close cooperation. Segregation of airspace around the suspected aircraft made by civilian air traffic control (ATC) is essential for rapid approach of the military QRA. The importance of Air Policing and the requirement to have air defence assets available at short notice remains fundamental. Airspace security comprise safeguarding of the airspace of responsibility from unauthorised use, intrusion, illegal activities or any other violation. This involves managing the airspace to prevent, detect and resolve possible airborne threats. For this purpose NATO has at its disposal a comprehensive system of air surveillance and airspace management means as well as QRA assets for immediate use. By means of radar sites, remote data transmission and central command and control centres the Alliance ensures constant control of its entire airspace to react within seconds to air traffic incidents in the Allies' airspace. This structure of weapon systems, control centres and procedures is referred to as the NATO Integrated Air Defence System (NATINADS). The aim is to deter a 9/11 type terrorist attack, verification of questionable flights and help the aircraft in emergency.

So it is vital for each country to have supersonic fighters capable conducting these missions. Unfortunately, some States cannot provide air policing missions because of lack of suitable aircraft or simply they have no air force at all. They are either covered by neighbouring alliance member with adequate „equipment", or by other NATO country fighters sitting directly on their airports on rotational basis. Apart from financial aspect in both cases, the first possibility is very ineffective due to longer distances QRA must overcome to reach the violator and thus poses insufficient security level for a given area.

## 4. POTENTIAL FUTURE THREATS

The potential future threats include especially two types of threats: cyber attack and possible misuse of unmanned aircraft systems (UAS).

### 4.1 Cyber attack

Aviation is more than just planes. It is supported by the needed ground equipment and systems as well as large scale computer network. Virtual attack against the computer network consists of operations through the use of computer networks to disrupt, deny, degrade, or destroy information residing in computers and computer networks or the computers and networks themselves.

Private companies working within the internet security industry report a growing level of hacking aimed at key industries and aviation industry is, without a doubt, one of them. Many hackers or terrorist groups may consider cyber attacks as an easy, cheap and very effective mean of demonstration of strenght.

Every radar, every ATC/ATM system, every link, and every phone line that makes the system go is thus a potential target. Cyber attacks have become a global pandemic and no system is immune. The hackers could remove e.g. all the protections of a traffic collision avoidance system (TCAS) which can lead to mid-air collision. A hack into the ATC system and consequent misuse of sensitive data is something that really needs to be addressed. In

better case it would interfere with the ability of controllers to handle their job and result in massive delays and restrictions in air traffic.

In the worst case, especially in combination with jamming up the radio frequency the consequences should be fatal. Also the economic disaster of taking down the ATC system would be huge could bring total chaos into air transport. In conjunction with cyber attacks we have to mention also radio-frequency jamming or electromagnetic pulse attacks as a serious threats to air transport.

The cyberspace is an emerging, critical and fast growing area of competition between both, state and particularly non-state actors like terrorist groups with their hacker`s community and many analysts are truly pessimistic about the future. To ensure an effective defence against the cyber threat is very hard, expensive and endless activity, because the attackers are always one step ahead. In contrary, the technical and economic barriers to entry into the cyber domain are much lower and significantly cheaper for any organization or subject. That is precisely the reason why almost anyone is able to develop the capabilities necessary to conduct cyberspace operations.

## 4.2 Unmanned Aircraft System

Although the UAS may seem a little exotic in present and no incident of UAS employment in a terrorist attack has yet been reported, they are posing a growing concern as a new threat to civil aviation.

This concern has been emphasized also the issue regarding near-time integration of UAS into the non-segregated airspace.

It is needed not only to solve challenges concerning technical, legal  and other areas, but also to be prepared for possible terrorist misuse of UAS, i.e. take into account  the security challenges towards their integration into non-segregated airspace.

Terrorist attack using the UAS can achieve a strong psychological effect of fear and uncertainty by getting the politicians and diplomats under pressure. Unfortunately, misuse of UAS brings several substantial advantages for terrorists:

  • Flexibility and covertness in selection of take-off site
  • They can be easily assembled
  • UAS are increasingly spreading around the world
  • Their technology is relatively cheap
  • Cost effectiveness when compared to possible caused damages
  • Relative high accuracy
  • Possibility of carrying biological or chemical weapons.

Poor effectiveness of existing air defences against such a small targets in combination with insufficient radar coverage at low altitudes makes the UAS practically intrepid and invisible. A slow moving and low level flying UAS is often by data processing algorithms in current radars evaluated as a bird, cloud or false reflection. Existing Ground Based Air Defence (GBAD) and QRA units are useless against this type of threat.

At present, it is practically impossible to defend against the small UAS. Even defending the airport perimeter would be extremely complicated, from both a technical and an economic point of view.

Thus, the main accent of dealing with this threat needs to be on measures to prevent the attack during its preparation stages.

Analysing the UAS issue as an potential new threat to civil aviation on the other side we can see also the advantages of UAS in the civil aircraft protection area, for example their possible use to detect and deflect missile attack on civil aircraft.

## 5. CONCLUSION

Terrorist acts can happen anytime, in anyplace and they are irregular and hard to predict. Their main characteristics are uncertainty, violence and fear. The fight against terrorist organizations is an extremely difficult effort. Most terrorist groups are extremely well organized and consist of only a few members, with many groups having adopted a cell structure. The difficulties connected with identifying the sources of terrorist financing present huge problems in combating terrorism. Counter-terrorist activities are very hard to conduct, because some terrorist organizations also have legal, legitimate public wings.

While significant progress has been made to strengthen aviation security, there is clearly much more work to be done. Moreover, process of improving the aviation (in-flight) security is neverending and needs to copy latest trends and developments in aviation technology and industry. In order to improve current aviation security system, risk analysis is essential to identify the occurrence frequency and risk level within the specific environment and ensure appropriate strategies being implemented to manage the risk. There is a need for close intergovernmental and inter-agency cooperation and coordination of all agencies (airports, airlines and government authorities) dealing with in-flight security to face the rising risks and terrorist threats. Each agency should have established appropriate mechanisms for sharing standard operating procedures with other agencies.

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