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ASIAN MILITARY REVIEW

On 24 August 2017, the Royal Malaysian Navy (RMN) launched its first Littoral Combat Ship (LCS) at Boustead Heavy Industries Corporation (BHIC) Lumut shipyard. The ship was named KD *Maharaja Lela.*

Editorial

CAUSE FOR CELEBRATION OR CONCERN

The extraordinary news that North Korea's President Kim Jong-un has offered to meet United States President Donald Trump - and that Trump has accepted - was breaking as this magazine went to press in mid-March. The meeting is due to take place by May this year.

While the prospect of a meeting between the two leaders who only recently traded insults could be a tremendous opportunity for breakthrough dialogue and a release of tension that many analysts had believed was heading towards military conflict, it could equally lead to potential disappointment and further danger.

The news was broken by Chung Eui-yong, the South Korean national security adviser, at a media briefing on 8 March at the White House in Washington DC. Chung's delegation had come to brief the White House on the content of the four hour meeting between North/South Korean high level delegates held on Monday 5 March.

In addition to the Kim Jong-un's offer to meet Trump, Chung added that he had also declared that North Korea would halt nuclear and missile testing up to the meeting, and acknowledged that planned US / South Korean military exercises still scheduled could continue. "Kim Jong-un said that he was committed to de-nuclearisation," reported Chung. Trump has asserted that all sanctions will remain in place at least up to the planned meeting.

A further result of that Monday meeting was news Kim Jong-un and South Korea's President Moon Jae-in, would be meet in April before the Trump meeting.

Talking live to broadcast news station *CNN* on Friday 9 March, Philip Yun, a past member of a US government working group during President Bill Clinton's administration and one of the delegation that travelled to North Korea with Secretary of State Madeline Albright in October 2000, said that any dialogue was welcome especially at the highest level. He said that lower level officials tended to get mired in detail and that any real progress was usually difficult to make.

But is this just part of Kim's plan to position North Korea as the equal of the United States. The recent and somewhat relentless missile testing programme over the last few months was followed in November 2017 by an announcement by Kim that North Korea's goals had been achieved (for now). This position has been further strengthened by the claim in 2016 that North Korean scientists detonated a hydrogen bomb.

North Korea's token attendance at South Korea's Pyeongchang Winter Olympics, was politically overshadowed by the fact that President Kim's sister, Kim Yo-jong, was also there ironically President Trump's daughter Ivanka Trump, who officially led the US delegation, was there too. Cynically, this could be seen as Kim Jong-un attempting to mirror the US, as both women also met with President Moon.

Korean Peninsular strategists and analysts, most caught completely off-guard with this political bombshell, are now in deep debate over whether Trump's hardline strategy and increasing sanctions is actually beginning to work, or whether Kim feels that he has now reached a position where North Korea's 'nuclear potential' (capable or not) is enough for him to begin meaningful dialogue.

Lessons from the past are not encouraging. During President George W Bush's administration talks to freeze its nuclear programme in exchange for the lifting of sanctions were dashed when North Korea returned to missile testing. Ex-presidents Jimmy Carter and Bill Clinton both met with North Korean leaders after their presidencies, but without meaningful long-term results. And officially, the Korean War has still not been ended with a peace agreement.

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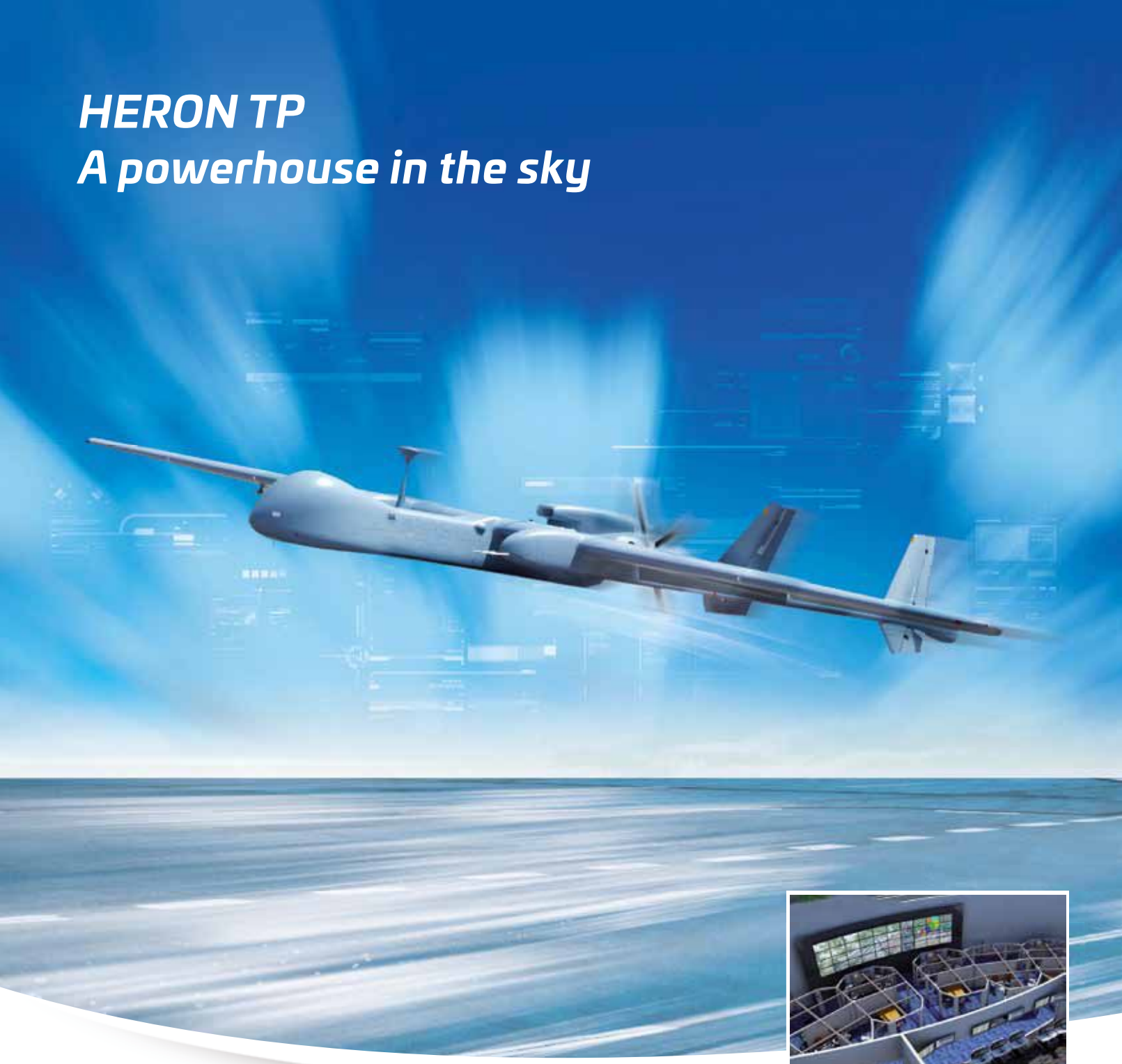

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IAI
Creating a Difference

The Republic of Singapore Air Force operates three Conformal Airborne Early Warning (CAEW) Gulfstream 550s fitted with the IAI Elta EL/W-2085 sensor system. They have boosted Singapore's AEW capabilities considerably since being put into operation in 2010. The capability was declared fully operational in April 2012.

