Enhancing the IAF's Qualitative Edge: The Air-Launched Cruise Missile Option

by Guy Plopsky

BESA Center Perspectives Paper No. 799, April 16, 2017

EXECUTIVE SUMMARY: The acquisition of advanced air and air defense systems by existing and potential adversaries presents the Israeli Air Force (IAF) with a new qualitative challenge. To maintain its technological edge, the IAF is investing considerable resources into upgrading its fourth-generation platforms, acquiring new fifth-generation F-35I multi-role fighters, and developing other relevant capabilities. These actions will secure the IAF's position as the dominant air force in the region. However, the IAF's fourth-generation fighters – its F-16s and F-15s –will be exposed to significantly greater risk than before. By acquiring and integrating stealthy, long-range air-launched cruise missiles on one or more of its fourth-generation fighter types, the IAF can greatly minimize the risk to their crews while allowing them to tackle a wide range of targets in highly contested environments.

The proliferation of advanced weapons systems across the Middle East has increased significantly over the past decade. Many states in the region are acquiring modern air and air defense systems. These systems, as some experts have correctly observed, present the Israeli Air Force (IAF) with a new qualitative challenge.

To maintain its technological edge, the IAF is investing considerable resources into upgrading its fourth-generation platforms and acquiring new fifth-generation F-35I "Adir" multi-role fighters, which, in addition to stealth, also feature advanced network-centric and electronic warfare (EW) capabilities. The next logical step for the IAF is to expand its standoff precision-strike

capabilities through the acquisition of long-range, very low-observable (stealth) air-launched cruise missiles (ALCMs) capable of engaging targets in heavily contested environments.

A key concern for the IAF is the proliferation of modern long-range surface-to-air missile (SAM) systems. Most notable is the acquisition of such systems by Iran, which has procured and introduced into service the Russian-made S-300PMU-2 (SA-20b) "Favorit." Manufactured by Russia's Almaz-Antey Aerospace Defense Concern, the road-mobile S-300PMU-2 incorporates advanced electronic counter-countermeasures (ECCM) features, making the system difficult to jam or spoof. It is armed with long-range 48N6E2 interceptors capable of engaging aerial targets at distances of up to 200 km. Tehran's S-300 deal also includes advanced 96L6E "all-altitude" 3D target acquisition radars with good ground clutter rejection, enhancing detection and tracking of low-flying targets. Iran currently operates four S-300PMU-2 battalions.

Another Middle Eastern state that recently acquired a modern Russian-made long-range SAM system is Egypt. Though Jerusalem's relationship with Cairo has improved markedly in recent years, historical grievances coupled with Egypt's acquisition of modern air defense systems and combat aircraft make the country a potential concern in the long run. Cairo selected Almaz-Antey's S-300VM (SA-23) "Antey-2500" system, which, like the S-300PMU-2, incorporates advanced ECCM features, is capable of engaging multiple targets simultaneously, and can deploy within a short time period.

The Antey-2500 is a tracked system, offering superior off-road mobility to the Favorit. The system utilizes two types of interceptors: the 9M83ME, which can engage aerial targets at ranges of 120-130 km; and either the 9M82ME or its extended-range 9M82MDE variant, which can engage aerial targets at distances of up to 200 km and 350 km, respectively. (There is no reliable information on whether Cairo procured the standard or the extended range variant of this missile).

While the range figures listed above are impressive, it should be emphasized that they are nominal. The real ranges at which a given target can be intercepted with a high probability of success is dependent on a wide range of factors. The probability of a small, maneuverable target (such as a tactical fighter) being intercepted by a very large, heavy SAM (such as the 9M82ME/MDE) is low, particularly at long ranges. Indeed, the 9M82ME/MDE's primary purpose is terminal defense against ballistic targets (at ranges of up to 30km) and long-range interception of cumbersome strategic aerial assets (for example, airborne

early warning and control (AEW&C) aircraft and aerial-refueling tankers). Nevertheless, even large, heavy SAMs can prove deadly against a tactical fighter over long distances if the latter fails to take appropriate evasive maneuvers, as was recently demonstrated.

