

# Western complacency versus growing SAM system capabilities

Dr Carlo Kopp

There are major disparities in the combat effectiveness of Soviet supplied Surface to Air Missile systems used in past decades across theatres of operation. Most interesting is how poorly these SAM systems performed in the Middle East compared to their combat effect in South East Asia.

This arguably obscure historical detail is nevertheless relevant to contemporary misconceptions of the effectiveness of the latest generation of Russian and Chinese built SAM systems. Often, in Western defence bureaucracies, the viewpoint is "We trashed Russian SAMs completely in 1991 so why should we care about the effectiveness of current SAM systems?". This view is widely held, and often fervently believed.

The material reality is that newer generation SAM systems such as the S-300PMU1, S-300PMU2 Favorit, HQ-9/FD-2000/FT-2000 and S-400 Triumf are technologically and performance-wise very close to, if not better than the US MIM-104 Patriot series. Importantly, Western air forces have not faced these SAMs in combat, including the formidable Israeli Air Force.

The volume of detailed technical material now available from open sources on Soviet era SAM systems is staggering by Cold War era standards, enabling a more focused and deeper analysis of the operational issues.

In South East Asia the Soviet SA-2 Guideline was used exclusively, with batteries used widely across North Vietnam from the mid 1960s. Sources vary widely on numbers but a common figure is 50 batteries rotating between 150 fixed SAM sites. Figures on the number of SAMs fired per kill also vary, with declassified data suggesting dozens of rounds per kill, worsening over time as the US improved its defence suppression technique and technology.

Perhaps most contentious in this discussion is what constitutes the best measure of effectiveness in assessing the PAVN SAM force. Over North Vietnam (NVN) most losses were produced by PAVN Anti-Aircraft Artillery (AAA) batteries. In fact, total US Air Force losses of 740 F/RF-4, F-105 and F-100 tactical fighters between 1964 and 1973 can mostly be credited to AAA in NVN and Laos. A good fraction of these losses came from low altitude attacks on SAM sites, and most others from low altitude attacks on other targets in an attempt to stay below the engagement envelope of the SA-2. While direct losses to SAM firings appear modest, the percentage of kills to SAMs was as high as 31.5



*Iraqi operated SA-6 2P25 TEL captured during OIF.*

per cent for F-4 in 1971-73, and 17 B-52s were lost, mostly to SAMs.

Usually supported by experienced Soviet or Warsaw Pact instructors, the PAVN operated the SA-2 to best effect, exploited its limited mobility fully, and used the SA-2 to bait 'flak traps' as well as drive US aircraft into the envelope of dense AAA fire. In addition, the effort to suppress or destroy SAM systems absorbed a large proportion of sorties flown into NVN.

Data from Middle Eastern conflicts other than Desert Storm is more fragmentary, and more than often contaminated by a reluctance on the part of the Israelis, Egyptians and Syrians to fully disclose combat losses. There have been ongoing public arguments over who killed what and when. Major clashes involving the use of Soviet SAMs were the War of Attrition between Israel and Egypt, the 1973 Yom Kippur war, and the 1982 invasion of Lebanon.

The first Soviet SAMs in the region were 15 to 25 SA-2 batteries delivered during the late 1960s but were not particularly effective. They were crewed by Egyptians with Soviet instructors, and some were captured in the Sinai advance of 1967. During this period Syria deployed the SA-2 and fielded 18 batteries, later supplemented by 16 SA-3 batteries. In early 1970 the Soviets initiated Operation Caucasus and deployed an overstrength division of Soviet PVO air defence troops, comprising 18 battalions in three brigades, led by General Smirnov of the PVO and drawn from PVO units. Each battalion comprised four SA-3 batteries, a platoon of ZSU-23-4 SPAAGs and supporting SA-7 MANPADS teams. While these units were ostensibly 'instructors' they were dressed in Egyptian uniforms and provided full crewing for the deployed SAM systems. Through early 1970 the PVO units were deployed along the Suez Canal. Operational doctrine was similar to NVN,



Egyptian SA-2 battery components, an SM-90 launcher, V-75 missile and SNRA-75 Fan Song radar.

with batteries relocating frequently and setting up ambushes for Israeli aircraft using multiple mutually supporting batteries. In subsequent engagements against the Israelis, the Soviets are claimed to have shot down five Israeli aircraft using the SA-3, making for a cumulative total of 22 lost to SA-2, SA-3 and AAA during this period.