Alan Warnes

SOUNDING WARNINGS SOONER

Most of the advanced military nations have some kind of Airborne Early Warning & Control systems (AEW&C). The widening use of gallium nitride allowing higher voltage is leading to more efficient radars.

by **Alan Warnes**

Sophisticated systems are now needed to track increasingly more diverse threats, like ballistic missiles, rigid inflatable boats (RIBs) and slow moving aircraft. The integration of the Airborne Electronically Scanned Array (AESA) radar is going some way to resolving that. The general availability of gallium nitride (GaN), once known among physicists as the material of the future, has been the biggest factor. For decades it wasn't possible to manufacture and process this highly costly material. But that's all changed with a good supply chain, as both Saab and China AVIC representatives confirmed to the author; the cost has also tumbled.

The use of GaN provides better power efficiency which results in improved radar performance. its use in electronic warfare aides also leads to better wide-band jammers.

Recognised Air Picture

The AESA radar, the generation of clear signals, increased digitisation and better software has led to a more comprehensivly recognisable air picture (RAP) in most modern AEW&C aircraft. The result can allow mission commanders in the rear of the aircraft to make more informed real-time decisions to thwart possible attacks. The RAP can be data-linked to ground stations for commanders and eventually political leaders with better situational awareness in the face of confrontation or conflict. Most of the new generation fighters, ground based air defences and naval vessels can also take on the RAP.

It's the need to monitor all the threats, not just in the air domain, but land and sea which makes the AEW&C aircraft such a valued platform. The further a platform can look, the more warning it can give. Today, ballistic missiles are the latest danger as has been witenessed by the actions of North Korea. A vigilant watch on China and Russia is also needed, so it is not surprising that Asian countries, particularly Japan and South Korea are keen to increase their capabilities. Clearly there is a need to modernise existing AWACS/AEW&C systems in Asia against new and existing threats that include terrorism, piracy and smuggling.

Coping with North Korea

While the US is an ally to both South Korea and Japan and rotates AWACS/AEW&C assets in the region, both allied air forces now have their own fleets which are interoperable according to the US.

Over the past two years, North Korea has fired up to 20 inter-continental ballistic missiles which flew either close to Japan or over it. Its AEW&C aircraft would have been on high-alert, but the shotcoming in their existing systems is a problem.

The Japanese Air Self Defence Force (JASDF) operates four Boeing E-767s which entered service in May 2010. They are operated by the Hiko Keikai Kanshitai (AEW Squadron) as part of the Keikai Kukutai (AEW Group) at Hamamatsu, in southern Japan. The aircraft's main sensor is the Northrop Grumman APY-2 radar, but the aircraft have been continuously upgraded throughout their 20-year operational history in a bid to


Alan Warnes

At the 2016 Zhuhai Show ZETC displayed a KJ-500/ZDK-06 with a rotodome on top, serving the Peoples Liberation Air Force. The company also presented two models at their stand representing a K/JE-03 with the balanced beam radar, but presented in different colour schemes.

overcome obsolescence. In late 2015, Boeing was awarded a $25.6 million contract to upgrade the aircraft's mission computers, electronic support measures, next generation interrogator friend or foe (IFF) transponder, automatic identification system and data link upgrades. This will allow Japan's AWACS fleet to be more compatible with the USAF's AWACS baseline fleet, and provide far greater interoperability. In February, this year the Pentagon announced that Boeing had been awarded a $60.9m contract to further upgrade the aircraft's mission systems, with the work being carried out in San Antonio, Texas.

The JASDF also operates 13 Northrop Grumman E-2C Hawkeyes, serving the Misawa based Hiko Keikai Kanshitai (Airborne Warning and Control Squadron) to provide surveillance of air and naval activity in the Pacific region. In June 2015, the US State Department approved the supply of four E-2D Hawkeyes under a $1.7 billion multi-year deal. One was ordered in November 2015 (for $151m) which made its first flight on 9 October last year. Jane Bishop, vice president, E-2D Advanced Hawkeye programmes said at the time: "The successful first flight of Japan's E-2D Advanced Hawkeye is a significant milestone in delivering advanced airborne early warning and surveillance capabilities to the country. The augmentation of the JASDF's current Hawkeye fleet with the E-2D AHE further strengthens its ability to meet Japan's evolving security and intelligence needs." Another was ordered in July 2016 ($163m) and both should be operational by March 2018. The E-2s provide aerial coverage of Japan's 29,800 km (18,500 miles) coastline, while the E-767s are used as strategic assets.

Across the Sea of Japan, South Korea continues to face up to its unpredictable northern neighbour. The Republic of Korea Air Force (ROKAF) operates four Boeing 737AEW&C Peace Eyes delivered by October, 2012. Korea Aerospace Industries (KAI) at Sacheon modified and supported testing of three out of four jets. All of them operate with the AEW&C squadron at Gimhae Air Base. The Northrop Grumman Multirole Electronically Scanned Array (MESA) radar is the centre-piece of the aircraft's tactical systems. It provides a wide area surveillance, claimed to be greater than 340,000 square miles at rates exceeding 30,000 square miles per second for a typical 10-second scan rate. It means most of North Korea can be continuously monitored very quickly.

Alan Warnes

At Singapore Air Show in February, IAI was marketing its Gulfstream Multi Mission Airborne Reconnaissance & Surveillance System (MARS 2). A modern day J-STARS according to the company. It has a launch customer, possibly South Korea, which will take delivery of the aircraft in 2021.

ROKAF battle space managers monitor multiple sectors with extended range and update rates while maintaining a 360-degree background surveillance picture. On board there are ten state-of-the-art mission crew consoles that can track airborne and maritime targets simultaneously. Operating at 40,000 feet (12,192m) the Peace Eye can track low-flying missiles and aircraft over various terrains. It is unlikely anything can fly in North Korea without the South knowing about it.

In the wake of the North's continued aggressive stance, South Korea has been actively looking for new defence systems. During the Singapore Air Show, South Korean officials showed interest in Israel Aerospace Industries (IAI) Gulfstream 550 MARS2, the Multi Mission Airborne Reconnaissance System. IAI describe it as being able to provide persistent stand-off ground, maritime and air surveillance coverage. It is equipped with the ELI-3150 system, covering an Elta Active Electronically Scanned Array (AESA) radar with a 360-degree coverage. The system includes a 'proven' SIGINT (Signals Intelligence) system, as well as an Electro Optical FLIR and synthetic aperture radar (SAR)/ground moving target indicator (GMTI) capabilities. IAI claims the launch customer will receive the aircraft in 2021.