On February 10, 2018, following a strike against Tiyas Airbase in Homs Governorate, an IAF F-16I "Sufa" fighter was shot down by a Syrian Soviet-era S-200VE (SA-5b) system using a long-range V-880E SAM. According to a subsequent IAF study, "[t]he aircrew failed to assess the situation, and did not defend itself as needed," enabling the missile to approach within close proximity to the fighter. The SAM's proximity-fused blast-fragmentation warhead worked as intended, detonating near the aircraft and showering it with fragments, prompting the crew of two to eject.

Deliveries to Syria of the SA-5b, along with colossal V-880E missiles (which have a 240 km operational range), commenced shortly after the First Lebanon War, during which Syrian air and air defense forces performed abysmally. Although the SA-5b possesses much greater range than other ground-based SAM systems operated by Syria, it was designed primarily to intercept strategic bombers and other cumbersome strategic aerial assets – not small, maneuverable fighters.

Occurring as it did well inside Israeli airspace, the February 10 loss marked by far the greatest distance at which an IAF aircraft has ever been shot down by an enemy SAM. As was widely reported in the media at the time, the incident also marked the first time since 1983 that an Israeli fighter was downed in combat. The shoot down, as some experts noted, was therefore "truly an exceptional incident." Still, this incident serves as an important reminder that even members of the most elite air forces make mistakes– mistakes that can prove costly. More importantly, it serves as a reminder that there is always risk involved.

While the IAF is more than capable of overcoming adversary air defenses, the risk to its F-15 and F-16 crews is much greater than it once was. Although highly advanced, these non-stealthy fighters are considerably more vulnerable to modern adversary SAM systems than they were to dated Soviet-era SA-2, SA-3, SA-5 and SA-6 systems (even when taking into account the IAF's sophisticated EW capabilities). The risk grows further if the SAM systems in question are operating as part of an integrated air defense system (IADS) rather than independently.

It should be noted that non-stealthy aircraft can avoid detection at longer ranges by flying below the radar horizon of a given SAM system. Uneven terrain can also be exploited to mask their approach. However, these tactics become markedly more complex to implement successfully when multiple SAM systems are present. This is particularly true when at least a portion of the SAM systems are mobile, as they are more likely to pose an unexpected (or "pop-up") threat. Furthermore, low-altitude penetration risks exposing aircraft to adversary anti-aircraft artillery (AAA) and infrared-guided SAMs. These air defenses, too, are likely to constitute pop-up threats.

Lastly, modern AEW&C aircraft can detect and track low-flying targets and then vector fighter aircraft towards them. This does not apply to Syria and Iran as they do not field such platforms; however, both Egypt and a number of wealthy GCC states do field AEW&C aircraft or have expressed interest in procuring them. As with Egypt, Jerusalem's relationship with many GCC states has improved a great deal, but they remain a potential long-term concern.

The introduction of the F-35I greatly expands the IAF's ability to operate in highly contested environments given that its radar cross section (RCS) is very low at frequencies used by fire control radars. In other words, the Adir can operate in very close proximity to adversary fighter aircraft and ground-based air defenses without being detected and tracked by their fire control radars. Thus far, however, Israel has committed to the procurement of just 50 F-35Is, and, while there are plans to procure more, the bulk of the IAF's fighter inventory in the foreseeable future will continue to consist of F-16s and F-15s.

To reduce the risk to its F-16s and F-15s, the IAF can rely on its stealthy Adirs to clear the way for them by targeting adversary SAM systems, fighters and AEW&C aircraft (should the latter two also be present). However, there is no guarantee that the location of all relevant SAM systems will be known so as to enable their destruction prior to the arrival of friendly non-very low-observable fighters. This is true even when taking into account the IDF's advanced intelligence, surveillance, and reconnaissance (ISR) capabilities. Nor is there any guarantee that all surviving SAM systems will be effectively suppressed or destroyed once hostilities are underway. Consequently, the most effective way to minimize risk for IAF fourth-generation fighters is to equip them, where applicable, with standoff precision-guided weapons to strike ground targets from distances well outside the engagement range of adversary ground-based air defenses.