The Egyptians sought to retake their 1967 losses in 1973, and to support that campaign procured three brigades of SA-6 Gainful, comprising 18 batteries. Unlike Soviet batteries using the shoot and scoot Long Track radar, Egyptian SA-6 batteries mostly used the semi-mobile Flat Face UHF radar. Syria is claimed to have procured two brigades.

When the Egyptians crossed the Suez Canal and the Syrians stormed the Golan Heights their ground forces and strategic targets were protected by SAM and AAA units. It is widely acknowledged that the Israelis suffered heavy losses of aircraft during the fighting in 1973. Exactly how many were lost to SAMs, and to which type of SAM, has been less well documented. Israeli public claims are that 303 aircraft were lost in combat, and other sources identify 40 of these as lost to SAMs, and between four and 12 to Arab fighters. This puts most Israeli losses as a result of low altitude AAA fire, and emulates the pattern observed in SE Asia – SAMs denying the use of high and medium altitude airspace, driving aircraft down into the envelope of

high-density AAA.

The Soviets were cast out of Egypt in early 1976, followed by Sadat's peace treaty with Israel and Egypt's realignment away from conflict with the West. Chinese and Western contractors took over support of the Soviet SAM systems.

The next major conflict to see SAMs used in anger was the Israeli invasion of Lebanon in 1982, named 'Operation Peace for Galilee', intended to drive the PLO out of Lebanon. This well thought out and planned campaign was an absolute rout of the Syrian SAM belt installed in the Bekaa Valley of Lebanon. The first attack in June 1982 resulted in 17 of the 19 Syrian SAM batteries annihilated. The Israelis used airborne standoff jammers extensively, supported by emitter locating systems, and they fired large numbers of AGM-45 Shrike and AGM-78 Standard anti-radiation missiles, plus domestically modified Shrikes with rocket boosters, launched from trucks like Katyusha rockets. Crippled and defenceless SAM batteries were then annihilated with free fall bombs.

The Soviet doctrine of ambush attacks, SAM system mobility, clever use of emission control and decoys, camouflaged SAM sites, and the use of supporting electronic warfare assets was abandoned by the Syrians completely. Hurley's summary of Syrian behaviour in the Winter 1989 issue of Air Power Journal is perhaps the best synopsis: "Syrian SAM

operators also invited disaster upon themselves. Their Soviet equipment was generally regarded as quite good; Syrian handling of it was appalling. As noted by Lt Gen Leonard Perroots, director of the US Defense Intelligence Agency: "The Syrians used mobile missiles in a fixed configuration; they put the radars in the valley instead of the hills because they didn't want to dig latrines - seriously." The Syrian practice of stationing mobile missiles in one place for several months allowed Israeli reconnaissance to determine the exact location of the missiles and their radars, giving the IAF a definite tactical advantage on the eve of battle. Even so, the Syrians might have been able to avoid the complete destruction of their SAM complex had they effectively camouflaged their sites; instead, they used smoke to 'hide' them, which actually made them easier to spot from the air. It is ironic that the Syrians, who have been criticized for their strict adherence to Soviet doctrine, chose to ignore the viable doctrine that emphasizes the utility of manoeuvre and camouflage. According to a 1981 article in Soviet Military Review, alternate firing positions, defensive ambushes, regular repositioning of mobile SAMs to confuse enemy intelligence, and the emplacement of dummy SAM sites are fundamental considerations for the effective deployment and survivability of ground-based air defenses."



SA-3 battery components, and Syrian SA-3 site. It is notable that Arab nations invested much less effort into the planning and hardening of fixed SAM sites, compared to their peers in the Warsaw Pact, and the PAVN. The results were inevitable.





*Modern SAMs like this Chinese HQ-9 system have none of the vulnerabilities of the SAMs defeated in the Middle East, and employ highly automated digital fire control systems and radars. They are direct equivalents to the US MIM-104 Patriot, but much more mobile and thus survivable in the face of air attack.*

The 1982 Bekaa Valley debacle was repeated on a much larger scale in January, 1991, when US led Coalition air forces annihilated Saddam's SAM defences, the decisive blows inflicted in the first few hours. Like the 1982 campaign, large scale use was made of anti-radiation missiles, support jamming, and precision weapons. The deployment pattern of Saddam's forces also differed little, with few batteries attempting to exploit any inherent mobility in their systems, and often undisciplined emissions permitting easy location, targeting and attack. The composition of Saddam's SAM force comprised much the same SA-2, SA-3, SA-6, SA-8 and SA-9 SAM systems, supplemented by some modern French supplied Thales Roland SAMs and Tiger series radars.