South of China

While South Korea and Japan's main concern is North Korea, further south most countries are focusing their attention on the Chinese threat. The disputed islands including the Spratleys

New Systems Saab's GlobalEye

One of the latest systems on the block is Saab's new GlobalEye swing role surveillance system (SRSS). The Swedish aerospace company see a big market in the region. Indonesia, Malaysia and Singapore are all on their radar. The company's latest AEW&C system was rolled out at Linkoping, Sweden, on 23 February, off the back of a combined $1.52bn order from the United Arab Emirates (UAE) for three aircraft.

The GlobalEye combines the new Erieye ER (extra range) active electronically scanned array (AESA) radar, a Leonardo Seaspray radar and FLIR Systems Star Safire 380HD EO/IR system inside a Bombardier airframe. The GlobalEye can work in the air, sea and land domain because of the three main sensors.

According to Saab the new aircraft can fly up to 30,000 feet ((,144m) for 11 hours, which claims it has a 70 percent improved detection range over the previous generation model, to more than 300 miles (450km).

Dr Frederic Wiessy, Saab's head of research and technology, Saab Surveillance said at the roll out: "We have a well committed customer with a far-reaching vision, that is being realised by Saab." He added, "Normally it is Sweden which is the launch customer and pushing our boundaries, but this time it is a foreign country. Understanding their requirements and needs has been very important."

IAI Elta CAEW Gulfstream 550

In addition to the MARS2 earlier, IAI Elta continue to market their AESA equipped CAEW Gulfstream 550 which is operational with Israel, Singapore and more recently Italy. Elta's Avishay Izhakian, deputy general manager marketing and business development told the author in late 2016: "it is a fourth generation CAEW - the main difference is the advanced radar technology which makes it more powerful. The aircraft fulfils several missions, not just tracking airborne targets but on the ground and at sea. We have developed the aircraft for the threats of the future not just today"

The EL/W-2085 AESA system provides a full 360-degree coverage, with its narrower field S-band antennas on the fore and aft of the aircraft, with wider-scoping L-band antennas mounted on the sides of the G550 CAEW fuselage. It has a ten-hour endurance and a 5,500 miles (7,000km) range.

and Paracel in the South China Seas, an area of economic potential including combustible ice, a natural gas hydrate that could yield significant wealth, needs close monitoring. Although of concern to many nations, the monitoring is largely carried out by the US with its fleet of E-3G AWACS, Boeing P-8A Poseidons and RC-135 Rivet Joint aircraft. The huge expanse of territory extends hundreds of miles south from China's Hainan Island to equatorial waters off the coast of Borneo, overlapping areas claimed by Brunei, Malaysia and Taiwan. Vietnam and the Philippines reject China's map and have pushed forward oil and gas exploration projects in blocks that exist within areas claimed by China.

Malaysia's military has repeatedly asked for funding for up to four AEW aircraft, but the government has so been unable to meet such requests due to budget constraints. Indonesia too has an urgent requirement for this capability, but must continue to rely upon three obsolete Boeing 737 Surveillers. They are equipped with an ageing AN/APS-135 (V) high resolution Side Looking Airborne Modular Multi Mission Radar (SLAMMR) but without datalink capability. There is unlikely to be any funding for a new AEW system until 2020 at the earliest. However, the Indonesian Air Force (Tentara Nasional Indonesia-Angkatan Udara, TNI–AU) is known to be looking at possible replacements. Boeing's Challenger Maritime Surveillance Aircraft (MSA) is known to have been shown to the military hierarchy, while the Saab GlobalEye is also a candidate. The Royal Thai Air Force flies two Saab 340 Erieye AEW&C aircraft, operated by Wing 7 at Surat Thani, not far from the border with Malaysia. They play a significant part in Thailand's new air defence system.

With the Malacca Straits and South China Seas being a hotbed of piracy, and tensions between Malaysia and Indonesia ebbing and flowing on a regular basis, the Republic of Singapore Air Force (RSAF) operates four Conformal Airborne Early Warning (CAEW) configured Gulfstream 550s of 111 Squadron which were declared fully operational on 13 April, 2012 at Tengah Air Base. The CAEW with its EL/W-2085 sensor suite, when operating at around 41,000ft, can see up to 250 miles (400kms).

Taiwan's Republic of China Air Force (RoCAF) operates six E-2K Hawkeyes, which are configured to the Hawkeye 2000 standard with new radars and software. Two are brand new aircraft operating alongside four E-2Ts delivered in September 1995 that were upgraded in a $250m deal completed in March 2013. They play a crucial surveillance role working in tandem with a network of land-based early warning radars. The operators on board provide a wide area surveillance of the Taiwan Straits, East and South China Seas.

China's emerging AEW aircraft

China's CETC (China Electronics Technology Corporation) is tasked with much of the radar development in China. The company prides itself on merging early warning detection, surveillance, reconnaissance - as well as command and control - into airborne integrated electronic information systems. Its philosophy is to 'find, fix, track, target, engage and assess' by establishing an air-to-air/air-to-ground combat system of systems to improve efficiency of the information extracted. At Zhuhai in 2016, the company showed three 1:20 scale AEW models – two K/JE-03 aircraft and a KJ-500/ZDK-06. The former is based on a Shaanxi Y-9E with a balanced beam radar, while the company's latest offering, the KJ-500/ZDK-06 is a Shaanxi Y-9E with a rotodome on top, housing three JY-06 AESA radars. However, with three radars, each taking up a third of the rotodome, it doesn't need to rotate.

For the AEW&C role, CETC ran a video at the event showing how capability improvements in the ZDK-06 have provided a more flexible means of attack and defence. Working with fighters, UAVs, navy ships and command centres, it can data-link the information it's detecting over long ranges and vice-versa and can downlink the aerial picture as well as uplink data from ground-based air defences.

Pakistan already operates four of the earlier ZDK-03 variants, which have been in service since 2011 alongside three Saab 2000 Erieyes. The latter will be boosted by a similar number of new aircraft this year. AMR

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Singapore Army

Singapore ACMS – Singapore's Advanced Combat Man System (ACMS) soldier suite employ Selex SSR+ communication technology.

The challenge of upgrading to software defined radios will reduce the need to overcome issues with upgrading traditional hardware for Asian militaries.

by **JR Ng**

Tactical radio technology is becoming increasingly capable and sophisticated, with industry pushing for more complex and integrated packages. But for Asian defence forces the most important features continue to be compatibility, weight, ease of operation, and cost.

