

# China's Air Defence missile systems

Dr Carlo Kopp

EARLY THIS MARCH THE US DoD RELEASED THE 2008 VERSION OF THE ANNUAL REPORT TO Congress on China's military power. Last year saw an important incremental improvement in what is already a formidable air defence capability, as the PLA deployed four battalions of the S-300PMU-2 / SA-20 Gargoyle high mobility long range SAM system. This is another step in China's long march since the end of the Cold War to deploy a modern multi-layered Integrated Air Defence System (IADS).

When the Soviet Union collapsed in 1991, China's air defence capabilities were of debatable effectiveness, built around indigenous clones of the Soviet S-75 Dvina / SA-2 Guideline along with indigenous fighter aircraft such as the Chengdu J-8 Finback in addition to vast numbers of 1950s and 1960s technology J-6 Farmer and J-7 Fishbed fighters. Radar capabilities centred on cloned 1950s Soviet equipment, some pre-Tienamen Western imports, and a stalled indigenous AEW&C program centred on a turboprop engined Tu-4 Bull / B-29 Superfortress airframe. Much has changed over the following decade and a half. While the SA-2 remains numerically significant, it has been modernised. Patriot class S-300PMU / SA-10 / SA-20 Grumble / Gargoyle long range SAMs have been acquired in strategically significant numbers. The Tor M1 / SA-15 has been reported and a range of indigenous short range SAMs have been developed. The KJ-200 / Y-8 and KJ-2000 / A-50 AEW&C programs are well into advanced development, and strategically significant numbers of the Su-27SK / J-11 and Su-30MK have been deployed, while the indigenous 'Sinocanard' J-10 fighter has achieved Initial Operational Capability.

The PLA's air defence capabilities are transforming from a legacy force with static and undeployable systems to a state of the art force, which is highly deployable in-country and demonstrably expeditionary as it matures. This evolution in capabilities has been sufficient to elicit alarm in many US analysts, recognising that legacy fighters such as the F-15C/E and F/A-18C-F have very poor odds of surviving if they need to penetrate the emerging PLA IADS.

China's investment in top tier SAMs has not gone unnoticed across the wider region. Indonesia has for some time been coveting the S-300PMU SAM system, and in a recent statement expressed an interest yet again in acquiring the latest Russian



Launch of the S-300PMU-2 Favorit 48N6E2 long range SAM.

SAM technology. What the growth in China's capabilities is achieving more than anything else is the stimulation of arms purchases, more than often of like technology, in lesser regional nations.

The scale of growth in the PLA's capabilities is revealed in any survey of the full gamut of area and point defence SAM systems deployed and developed.

## HQ-1/HQ-2/CSA-1 (S-75 / SA-2) GUIDELINE

The Chinese-built derivatives of the Soviet SA-2 Guideline were until the arrival of the SA-10/20 the numerically most important SAM system in PLA service. Current official US estimates put the remaining inventory at more than 60 batteries, for a total of about 400 single rail launchers.

When the PRC split with the Soviets during the Krushchev era, early variants of the S-75 were the only then modern weapons China possessed,

with a mere six batteries in service. These comprised the standard static road transportable semi-mobile rail launchers, the S-band Fan Song engagement radars, and the VHF band P-12 Spoon Rest acquisition radars. China's 5th Research Academy of the Ministry of Defence subsequently reverse-engineered this hardware and started the manufacture of the HQ-1, a cloned S-75 system. By 1966 an improved HQ-1, the HQ-2, was introduced with incremental upgrades to the HQ-2A during the 1970s, and HQ-2B during the 1980s.

The HQ-2B was a significant advance on the Soviet original since it introduced a high mobility tracked TEL (Transporter Erector Launcher) vehicle. Other improvements included a better liquid rocket motor, more G capability, better warhead, digital command link for guidance with crypto capability, a monopulse engagement radar capability for jam resistant angle tracking, and electro-optical angle tracking.

The stated long term intent is to replace the HQ-2 with the indigenous HQ-12/KS-1A SAM, as a second tier supplement to the Russian S-300PMU series.

## HQ-12 / KS-1A KAI SHAN 1

The indigenous HQ-12 is now being deployed with PLA air defence units, and the US DoD puts the number of fielded launchers at 60 units. Developed to replace the HQ-2, the HQ-12 has been observed in a number of variants, these including static rail launchers clearly derived from the HQ-2 design, a 6x6 road mobile TEL also derived from the HQ-2 launcher, and a road mobile Patriot like box launcher.

The single stage solid propellant KS-1A missile itself compares best to the RIM-66 SM-1/2 in general layout, but with a very short span delta wing design more akin to the US Hawk. The rail launchers are conceptually similar to the underslung SM-1

rail launcher. Missile performance is cited at a maximum range of 27 nautical miles, maximum altitude of 80 kft, and a maximum load factor of 20G with capability against 4-5 G targets. The nearest equivalent US missile is the RIM-66 SM-1 and SM-2 series, the KS-1 falls between the SM-1 and SM-2 in performance, and it is about 20 per cent larger and 40 per cent heavier at launch.