By far the longest range air-to-surface weapon in the IAF's inventory today is the subsonic Delilah ALCM. Built by IMI Systems, the 250 km-range Delilah is designed to engage fixed, relocatable, and moving targets, and features a two-way data-link permitting in-flight updates and "man-in-the-loop" targeting. The missile relies on a GPS-aided inertial navigation system (INS) for midcourse guidance and a forward-looking infrared/charge-coupled device (FLIR/CCD) seeker for terminal guidance. The Delilah was likely the weapon utilized to successfully destroy an Iranian unmanned aerial vehicle (UAV) ground control station at Tiyas Airbase on February 10. The missile's small 30kg warhead makes it appropriate for use against such targets. However, such a small warhead also makes the weapon unsuitable for targeting hardened and/or buried structures. The exception to this are hardened aircraft shelters with open or no doors, as the Delilah can be flown in through their openings to eliminate the contents inside. However, if the objective is the destruction of the shelters themselves, heavier munitions must be utilized.

Furthermore, due to its 250 km range, launching the Delilah could require the carrier platform to operate within the engagement range of adversary SAMs that may be positioned well ahead of the desired target. Such a scenario can become particularly challenging and risk-prone if there is a desire to avoid targeting third-party adversary air defenses. This was the case during the February 10 strike. Syria's SA-5b systems were stationed much closer to the Israeli-Syrian border than Tiyas Airbase, placing the F-16Is involved in the strike well within their engagement range. The subsequent IAF strike against a number of Syrian SAM sites was in response to the downing of the jet; there was no intention beforehand of targeting them.

It is important to add that other, heavier IAF standoff weapons, such as Popeye air-to-surface missiles and SPICE-1000 precision-guided munitions, are suitable for engaging hardened and/or shallow buried targets. However, their operational ranges are considerably shorter than those of the Delilah. As for prospective IAF standoff weapons, according to media reports from 2013 Washington offered to sell Jerusalem the Orbital ATK AGM-88E– an advanced version of the AGM-88 High-Speed Anti-Radiation Missile (HARM). The AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) allows targeting of both emitting and non-emitting targets, and its supersonic speed makes the missile particularly well suited for striking time-critical targets. However, the AARGM's range and payload are also relatively limited.

Apart from payload/range limitations, another potential concern for current IAF standoff weapons is survivability. On February 10, a Syrian source informed Russia's Sputnik news agency that Syrian air defenses had succeeded in downing six Israeli missiles. Similar remarks were voiced by Russia's Ministry of Defense following an alleged IAF strike against Tiyas Airbase on April 9. Such claims are, of course, of dubious validity. Syrian and Russian sources have provided no proof to support these or previous claims.

That said, current IAF air-to-surface weapons, including the low-RCS, low-altitude-capable Delilah, are increasingly vulnerable to modern air defense systems. Syria, for example, operates modern medium-range Buk-M2E (SA-17) systems and short-range Pantsir-S1E (SA-22) gun-missile systems capable of intercepting standoff weapons.

Given these limitations and challenges, Israel could examine the possibility of acquiring Lockheed Martin's AGM-158B JASSM-ER, an extended range variant of the AGM-158A Joint Air-to-Surface Standoff Missile. Utilized by the United States Air Force (USAF) in combat for the first time as part of the April 14 US-led strikes against Syria, the turbofan-powered subsonic JASSM-ER ALCM has a range in excess of 926 km and is intended for engaging high-value fixed and relocatable targets. A 450kg-class dual-mode penetrator/blast-fragmentation warhead allows the missile to be used against both soft and hardened targets, including hardened and shallow buried structures. The AGM-158B relies on a GPS-aided INS for midcourse guidance, and features an imaging infrared (IIR) seeker and an automatic target correlator (ATC) that enable very high terminal accuracy. The combination of a very stealthy airframe, advanced digital anti-jam GPS-receiver, and long range make the JASSM-ER exceptionally well suited for engaging targets in highly contested environments.

The JASSM-ER, it should be noted, is not without limitations. The AGM-158B does not currently feature a post-launch retargeting capability (though this may be added in the future). This means a JASSM-ER cannot engage pop-up targets that are detected, or relocatable assets that leave the target area, following the weapon's launch. Such targets, including targets that are on the move, would require the use of a different weapon (for example, the Delilah). Nevertheless, the JASSM-ER is suitable for targeting a wide range of high-value assets, its long operational range enabling the launching platform to remain well beyond the reach of adversary air defenses. This capability is of particular relevance for operations where there is a desire to avoid targeting third-party air defenses, such as those conducted by the IAF over Syria.