Regional users also have disparate requirements, considering the wide range of operating environments from the thick foliage of Southeast Asian jungles to the vast mountain ranges of the Himalayas. Moreover, compatibility is taking on greater importance with military operations and training being conducted in coalitions. However, these efforts are hampered by legacy products that need to be included, as well as by several competing integration standards.

Radio-based communications can also be unreliable with environmental and technical challenges impacting on performances. Tactical networks for voice, data and video communications can be versatile and reliable, but a lack of international standards in communication architecture introduces several challenges, especially with ageing legacy systems that were not designed to connect to modern, data-enabled internet-protocol (IP) networks.

Regional forces are also beginning to adopt software-defined radios (SDRs), which not only enable additional capacities to be incorporated via software updates rather than replacing hardware, but also allow these forces to develop customised waveforms for enhanced

security. Interoperability among radio sets is potentially increased because the same waveform software can be adopted to other SDR systems within the same standard.

Indonesia

The Indonesian Army (Tentara Nasional Indonesia-Angkatan Darat, or TNI-AD) soldiers are typically equipped with a tactical handheld or manpack radio during military operations.

Known radio sets in service include the venerable Associated Industries AN/PRC 77 manpack system, although this is being phased out for newer systems; the Alkom LRT-07H and LRT-08H (3 to 30MHz); and the General Dynamics URC-200 (V2) which is used by the Indonesian Air Force's (TNI-AL's) Paskhas special operations units for forward air control (FAC).

Meanwhile, the Indonesian Marine Corps (Korps Marinir) is understood to operate the Saab Systems Grintek (SSG) TR2400 which is part of the SSG tactical HF communication product range; which was developed to meet the requirements of the modern digital battlefield. The TR2400 HF SSB transceiver covers 1.6 to 29.9999MHz and is used primarily for long-range reconnaissance patrols by military and paramilitary forces. The transceiver provides the user with voice and data communications for manpack applications, as well as base station and vehicle installations. Micro/DSP technology is designed to provide configuration flexibility and a ready upgrade path. The TR2400 is also reported to have been supplied to the Bangladesh Armed Forces where it replaces the AN/PRC-77.

Indonesia is also pursuing indigenous SDR technology with defence prime PT Len producing the VDR10-MP SDR is a 10 Watt (20W PEP maximum) VHF manpack. The radio covers the 30-88MHz frequency range with a 16 kbit/s data rate. About 734 units are believed to have been ordered for the army, with deliveries commencing late 2015.

India

The Indian Army presently maintains the Army Radio Engineered Network (AREN), which is a secure HF system operated at the brigade level.

Indigenously developed FH radio sets with integral encryption devices have been introduced into service at the squad level and above in recent years. These include the LVP 275 VHF FH manpack radio, the LVP 285 and 333 VHF handheld radios (136-174MHz and 30-88MHz respectively), and LUP 291 secure ultra-high frequency (UHF) handheld radio, which are produced by Bharat Electronics Ltd (BEL).

BEL has also developed the Secured Tactical Army Radio System VHF (STARS-V) in 5 and 25 W power output configurations. The radios support communication in clear and secure voice and in data modes. The latest model, STARS-V Mk II was developed to provide secure tactical VHF radio communication in contested electronic environments.

According to BEL, STARS-V Mk II operates in the frequency band of 30.000 to 87.975MHz with 2,320 channels and 25kHz channel spacing. The radio can be configured as a manpack station with a suitable harness, a vehicular installation, or as a low power static station, with a number of these systems understood to have entered service with the Indian armed forces.

The country is also aiming to introduce next generation handheld and manpack SDRs to boost its network-centric warfighting capabilities. Stated requirements include a ground to ground communication range of over 3km for handheld systems, while manpack radios must have a range in excess of 10km. The Indian paramilitary forces already operate the MaxTech Savion SDR radio.

Singapore

The Singapore Armed Forces (SAF) largely operate the PRC-940A VHF manpack and the AHF-130 for HF communications, with some legacy PRC 640 VHF/HF dual-band radios still believed to be in service.

Communication devices are typically assigned to the squad level and above, with a specially trained signaller attached to a squad. More may be attached depending on the mission. However, specialised infantry units outfitted with the Advanced Combat Man System (ACMS) soldier suite are assigned individual Selex SSR+ systems.

The SAF unveiled that it has operationalized a software defined radio (SDR) capability with the vehicle borne and static Rockwell Collins-Thales FlexNet-One system, which is now an essential part of its Army Battlefield Internet system. Efforts to introduce compatible manpack SDR radios are believed to be under way.

Philippines

The Armed Forces of the Philippines (AFP) has traditionally relied on US systems for its tactical communications needs. Known tactical communication systems acquired prior to 2010 include Harris Corporation's Falcon II RF-5800H-MP (export variant AN/PRC-150); Falcon II RF-5800V. Post 2010 acquisitions

Harris Corporation

Harris Falcon III manpack – Harris Corporation has made significant traction in Asia, with the Armed Forces of the Philippines being a regular customer of its tactical radio systems.

include the Falcon RF-7800V handheld VHF Combat Net Radio.

It is also a known operator of Israeli-made systems with Tadiran (now Elbit) supplying U$8 million worth of tactical radios to the AFP in 2002. However, the type of radios supplied has not been disclosed.

Harris Corporation announced in February 2016 that it had secured a $12 million order to provide the AFP with Harris Falcon III tactical vehicular radios, intercom systems and handheld radios. The company will provide the Light Armored Division of the Philippine Army with the Falcon RF-7800V Combat Net Radio integrated into the RF-7800I Intercom Systems, as well as the Falcon RF-7800V handheld VHF Combat Net Radio for general use by the army.

"These radios will provide soldiers in the Philippine Army with advanced command and control, and real-time situational awareness capabilities," Brendan O'Connell, president, Tactical Communications, Harris Communication Systems, said in a statement. "They also will have secure interoperability with more than 15,000 Harris Falcon radios currently fielded within the AFP."

In late 2017, funding was made available for an additional acquisition of 3,185 units 5W VHF handheld radios worth PHP678 million, and 150 units of 20W VHF manpack radios worth $4.35 million. Also funded was the Philippine Navy's C4ISTAR project for an unspecified number of 5W VHF handheld radios worth $5.7 million. These as yet unspecified radios will be supplied by Harris Corporation under a Foreign Military Sales (FMS) programme with the US government.

Other Asian countries

The Royal Thai Army (RTA) operates the venerable AN/PRC25 and AN/PRC77 VHF/FM radios, as well as the Tadiran AN/PRC 624 VHF/FM and CNR-900 VHF (30-88MHz) station. The PRC-1099 manpack HF radio system is also used at the battalion level. Sources indicate radio sets are typically issued at the platoon level and above, but troops on security detail may also be provided with communication devices for situational awareness.