Chinese sources claim early KS-1 variants used the HQ-2 radar package, but since then the H-200 phased array engagement radar has been disclosed as the primary radar component of the KS-1A system. This phased array compares closely in configuration to the US MPQ-53 Patriot and Russian 30N6E series engagement radars, and is available either as a static relocatable installation, or a fully road mobile design on a 6x6 truck. Chinese sources claim a high resistance to jamming, which is credible given the phased array design technique used.

The HQ-12 is clearly a credible modern SAM system, and like the J-10 fighter, illustrates China's technological capability to compete in the design of modern weapons.

### CADT HQ-9 / CPMIEC FT2000

The HQ-9 was developed to provide a long range SAM capability, distinct from the medium range capabilities of the HQ-12/KS-1 series. The FT-2000 is a derivative fitted with an anti-radiation seeker and intended for engagements against AEW&C/AWACS and stand-off jamming aircraft. The US DoD puts current deployments at 64 launchers, making for 8 to 16 batteries.

The PLA have not been overly generous in disclosing details of this design. There is general agreement in open sources that the HQ-9 uses Russian S-300PMU technology extensively, including the cold launch design for vertical ejection from launcher tubes on TELs, 48N6 rocket motor technology, and a range of other S-300PMU components, including an 8x8 four tube TEL modelled on the 5P85DU series. Some sources claim the weapon uses a two-stage arrangement akin to the S-300V but in the absence of good imagery this is difficult to validate. Slant range performance figures also vary across sources, between 50 and 100 nautical miles. What data is available suggests a missile which is similar in capability to early variants of the MIM-104 Patriot and SA-10B 48N6E, including Track via Missile (TVM) guidance.

The HQ-9 is supported by the HT-233 phased array engagement radar, like the H-200 modelled on the MPQ-53 and 30N6E designs, carried on the Taian TAS5380 8X8 high mobility vehicle, common to the HQ-9 TEL and similar in design to the S-400's BAZ-6900 series vehicle. Chinese sources claim C-band operation with 300 MHz receiver/antenna bandwidth, detection range of 65 nautical miles, and monopulse angle tracking to resist jamming.

According to the US DoD, the FT2000 has yet to be deployed, as is the case with the follow-on HQ-9 variants. Open sources describe the FT2000 as an inertially guided SAM with an anti-radiation terminal seeker, programmed before launch for the characteristics of the intended target. Each battery includes four ESM vehicles, used to generate targeting data for the missile battery.

Given that the FT2000 is derived from the HQ-9, any claims that this weapon has not been deployed should be treated with caution since the missile and its guidance support package could have been integrated into the baseline HQ-9 system design,

and other than by covert intelligence gathering or PLA disclosure, this cannot be easily determined by simple observation. It is entirely conceivable that a HQ-9 battery could be armed with a mix of HQ-9 and FT2000 rounds, and this could only be determined in combat once missiles are actually launched and enter their terminal guidance phase.

### ALMAZ S-300PMU / SA-10B/C GRUMBLE

The S-300PMU was the first of the S-300 family of missiles to be procured by the PLA, and the US DoD puts current launcher numbers at 32, making for 4 to 8 deployable missile batteries. This system is the export configuration of the high mobility Soviet S-300PS (P- PVO, S – Samochodnyy/Self-propelled) system, usually designated SA-10B Grumble, successor to the Patriot-like semi-mobile S-300PT. This subtype is either designated as an SA-10B or SA-10C in the literature.

The S-300PMU best compares to earlier variants of the US Patriot system, but with the important difference that the S-300PMU is highly mobile, with all key battery elements carried on MAZ-7900/543 variant 8x8 vehicles, common to the Scud TEL. The S-300PS/PMU was the first true 'shoot and scoot' SAM system to be deployed, specifically built to evade the F-4G Wild Weasel. When the export variant was defined a towed semitrailer TEL was introduced, the 5P85T with a KrAZ-260B tractor, self-contained electrical power supply and masted radio datalink for remote launch control of TELs. Excluding mast mounted components, the battery could deploy or stow itself in five minutes or less.