Furthermore, the AGM-158B's extended range would also be of great utility in operations covering long distances, notably a strike against Iran. Integrating the JASSM-ER on IAF F-16Is would allow the fighters to strike targets well within Iran without the need for in-flight refueling, thereby allowing for a larger strike package to participate in such a mission (the number of participating fighters carrying shorter range weapons would depend on the availability of the IAF's limited tanker assets). Whereas Iran's deeply buried sites require the use of munitions heavier than the JASSM-ER, F-16Is armed with these ALCMs could be employed against other high-value Iranian targets, including air defense assets, ahead of the arrival of friendly F-16Is, F-15Is, and F-35Is armed with other ordnance.

Should Israel express interest in the JASSM-ER, there are two primary potential obstacles to its acquisition. One potential obstacle is cost. ALCMs are not cheap, and the JASSM-ER is no exception. Acquiring the required quantity could therefore be deemed too costly. That said, since the AGM-158B is an American-made system, procurement of the JASSM-ER weapon system along with associated equipment, parts, and associated US-provided services (training, logistics, and technical) could be financed using Foreign Military Financing (FMF) funds granted by the US to Israel. Furthermore, JASSM-ER ALCMs are "wooden rounds"; that is, they do not require regular maintenance. As a result, they offer considerable operations and maintenance cost savings over the course of their service life.

Another potential obstacle is Washington's possible unwillingness to permit the sale of this ALCM to certain allies, including Israel. The US denied South Korea's request to acquire the 370 km-range baseline AGM-158A JASSM, prompting Seoul to procure the German-Swedish 500 km-range Taurus KEPD 350K ALCM instead. Washington's refusal to export the JASSM to South Korea likely stemmed, in part, from considerations regarding the voluntary Missile Technology Control Regime (MTCR), which, among other things, aims to restrict the proliferation of complete unmanned aerial systems, including cruise missiles, capable of delivering a payload of at least 500 kg over a distance of at least 300 km.

With that said, Washington has sold the baseline JASSM to a number of allies, namely Australia, Finland, and Poland. In late 2016, Warsaw also signed a contract for the acquisition of the JASSM-ER, making Poland the first export customer for the extended range variant. As for Jerusalem, the US has repeatedly reaffirmed its commitment to maintain Israel's "qualitative military

edge" (QME) over other militaries in the region. This means Israel may be permitted to procure the weapon should such a capability be deemed necessary and financially viable.

Indeed, given the proliferation of modern air and air defense systems in the region, authorizing the export of the JASSM-ER to Israel would certainly be appropriate and in compliance with the definition of QME. According to the Naval Vessel Transfer Act of 2008, QME is defined as "the ability to counter and defeat any credible conventional military threat from any individual state or possible coalition of states … while sustaining *minimal damage and casualties*, through the use of superior military means, possessed in sufficient quantity, including weapons … that *in their technical characteristics are superior in capability* to those of such other individual or possible coalition of states" [emphasis added]. Moreover, Israel would not be the first state in the region to field ALCMs with a 450kg-class warhead. Variants of the stealthy Franco-British Storm Shadow/SCALP ALCM are already in service with, and are being acquired by, a number of GCC states. These variants possess ranges approaching, and possibly in excess of, 300 km. As discussed above, this is greater than the range of any air-to-surface weapon currently fielded by the IAF.

The acquisition of the stealthy fifth-generation F-35I, the continued upgrade of fourth-generation fighters, and the continued development of other relevant capabilities will secure the IAF's position as the dominant air force in the region. However, the IAF's fourth-generation fighters will be exposed to significantly greater risk than before. The procurement of a long-range very low-observable ALCM and its integration on one or more of these fighter types would allow them to hold a wide range of targets in contested and highly contested environments at risk while minimizing risk to their crews. A stealthy, long-range ALCM would also greatly enhance their ability to support the F-35I and would bolster Israel's conventional deterrence vis-à-vis existing and potential adversaries. Expanding the IAF's standoff precision-strike capabilities via the acquisition of such a capability is therefore the next logical step.

Guy Plopsky holds an MA in International Affairs and Strategic Studies from Tamkang University, Taiwan. He specializes in air power, Russian military affairs and Asia-Pacific security. You can follow him on Twitter.

BESA Center Perspectives Papers are published through the generosity of the Greg Rosshandler Family