The Royal Cambodian Army (RCA) tactical communications systems and doctrine. The service is primarily a light infantry force that relies on foreign aid/supplied equipment. It is understood that much of the RCA's present equipment is Chinese and Soviet-era vintage.

In 2016, China donated equipment for a trunked, two-way radio communications system along with over 1400 two-way radio handsets. The type remains unknown but sources suggest that these could be the PRC-7501 VHF frequency hopping (FH) hand-held radio, which operates in the 30 to 87.975MHz range and is interoperable with various manpack and vehicular VHF radios.

Japan produces its own radio equipment with no known exports currently observed. The country's standard manpack is the JPRC-F70 manufactured by Mitsubishi, and are widely employed by the Japan Ground Self Defense Force (JGSDF).

Although much of indigenous development remain shrouded, US Federal solicitations allude to what appears to be a modern software defined radio (SDR) network, called the Broadband Multipurpose Wireless System, already in place as of 2015.

Japan's NEC Corporation has also developed what it calls the 'Field Communication System' for the JGSDF. This comprises the Mobile Type I radio (handheld) and the Mobile Type II (manpack). These are stated to be capable of handling voice and data communications.The Mobile Type I handheld radio appear to be assigned to squad leader and above level.

South Korean firm LIG Nex1 produces the in-service PRC-999K VHF CNR, as well as the smaller but incompatible PRC-96K, for the Republic of Korea Army. The PTRC-999K is a VHF/FM combat net radio (CNR) designed for voice and data applications. According to the company, the low power, broadband equipment offers more channels than conventional VHF/FM CNRs. LIG Nex1 has also developed the PRC-999KE, a smaller and lighter version of the original radio with improved VHF performance, extended battery life, and embedded GPS.

The country is also benefiting from SDR technology through LIG Nex1's Tactical Multi-Mode Radio (TMMR) effort as part of the wider Tactical Information Communications Network (TICN) transformation programme. TICN brings together expertise from LIG Nex1, Huneed Technology, and SamsungThalesJV (now Hanwha Systems) to develop the future tactical communications infrastructure for the army and marines, and is expected to replace large quantities of legacy CNR sets the TMMR through 2020.

The Sri Lanka Army (SLA) expanded rapidly in the 1983 to 2009 period during the civil war against the Liberation Tigers of Tamil Eelam (LTTE) rebellion in the north of the country, prompting the government to update some of the SLA's equipment in order to deal with the threat.

The country is known to operate Turkish ASELSAN PRC-9600 VHF radio. Meanwhile, Special Infantry Operations Teams (SIOT), which have been at the forefront of past combat operations with the LTTE are understood to be equipped with indigenously developed HF radio sets with extended antennas that boost useable range to 54km, up from the 45km potential of unmodified systems. AMR

MoD

Finland's Hamina-class vessel is constructed with an aluminum hull and re-enforced carbon fibre composite superstructure. It is armed with a Bofors 57 mm/70 SAK Mk3, four Saab RBS-15 Mk2 SSMs and Denel Umkhonto-IR SAM.

FAST ATTACK: STILL A THREAT IN THE LITTORAL

Small, swift missile-bearing attack craft can do great damage at range if allowed to do so.

by **Stephen W. Miller**

Fast craft have received a great deal of attention since their well publicised use by the Iranian Revolutionary Guards in the Persian Gulf. Their wide naval use, however, goes back at least to the 1870s with development of the self-propelled torpedo. Today the missile boat has largely, but not totally, replaced the torpedo boat but these and other fast craft continue to fill a range of roles. Although the level of emphasis and numbers and types of boats differ in various navies, they remain an important asset.

Torpedoes to Missiles

The first true surface attack fast craft was the motor torpedo boat (MTB). These combined sleek hulls with large engines providing fast and agile boats that could attack larger ships using torpedoes. The idea was that a number of boats would attack together using their speed to quickly move into firing range, launch their torpedoes and turn away. The torpedo boats were viewed with great concern by the major naval powers with large capital ships. They responded by developing and install rapid firing naval guns on existing combatants, as well as, the design and launching of an entirely new ship class, the destroyer (originally called torpedo boat destroyers).

Many navies then, as today, saw these fast boats as an inexpensive counter to major capital warships. However, despite their wide spread use in World War II and some successes they did not fully meet combat expectations in the attack role for which they were originally promoted. Most were retired or assigned patrol duties. The development of the anti-ship missile in the 1950 renewed interest in the fast craft replacing the torpedo with missiles that could be launched 50km and more from a target. Improvements have increased flight speeds to supersonic and ranges around 1000km are possible, although most are below 300km.

The fast missile boat remains popular with navy's that have more confined waters and broad littorals to defend. This is represented by the Peoples Liberation Navy of China's commitment to such craft with over 109 in service. These include the Type 22 (*Houbei* class) a catamaran design launched in 2004 using water jet propulsion that reaches speeds of 36 knots (66km/h). It has eight C-801/802/803 anti-ship missiles plus a 30mm AK-630 rotary cannon. The C-803 has a range over 350km and an active homing seeker. The craft's lines and construction seek to reduce its radar and other sensor signatures. The primary role of the 30mm gun is defence against attacking aircraft and incoming missiles.

Today speed, missile range and also stealth are keys to the fast missile craft's ability to succeed. Avoiding detection or at least reducing detection time is critical. Boats seek to launch their missiles before being engaged. The goal of the force being attacked is to detect and destroy the boats before they fire. Considering the ranges of anti-ship missiles, this becomes the job of surface or airborne surveillance. Therefore, there is increasing emphasis on stealth in the latest fast craft designs. Even then the common employment remains committing many boats to attack in concert firing salvos of missiles so as to overwhelm the enemy – much the same tactic as used by torpedo boats.

The design goals of Umoe Mandal, developer and manufacturer of Norway's *Skjold*-class, were that 'although high