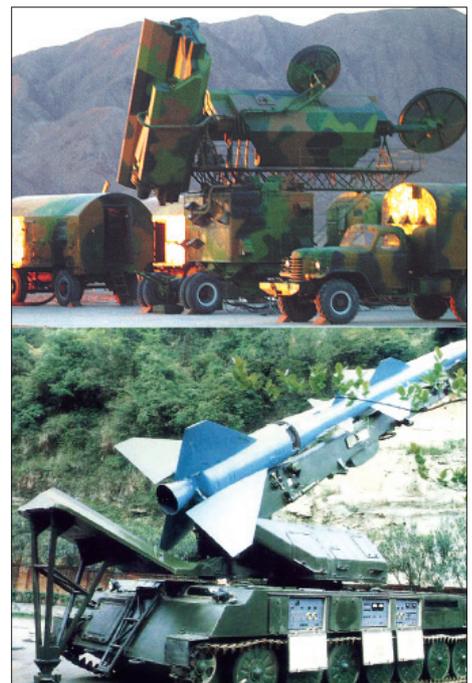
The search and acquisition radar package comprised the high altitude oriented 36D6/ST-68UM Tin Shield rated between 1.23 MegaWatts and 350 kiloWatts, optionally on a semi-mobile 40V6, 40V6M and 40V6MD mast system, and the low altitude FMCW (Frequency Modulated Continuous Wave) 76N6 Clam Shell radar. The latter, mounted on the 23.8 metre tall 40V6M or 37.8 metre tall 40V6MD, was specifically built to hunt the US AGM-86 and BGM-109 cruise missiles. The engagement radar is the 30N6E Flap Lid, usually fully mobile on a MAZ-7900/543 but also available semi-mobile on the 40V6M mast for cruise missile defence. Technically, the 30N6E compares best to the MPQ-53 Patriot radar.

The command link guided missiles in the S-300PT were supplanted by TVM guided extended 50 nautical mile range 5V55KD and 5V55R rounds. With all-altitude coverage the S-300PS/PMU was a formidable system, capable of threatening the full gamut of conventional combat aircraft, and provided the impetus for the development of the F-117A and B-2A stealth aircraft.

### ALMAZ S-300PMU-1 / SA-20A GARGOYLE A

Initially designated the SA-10D Grumble, and later redesignated the SA-20A Gargoyle, the S-300PMU-1 was a 'deep modernisation' of the S-300PS/PMU system. The US DoD puts the current PLA inventory at 64 launchers, for a total of 8 to 16 batteries.

While the S-300PMU-1 retained improved Flap Lid, Clam Shell and 5P85TE/DE TELs, it introduced two major new improvements intended to match or outperform the Patriot PAC-1 and PAC-2 configurations. The first was a new missile design, the 80 nautical mile range 48N6 with a seeker capable of engaging 0.02 square metre targets.



The HQ-2 Guideline was the mainstay of PLA air defence for decades. The late build HQ-2B bears little resemblance internally to the original Soviet product, and is carried on a tracked TEL for high mobility.



China's indigenous HQ-12 / KS-1A best compares in capabilities to the US RIM-66 SM-1/SM-2 Standard SAMs. The H-200 phased array engagement radar is available in semi-mobile configuration (depicted) or a fully mobile arrangement resembling the Russian 30N6.



China's indigenous HQ-9 is widely regarded to be a spin-off of the early S-300PS/PMU Grumble – it known to have extensively used S-300PMU technology. The FT2000 is a derivative long range anti-radiation SAM intended to kill AEW&C/AWACS and SOJ platforms. Depicted is the TEL and HT-233 engagement radar.



The Tin Shield long range search radar is widely used with earlier variants of the S-300PMU series.

The Clam Shell is a specialised low altitude search and acquisition radar, developed to hunt cruise missiles. It is usually deployed on a semimobile 40V6M or 40V6MD mast system to markedly improve low level coverage.



Variants of the 54K6E mobile command post are used with all later variants of the S-300PMU and S-400 systems.



The 30N6E Flap Lid engagement radar is a Russian analogue to the Patriot MPQ-53, but is larger. It is available in high mobility and semi-mobile mast mounted variants.



The S-300PMU-1/2 NIIP 64N6E Big Bird phased array best compares in capabilities to the naval SPY-1 Aegis system. This highly mobile search radar can deploy and stow in under five minutes.

The more important addition was the NIIP 64N6E Big Bird 3D search and acquisition radar carried on a high mobility 8x8 MAZ-7910 series articulated vehicle. This Janus-faced large phased array was built to provide the S-300PMU-1 with long range acquisition and tracking capabilities akin to those in the SPY-1 Aegis naval radar – so that the missile batteries could survive in heavily jammed environments and engage supersonic aircraft, cruise missiles and ballistic missiles. The 64N6E has no Western equivalent and provides a significant capability to manage engagements in a rapidly evolving high threat and high density environment.

Until recently, the S-300PMU-1 was the most lethal SAM system the PLA deployed but it has been now supplemented with the S-300PMU-2.

### ALMAZ S-300PMU-2 FAVORIT / SA-20B GARGOYLE B

The last of the S-300P derivatives to carry the S-300P designation, the S-300PMU-2 Favorit, adds further capabilities. According to the US DoD, the PLA has deployed 32 launchers for a total of 4 to 8 batteries.