The common thread of the latter Middle Eastern SAM versus air power campaigns is very clear: the use of ageing and often obsolescent SAM and radar technology and the abandonment of the by then mature Soviet doctrine of SAM system mobility, concealment, deception and mutual support. Most of the fire control and search radars used were by then fully compromised to the West, and highly effective electronic countermeasures were available.

There is another consideration, which is difficult to establish through published sources, which is that of the education, training, proficiency and competencies of the SAM battery crews operating Syrian and Iraqi systems during this period.

Study of the plethora of detailed technical materials now available on Soviet SA-2, SA-3, SA-5, SA-6 and SA-8 SAM systems, and discussions with former Warsaw Pact missileers, indicate that the full effectiveness and performance potential of these first and second generation Soviet SAMs required crews who were highly intelligent, with a good technical education, highly trained and proficient. Tight teamwork in the missile control van was essential, as the crew had to integrate and interpret outputs from multiple sensors, using often rudimentary analogue displays. Critical tasks such as initial target acquisition and target tracking

were more than often performed manually, with the operator having to concurrently interpret more than one display output in real time. Limited electronic counter-counter measures were available, requiring a smart operator to interpret and understand the type of hostile jamming, to manually select alternate frequencies and modes. This was paralleled by challenging demands for technical personnel, especially in the setup and tear down of SA-2 and SA-3 batteries, which a highly proficient crew could relocate in about six hours. Launchers and vans had to be deployed, everything connected by cable harnesses, antennas needed alignment, and the whole system had to be tested before it could go online. While the SA-6 and SA-8 were designed for shoot and scoot mobility, maintenance of their complex systems was no less challenging, requiring vanloads of test equipment. Training for all of these systems required a van full of equipment to provide simulation inputs for the SAM control system.

The 1999 bombing of Serbia is the case study that closes the loop. While Serbian SA-2, SA-3 and SA-6 batteries were largely ineffective due to the use of standoff jamming, anti-radiation missiles and stealth, they also proved vastly more difficult to kill due to smart use of mobility, camouflage and emission control. A single SA-3 battery commanded by then LtCol Zoltan Dani downed an F-117A and an F-16C, and damaged another F-117A. Prior to the conflict, Dani worked his crew for weeks in the simulator, driving up proficiency and crew teamwork. During the conflict, he relocated his battery as frequently as possible and exercised strict emission control. His battery survived and inflicted the single most embarrassing combat loss the US has suffered for decades. Serbian SA-6 crews, following the same hide, shoot and scoot doctrine, mostly survived the war. The Serbian SAMs and radars were of similar vintage and subtypes as those used by the Iraqis and Syrians. The fact that NATO forces were unable to quickly kill off the Serbian SAM batteries forced continuing and ongoing sorties by NATO

support jamming and defence suppression aircraft, driving up the cost to drop each bomb delivered several-fold. NATO forces launched 743 AGM-88 HARM anti-radiation missile rounds for very little damage effect – around one third of the number used to cripple Iraq's much larger air defence system in 1991.

Comparing Desert Storm to Allied Force, the SAM systems may have been largely the same but NATO had better electronic warfare systems, many more emitter locating systems, and an abundance of newer smart munitions, including newer and better anti-radiation missiles. The fundamental difference was in the personnel operating the SAM systems. They were better educated, better trained, and highly motivated.

There are important lessons to be considered from the outcomes of these conflicts. Contemporary SAM systems such as the SA-20 (S-300PMU1, S-300PMU2 and HQ-9/FD-2000) and SA-21 (S-400) are modern systems with highly jam resistant radars, and if the Chinese are correct, basic low probability of intercept capability. These systems will be difficult to locate, jam and guide anti-radiation missiles against. No less importantly, they have modern highly automated digital fire control systems, not unlike Western SAMs of this era. The demands for proficiency and technical understanding of operation by crews seen in early Cold War SAM systems no longer exist, as operators have sophisticated LCD panel displays with synthetic presentation. In deployment, these systems are heavily automated, and little operator skill is needed to set up or relocate a battery – most can shoot and scoot in five minutes.

The perception that contemporary Russian and Chinese SAM systems can be defeated as easily as Syrian and Iraqi systems in 1982 and 1991 is nothing more than wishful thinking, resulting from a complete failure to study and understand why and how SAM defences failed or succeeded in past conflicts.