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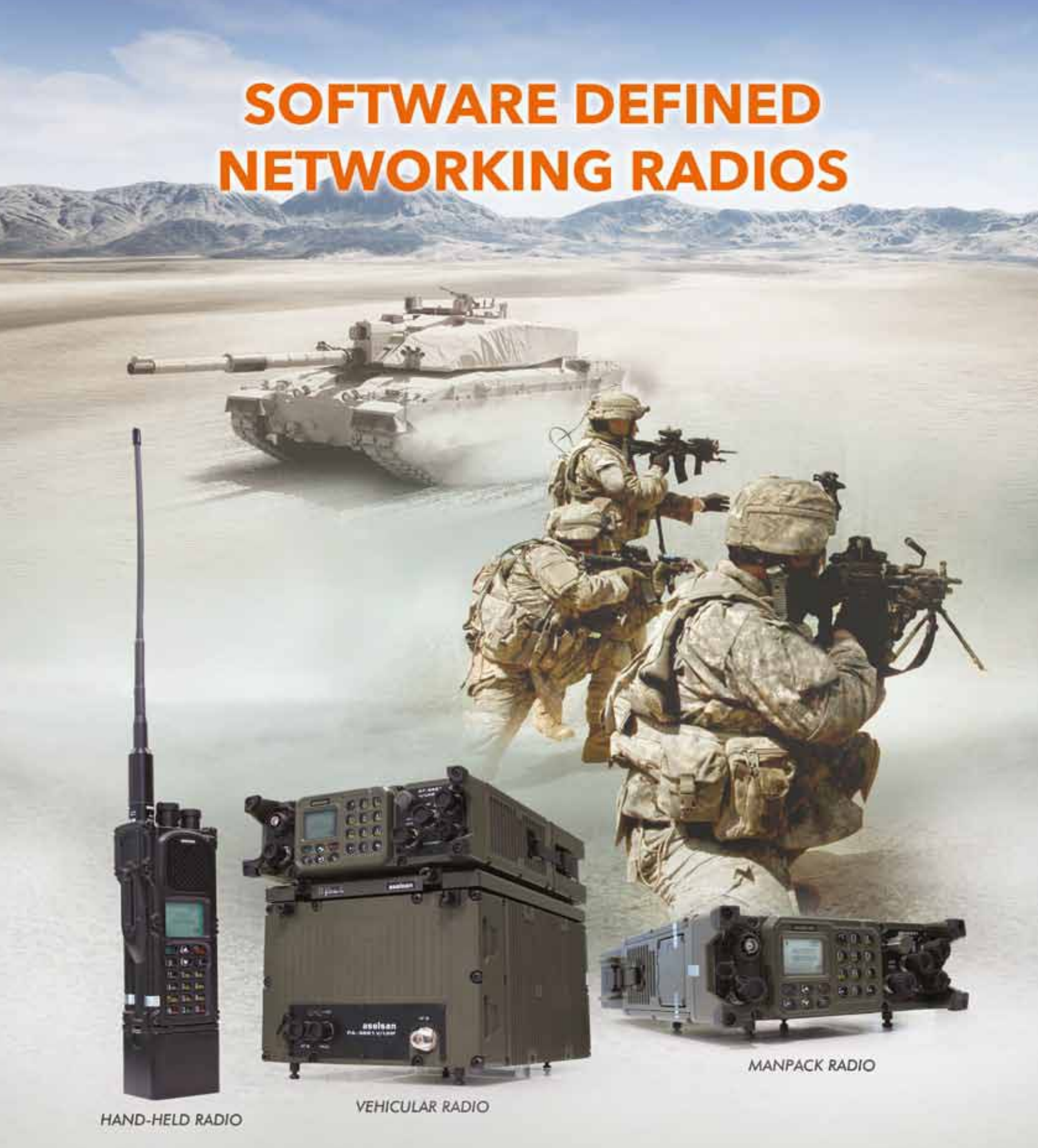

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The Peoples Republic of China has made a major investment in fast missile boats. Its Type 22 Houbei class Missile Boat, here firing aYJ-83 SSM, seeks to combine speed of a catamaran hull with low-detectability using smooth lines in the superstructure.

speed is important, achieving stealth is critical to craft survival and mission success'. Its 274 tonne *Skjold* air-cushioned surface effects catamaran hull at 60 knots (111km/h) is not only fast but achieves the lowest possible radar and thermal signature. An executive explained that 'not only are the lines configured to reduce radar returns but radar absorbing materials (RAM) are incorporated into the structure itself". It carry's eight Kongsberg Nye Sjoemaals Missiler (NSM) anti-ship missiles, an Oto-Melara 76mm rapid fire cannon, and MBDA Mistral surface-to-air missiles.

Past combat actions by missile boats have suggested several lessons learned. First, counter-measures like ECM, chaff and decoys can be very effective in spoiling a missile attack. This applies to the missile boats themselves as well. Second, an effective on-board air defence capability can at least complicate air attack against boats. This was demonstrated in the Iran-Iraq war when an Iranian Combattante II-class Missile Boat not only survived an attack by four MIG-23s but shot two down. Another point is that combat results suggest that multiple missile hits are required to fully take a ship out of action; therefore, a number of missiles must be launched at each target.

These requirements, as well as the desire to enhance cruising range and endurance needed for blue water missions has seen missile boat sizes increase. The Corvette designation is becoming increasingly applied to these new designs. Corvette sized vessels of 500 to 1000 tonnes allow outfitting with more diverse weapons and defensive suites. In addition, the versatility of the craft is enhanced including countering opposing fast craft when appropriately equipped with anti-ship missiles, rapid fire gun, surveillance and targeting systems, and possibly a helicopter landing pad. Builders have demonstrated that despite the increased displacement these vessels are capable of high speeds of well over 35-40 knots (65-74km/h).

Finland's Hamina-class, although only 250 tonnes, reflects this. In addition to its superstructure made of reinforced carbon fibre composite the shape and materials that reduce the ship's magnetic, heat and radar signatures. It has an armament suite of 100km range RBS-15 missiles, a Bofors 57mm cannon, and Umkhonto-IR surface-to-air missile system capable of engaging multiple aircraft at up to 14km. This is complemented by Rheinmetall's multi-ammunition soft-kill system (MASS) with Philax chaff and infra-red flare decoys, an Etienne Lacroix anti-threat optronic screening (ATOS) system and a MEL Matilda radar intercept ECM.

Sweden's Visby-Class designed by Swedish Defence Materiel Administration (FMV) and built by Kockums is another combination of speed and stealth in a larger (640 tonne) platform. Saab's design minimises the vessels transmitted and reflected energies – heat, light, sound, electric potential, and electromagnetic radiation to deny an op-ponent the opportunity to locate, identify, track, and attack it. These properties and speed and agility are seen as critical to the multiple missions the Visby is designed to perform. To this end Visby uses combined diesel or gas (CODOG) turbine arrangement for high speeds and two diesel engines for low-speed driving two water jet propulsors. The propulsion system provides a continues maximum speed of 15 knots in diesel engine mode and 35+ knots (65 km/h) in gasturbine mode. This arrangement is also addresses an operational limitations of many fast craft – that of having limited range and endurance. Visby can travel up to 2500nm (4600km).

Fast Attack Craft

This covers small craft ranging from pleasure craft or racing boat designs armed with small arms and portable rockets to purpose built high speed boats. Used in close waters and where cover and concealment can be provided by coastal topography the sortie and withdrawal tactics they use can be effective. In more restricted waters which channel ship passage, like the Straits of Gulf of Hormuz and Malacca or against unexpecting or unprepared ships it can be decisive.

Despite the public attention that they have received these most of these craft are not capable of sinking a major ship. The exception to this, as demonstrated in a US war gaming several years ago, is where craft are used in massive suicide attacks. They have short range and are primarily useful controlling local sea space, deterring intrusions, and harassing and challenging shipping operating in home waters. They are capable of hit and run attacks against armed ships but could have much more serious consequences employed against commercial shipping.