The Favorit is an incrementally enhanced S-300PMU-1 encompassing the 30N6E2 Flap Lid, 64N6E2 Big Bird, 54K6E2 command post. and providing interfaces and software to control legacy missile batteries, such as the S-200VE/SA-5 Gammon. It is intended to compete directly against the Antey S-300V Giant and Patriot PAC-2/3 systems as an Anti-Ballistic Missile system. The new LEMZ 96L6E search radar is available as an option with the Favorit.

With the S-300PMU-1 and PMU-2, the PLA gains enough range to be able to threaten aircraft over Taiwan if the missile batteries are deployed along the coastline. The systems have a robust capability to engage reduced signature aircraft such as the F/A-18E/F and Eurofighter Typhoon, and from some aspects will threaten the Joint Strike Fighter. US Air Force sees only the F-22A and B-2A as survivable against these systems.

### S-400 TRIUMF / SA-21A GROWLER A

There are no reports to date that the S-400 has been procured by the PLA although there are claims that China partly financed the development of this S-300PMU-2 derivative.

The S-400 recently achieved IOC in Russia with the first batteries deploying around Moscow last year. The system extends the reach of the S-300PMU-2 by adding the 200 nautical mile class 48N6DM missile, and the highly agile 9M96E/E2 interceptor missiles modelled on the PAC-3 ERINT design. In an S-400 battery, 48N6 launch tubes can be replaced by four-round tube clusters of the 9M96E/E2, providing a battery with considerably more firepower.

### 9K331 TOR-M1 / SA-15 GAUNTLET

While most of the PLA's investment in SAMs has been focused on expanding and enhancing strategic and long range area defence coverage, much effort has also been put into the modernisation of point defence SAM capabilities.

During the 1990s the PLA procured the Russian 9K331 Tor-M1 / SA-15 Gauntlet system, a highly mobile rapid reaction SAM built to replace the Cold

War era SA-8 Gecko system. Like the SA-8 Gecko, the Tor M1 TELAR is a fully self contained package, with a search radar, a monopulse tracking and engagement radar, and a magazine of Automatic Command to Line Of Sight guided missiles. The design aims of the Gauntlet were, however, broader than those for the Gecko, and not only are low flying aircraft and helicopters intended targets but also cruise missiles, standoff missiles and smart bombs during their terminal flight phase. Russian thinking is that S-300PMU/S-400 battery elements such as radars and command posts are to be covered by Gauntlet point defence systems, intended to engage and destroy guided munitions targeting the S-300PMU/S-400 battery elements.

The Gauntlet is carried on a GM-355 tracked chassis. The E/F-band folding surveillance radar is carried on the top of the turret, and the G/H-band engagement radar, claimed to be a phased array design, is mounted on the front. Eight vertically launched 9K331 SAM rounds are carried in sealed magazines. These are vertically ejected before ignition using the cold launch technique. Once clear of the TELAR, the canard missiles use nose rocket thrusters to pitch over in the direction of the target and effect the engagement. Reaction time to threats is credited in seconds between track confirmation and launch.

While in conceptual terms the Gauntlet compares well to the Franco-German Roland; the missile is more advanced and the TELAR far more capable than the Roland ever could be.

Chinese sources put the SA-15 inventory at around 25 systems deployed with the 31st and 38th Army Groups. The Russians have exported this system to Greece and Iran.

### HQ-6 AND HQ-7/FM-80/FM-90 / CSA-4 CROTALE

The US DoD credits the PLA with 30 'HQ-6' launchers, most likely referring to the HQ-61 series point defence SAMs deployed during the 1980s. The missile round most closely resembles the US RIM-7 Sparrow but is larger, heavier and is equipped with a semi-active radar homing seeker and midcourse command link guidance. A 6x6 YanAn SX2150 truck carries two rounds on a slewable elevating launcher. Guidance is provided by the Type 571 radar system. The HQ-61 series has been largely superseded by the HQ-7.

The HQ-7 is a Chinese clone of the French Thales/Thomson CSF Crotale SAM. During the 1970s the French supplied samples of the Crotale, which was promptly reverse engineered. The cloned Crotale has been built in two configurations, a high mobility variant for PLA Army units on a 4 x 4 scout vehicle and a less mobile PLA-AF air field defence system, using either a trailer or a truck platform. A four-round elevating tube launcher turret is used, mounting the X-band Automatic Command to Line Of Sight monopulse radar dish antenna. Export variants are the FM-80 and FM-90 with a FLIR tracker and longer ranging missiles. HQ-7 batteries are typically supported by an acquisition radar system, usually on a 6x6 light armoured personnel carrier. The HQ-7 has been widely deployed as a naval point defence weapon on PLA-N warships.