MANPADS* Countermeasure: Sky Security vs. Ground Security

"No threat is more serious to aviation than man-portable air defense systems"
Colin Powell, US Secretary of State

By: Dr. Hillel Avihai, *ICT fellow researcher*

The USA TODAY on-line newspaper (5 January 2008), reported that three Boeing 767 jets flying between New York and California will be equipped with laser anti-missile systems, developed by BAE[1].

This news brief may reflect that, in the aftermath of the September 11 attacks, aviation terrorism remains a significant threat requiring modern protection measures.

Laser anti-missile technology represents an attempt to create airline defense systems in order to counter both present and future threats. This subject is presented below with the discussion of two airborne counter-measure systems:

The first of these is a flare system, aimed at confronting first generation MANPADS, such as the Russian “Strela” missiles, most commonly used by terrorists. First generation “Strela” MANPADS were used against a civilian aircraft in November 2002, when two missiles were launched at the Israeli “Arkia” Boeing 757 airliner in Mombasa, Kenya.

A prominent example of the flare system is the Israeli ELTA–IAI 'Flight Guard', aimed at confronting first-generation MANPADS. This system is based on confusing the missile’s heat-seeking sensor,

which causes the missile to seek the flare rather than the aircraft itself. Flare technology is widely utilized by the Israeli Air Force in helicopters and fighter jet planes. Notwithstanding the widespread availability of this technology, however, such systems have not been installed on the entire Israeli air fleet due to various economic, bureaucratic and operational considerations.

The traditional approach to airline defense facilitates reactionary solutions that are installed after the incident, rather than focusing on pro-active responses to emerging threats.

Wayne Gretzky, the famous Hockey player, was quoted saying that, “most players skate to the place where the washer is. I skate to the place where the washer will be…” .

This quote presents an interesting analogy with the second type of countermeasure systems, which are based on Laser technology. These systems, including the Israeli 'Britening' (RAFAEL), BAE's JetEye and Northrop Grumman's Guardian, represent an attempt to minimize the gap in the evolution of offensive tactics (advanced MANPADS) and defensive measures (airborne countermeasure systems). Laser defense technology is designed to confront current-generation MANPADS, and to anticipate missiles that will be developed in the near-future. More specifically, Laser countermeasures would defend against second generation, anti-flare, missiles, such as the US “Stinger”. The United States transferred an estimated 750 “Stinger” units to the Mujahideen in Afghanistan, in support of their struggle against the Soviet Union. These missiles were used to shoot down over 100 Soviet aircraft[2]. Some of these “Stinger” missiles remain in Afghanistan and are suspected to have fallen into the hands of Al Qaeda.

Another advanced missile is the Russian-made SA-14/16 “Igla”. Similar to the “Stinger”, these missiles have the capacity to overcome flares, and, in some cases, to target other parts of the aircraft.

These MANPADS are at the focus of the designers of Laser countermeasure systems, often named DIRCM (Directed Infra-Red Counter Measure). DIRCM systems utilize a Laser beam that diverts the missile from its flight path by jamming its detection sensors.

After the introduction of the two types of countermeasure technologies, the following paragraphs will focus on discussing the adaptation of a suitable defensive approach and choosing an appropriate airborne defense system.

One approach focuses on sky security, emphasizing that the defense system should be installed on the civilian aircraft itself, while the other approach concentrates on ground security, stressing the importance of installing countermeasure systems in the vicinity of airports.

Sky Security

Proponents of the sky security approach argue that installing airborne counter measure systems will offer defense against both first and second generation MANPADS. The aircraft are seen as a preferred target by terrorists[3], thereby necessitating advanced protection measures. Airborne countermeasures thus should be employed to prevent successful terrorist attacks on civilian aircraft, especially in light of the symbolism attributed to Israeli airliners.

This thinking encouraged decision makers to recommend the installation of flare systems, such as the Israeli Flight Guard, which,

despite its proven technological and operative advantages, is yet to be installed on the entire Israeli fleet. In addition, Laser systems, aimed at confronting second generation threats, have been recommended for protecting Israeli civilian aircraft.

It is safe to assume that most readers of this article will agree with the necessity to protect civilian aircraft, especially following attempts by terrorists to target passenger airliners. The reality of airline defense, however, shows a major discrepancy between theory and practice.

There has been some opposition to the sky-security approach, as in the case of American Airlines, claiming that the sky security perspective is "…Philosophically opposed"[4] to anti-missile technology on commercial planes. American Airlines management argued that the decision to install sky security systems should be subject to a cost-benefit analysis, thereby triggering the traditional question of “Who is going to pay for it?”

The costs are high indeed, as the American passenger fleet is estimated to comprise 6800 aircraft and each sky defense system costs between 0.5 and 1 million US dollars. This, however, is only part of the issue, since annual maintenance costs of the Laser systems are 300,000$ per aircraft.
In addition, airlines claim that installing such a system (usually at the bottom section of the aircraft) will cause extra drag and increase fuel consumption, especially at a time when the price of an oil barrel has exceeded 100$.

Yet, the high costs are not the entire problem. Even if such systems are installed, terrorists will continue to advance their technological capabilities, which would lead to an endless arms race. What would be the outcome of this arms race? Civilian aircraft would become

heavily-armed flying ramparts, rather than being an enjoyable platform for passenger transportation.

In addition, we should not rule out the possibility that the mere presence of defense systems would present a unique challenge to terrorist groups and compel them to target passenger airliners. As an example, we can take the giant Airbus A-380 (carrying 500~ passengers). In the eyes of a determined terrorist, such a masterpiece of Western high-end technology is undoubtedly perceived as a primary target.