Iran's Navy of the Army of the Guardians of the Islamic Revolution (also referred to as the Revolutionary Guards) has been aggressive in collecting fast attack craft (FAC). The reverse engineering of the Ice Marine Bladerunner has assisted them in design and manufacture of the indigenously produced Seraj-1 fast attack craft. Another, the Torgah fast attack craft, is based on the Swedish 'Boghammar'. Their fleet has expeanded to include additional craft, all locally designed and manufactured, with an objective of fitting more powerful weaponry than recoilless guns and heavy machine guns. The Zolfaghar fast attack craft includes twin tubes for Nasr-1 cruise missiles and a 70 knot (130kmph) top speed. Iranian officials claim to have adapted other anti-ship missiles to their FACs as well such as the Shkval E, a supercavitating

200 kt torpedo with 7,500m range. These could significantly change the threat and appropriate counter actions.

For other Navies, including the US Navy, high speed craft are largely employed for near shore patrol and special operations in littoral and riverine support. The MarkVI PB, built by Safe Boats, is the US Navy's most recent entering service in 2015. Hartwell Champagne, senior vice president of operations, shared with *AMR*, "the vessel is designed for optimal performance, fuel economy, and firepower, as well as, reducing Total Ownership Cost (TOC). Its twin diesel engines and water jets, provide speeds in excess 30 knots at full load and 600+nm range. It has berthing accommodations, galley and facilities for extended missions." The US models have two remote operated MK-38 Mod2 25mm guns plus mounts for 50-calibre machine guns.

Ramta, a division of Israel Aerospace Industries (IAI), has provided its Super Dvora MKIII multi-mission patrol and attack boats to Israel and others. The 27.4m boat has twin water jets for 40+ knots speeds. It mounts a Rafael Typhoon stabilised 25mm cannon, and optional missiles like the 8km range Hellfire with semi active laser homing millimeter wave radar seeker.

Singapore, through ST Marine, developed and fields the 25m (82 ft) 45 tonne Specialised Marine Craft (SMC) which has only two meters above water. Its twin 2500hp MTU engines with Hamilton water jets and coupled with a flatter hull form allows tight turn and speeds in excess of 30 knots (56km/h). A stabilised 12.7mm machine gun is mounted forward. The last of eight SMC's were delivered in 2017.

Unmanned Fast Craft

Advances in remote and autonomous control have allowed successful demonstration of unmanned fast surface craft. "Maritime Tactical Systems (MARTAC) have designed and successfully tested their MANTAS, a low profile, twin hull, Tactical Autonomous Unmanned Surface Vessel (USV) in sizes from 0.9m (3 ft) up to 3.7m (12 ft). Chris Val-dez, chief information officer, indicates that larger, currently up to up to 6.1m (20 ft) craft, are already in design and could be available within 9-12 months. He stressed "that although these USV craft offer 'burst speeds' of up to 50 knots, it is their excep-tional manoeuvrability, stability, and payload capability that most sets them apart from similar sized craft." China's People's Liberation Army (PLA) Daily reported in October 2016 that it too has demonstrated an "intelligent unmanned fast sea vessel" the SeaFly-01. The 10.25m vessel has a maximum speed of 45 knots. Both are currently viewed as sensor platforms but other missions are possible.

Fast Craft How Valuable?

Fast craft have an undoubted advantage in close waters and complex littorals. For them success depends on gaining and maintaining the initiative through surprise and speed of manoeuvre. If this is forfeited they, even in numbers, can be destroyed. AMR

The General Dynamics Light Armoured Vehicle (LAV) has been in service with the US Marines, Canadian Army, Australian Army and others and continues to be employed is the result of a series of upgrade and improvement programmes that have been planned and executed since its introduction in the 1980s. As a result many of these will continue in service though the 2030s.

COMBAT VEHICLE MODERNISATION

The desire to retain and operate a selection of armoured combat vehicles in Asia Pacific is encouraging local industry to get 'in on the act'.

by **Stephen W. Miller**

The range of armoured combat vehicles available to the modern soldier include direct fire vehicles centred on main battle tanks (MBTs), 'light tanks' and tank destroyers, as well as infantry carrier vehicles (ICVs), infantry fighting vehicles (IFVs), and armoured reconnaissance vehicles (ARVs).

These can have tracked or wheeled running gear but in either case are designed to move on and off-road and to manoeuvre to gain advantage over the opponent. Vehicles can mount armament ranging from large calibre cannon to medium calibre auto-cannon or machine guns. Each is protected to some level by armour but may also incorporate a range of other protective measures. They typically have optical sighting systems and fire controls that provide accurate engagement of various targets at maximum ranges and in various battlefield conditions. Combat vehicles offer significant offensive and defensive capabilities and when properly employed in conjunction with other combat arms like anti-tank guided missiles, mortars, artillery, and attack helicopters as well as aircraft, can dominate the battlefield.

Armoured combat vehicles, however, are costly both to acquire and operate/maintain. Warfare, especially armoured manoeuvre warfare, is dynamic with threats evolving, new more lethal and capable weapons being introduced and technologies being perfected and fielded that challenge existing combat systems. The diverse range of threats that they face include long range anti-tank missiles, hand held anti-armour weapons, mines and improvised explosive devices (IED) As ever, industry equally responds with improvement, upgrade and modernisation programmes for these vehicles.

These modernisation efforts have overall been remarkably successful. Some projects embody the phased introduction of improved capabilities as new technologies, sub-systems and components become available. The addition of 'A1' or other number to the original designation often reflects this upgrade approach. The Leopard2 A6 indicates an improved version of the earlier Leopard2 MBT. This 'block' improvement process is often used by armies to upgrade their existing fleets through a rebuild process where fielded vehicles are returned to the factory or depot and then fully disassembled and rebuilt to the new standard. The US Army M1 Abrams MBT, placed in service in 1980, has undergone a number of such efforts and remains in use with major changes.

Considering the cost associated with replacing an army's combat vehicles, a Service Life Extension Programme (SLEP) offers a way to extend the life of existing vehicles by regaining and sometime improving reliability. SLEPs take advantage of the work process to replace components and sub-systems not only with new equipment but often the latest and improved versions. Installing new power packs (engine, transmission and drives), suspensions, and today's digital open architecture controls are common. These efforts are often tailored by industry and militaries to also address problems and lessons learned during operations. The US Marines Assault Amphibious Vehicle AAV7 fielded in 1970s and Light Armoured Vehicle (LAV) introduced in 1983 have both undergone several SLEPs allowing their use to be extened through 2030 and 2035 respectively.