The sky security approach faced considerable opposition, not only from politicians, but also from the airlines, which claim that, statistically, MANPADS are merely a marginal tactic among other threats.
A research conducted by the author of this article shows a very different statistic. In this research, 198 cases of pure aviation terrorism attacks that took place in 1968-2004 were examined. Among the 198 incidents, 22 MANPADS cases were counted, causing the deaths of 658 persons; this is out of 5000 casualties resulting from terrorist attacks against civilian aircraft, including the attacks on September 11.
Can we really use a cost-benefit analysis proposed by some airlines in regard to saving human lives or protecting symbols of national interest?

Ground Security

The ground security approach argues that instead of arming the aircraft with countermeasure systems, it is more beneficial to invest in systems that detect and eliminate the threat from the ground. One example of the latter type of system is Raytheon's Vigilant Eagle, which is designed to utilize a high-power microwave phased array

pulse that scrambles the missiles' electronics, thereby creating a protective dome around the airport. Another ground system is based on the High Energy Laser (HEL) technology. Instead of jamming or diverting the missile, this technology destroys the missile using its mega-energy laser beam which melts the missile warhead (this technology was at the core of an ambitious American - Israeli project named 'Nautilus', originally aimed at confronting ‘katyusha’ rockets launched from Lebanon). The HEL system is still in development and both above-described systems are yet to be installed.

According to media reports, ground security systems will be installed at Israel's Ben-Gurion international airport. The adaptation of the ground-based countermeasures stems from the understanding that the aircraft faces its greatest threat during take-off and landing, as shoulder missiles are not effective against aircraft flying at an altitude of 33,000~39,000 feet.

Supporters of this approach argue that ground-based systems possess a number of significant advantages vis-à-vis airborne systems:

1. Ground systems are far less expensive than airborne systems. Costs are lower not only in terms of basic unit installation, but also in terms of maintenance, and airplane fuel consumption.
2. Airlines prefer to adopt ground-based systems rather than installing is on board of airplanes.
3. Ground systems do not infringe upon the normal travel experience of airline passengers, while sky security measures lower the perceived level of in-flight comfort.
4. It is unlikely that many airlines would be willing to install airborne counter-measure systems that cost $1 million per unit, especially when we take into account the poor financial records of airlines based in developing countries. On the other hand, it is highly probable that international airports will adopt ground systems as a mandatory counter-measure.

Which approach is predominant?

Proponents of the sky security argue for the adaptation of airborne countermeasures because these are currently available, while ground-activity platform are still in development. An additional argument for the sky security approach is the fact that international cooperation, especially regarding the necessity of confronting international terrorism, has been slow. Thus, the feasibility of implementing ground countermeasures at the international level remains distant.

In principle, ground security systems do not face significant opposition, but this could be attributed to the fact that such systems are yet to be tested and installed.

Although the above resented arguments in favor of ground security measures seem more convincing vis-à-vis the sky security approach, a few issues remain:

Let's take a hypothetical example of a ground countermeasure system installed at an international airport. Advanced MANPADS offer terrorist firing distance of a few miles. Would the ground defense measures be capable of covering such an extensive launch perimeter?

It seems that neither alternative provides full coverage from all threats and attends to the full range of considerations involved in protecting the international aviation industry from from advanced MANPADS.

The threat of MANPADS is clear and present in the two examples presented below:

Firstly, the “Wassenaar Arrangement”, conducted by a group of 33 governments in 2000, aimed at implementing measures to control export of MANPADS. In light of the fact that not all states participated in this conference, that MANPADS technology remains freely available and that the production of MANPADS are not limited to Western democratic states, there is considerable doubt regarding the effectiveness of the “Wassenaar Arrangement”.

Secondly, the Israeli attempt at conducting an international conference in Jerusalem in April 2006, aimed at elevating the awareness of the threat of MANPADS to the aviation industry. The effectiveness of this conference is also uncertain, as it was not attended by representatives of states hostile to Israel, such as North Korea and Iran (which produces the Misag-1 shoulder missile).

Is there a third approach?

Another perspective, which may become a combination of the sky security and ground activity approaches, is the use of Unmanned Aerial Vehicles (UAV). These aircraft will fly near the airport and will have the capability to detect, divert or even destroy incoming threats. This technology is used by the Israeli Air Force, for example, in the “Harpy” Aerial Vehicle.

This technology presents a significant cost-benefit advantage over others and has better chances of being adopted by all parties concerned, especially by governments and airlines. UAVs divert the threat from the aircraft itself, offering an on-the-shelf solution, and enable the aircraft to preserve its basic role in a comfortable manner. As opposed to the other countermeasure systems, UAVs are relatively effective, affordable, do not increase fuel consumption and limit passenger fear and antagonism that may be caused by sky security systems.

In conclusion, a combination of platforms should be utilized to provide a suitable answer against MANPADS. In light of the MANPADS threat, however, even adopting a single type of countermeasure approach is preferable than doing nothing. Bearing in mind Colin Powell's words, quoted at the beginning of this article, urgent actions should be taken before we will be facing another airborne disaster - while decision-makers talk, terrorists act.

---

[1] Hall, M (2008) 'Passenger jets get anti-missile devices', USA TODAY (on-line newspaper), January 5, 2008.

[2] Schaffer, M.B (1999) 'The Missile Threat to Civil Aviation' in: Wilkinson, P. AND Jenkins, B.M (Eds.) "Aviation Terrorism and Security" London: Frank Cass

[3] Avihai, H. (2006)'Evolution and escalation of aviation terrorism: From bargaining chip fashion to total destruction orientation' (PhD dissertation, UK: Anglia Ruskin University)

[4] Hall, M (2008) 'Passenger jets get anti-missile devices', USA TODAY (on-line newspaper), January 5, 2008.

***MANPADS - Man-Portable Air Defense System(s)**