Finding and implementing critical improvements - sometimes just a single issue - can affect the ability to successfully employ the combat vehicle and prevent casualties. If this is identified during a particular ongoing deployment, industry is required to conduct rapid development and fielding. The US operations in Iraq saw a number of such efforts in response to the widespread use of IEDs and rocket propelled grenades (RPGs) particularly in close urban combat operations. For examples, fitting bar or slat armour to the Bradley IFV and Stryker ICV could be accomplished in the field through the design of a special double V-hull (DVH) helped to defeat mines and IEDs which the original flat bottom hull would not. Wendy Steiger, the GDLS programme manager revealed: "The complexity of incorporating the DVH necessitated a complete chassis replacement so the Army incorporated into a 'reset' programme in which old Strykers were turned in and replaced by DVHs in 'zero miles/zero hours' condition. The old vehicles were then used as the basis for additional DVHs. This also allowed the incorporation of Engineering Change Proposals (ECPs) that further improved the vehicles abilities and reliability."

Modernisation, upgrade and improvement is a tool employed by virtually every army worldwide but has been actively utilised over the past few years by a number of Asian-Pacific army's in particular to enhance their armoured force's capabilities. The process offers a cost effective way to update current fleets and to recover reliability, meet current threats and extend the useful field life of their vehicles. A number of such programmes are underway with many levering collaboration with long establish combat vehicle developers and suppliers and local industry.

Singapore

Singapore's Army (Tentera Singapura) has worked with local industry partner ST Kinetics to achieve a strong local defence armament capability. This has included the modification and upgrade of acquired foreign manufactured combat vehicles. Its M113A2 Ultra IFV used the M113A1 which was then upgraded to the A2 standard and adding armour and a twin 40mm automatic grenade launcher/.50 calibre heavy machine gun in a protected weapon station. Alternately a Rafael Overhead Weapon Station with a M242 25mm Bushmaster auto-cannon was used. According to ST Kineticsthe ' M113 Ultra provided the basis for the later Bionix 40/50 and Bionix 25 IFVs which

Almaz– Antey

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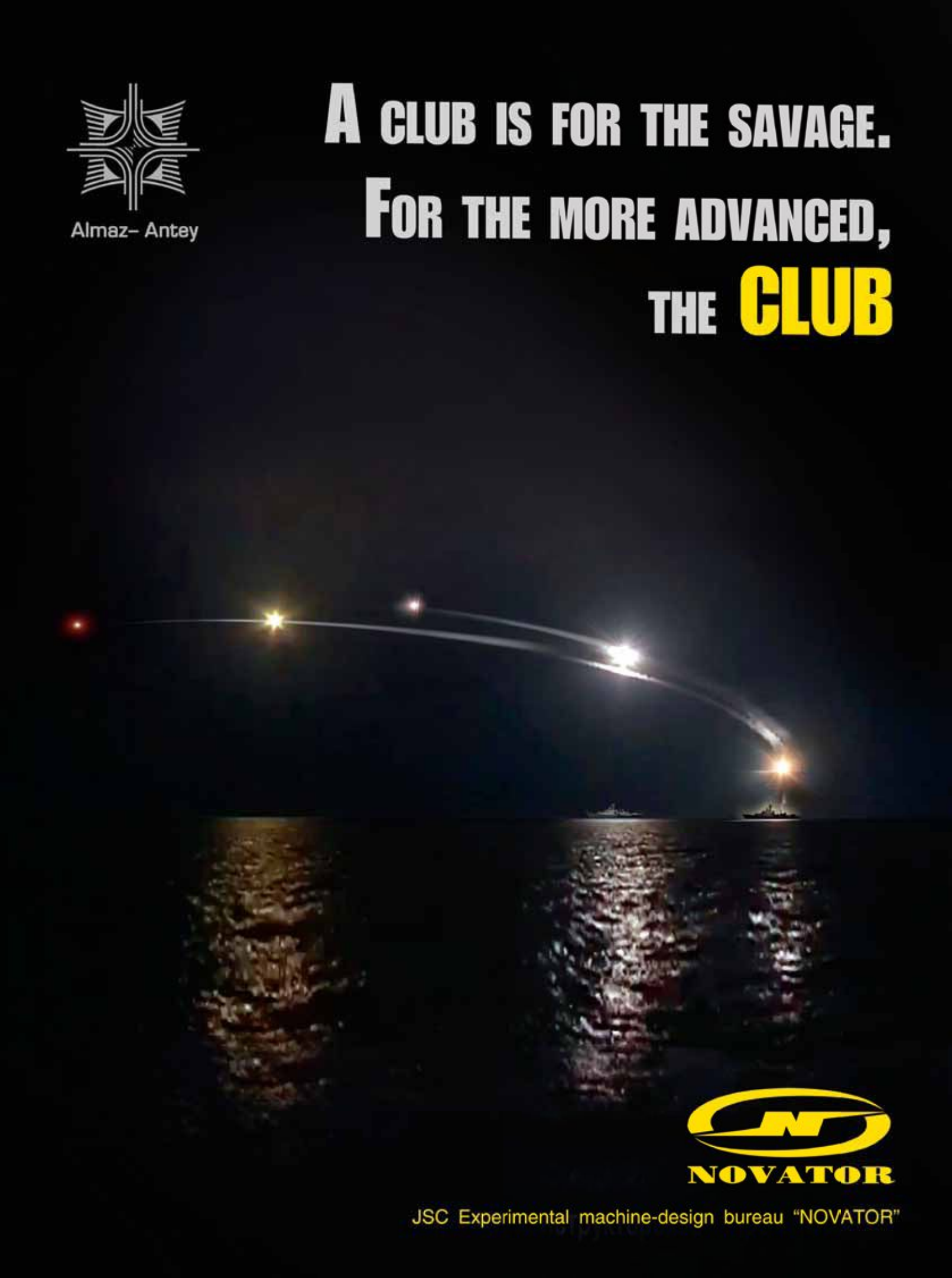

NOVATOR

JSC Experimental machine-design bureau "NOVATOR"


NORINCO

NORINCO is upgrading the Type 86 IFV (similar to the Russian BMP-1) by replacing the 73mm turret with a 30mm auto-cannon and HJ-73 ARGM. The new Type 86G will be the standard.

constitute the majority of the Army's tracked combat vehicle fleet."

Indonesia

The Indonesian Army (Nasional Indonesia Angkatan Darat - TMI-AD) has for several years been modernising its armoured force. It had added over 100 Leopard 2A2RI (Republic of Indonesia) MBTs customised to TMI-AD requirements. Acquisitions from Rheinmetall have added 42 Marder 1A3 IFVs and support tanks. In the case of the later, Rheinmetall's Oliver Hoffman said that "the Marder adaptation for Indonesia is being accomplished in collaboration with local industry".

In February 2017, PT Pindad and Timoney signed a contract to upgrade the TMI-AD's Badak 6x6 armoured fire support vehicle with a Timoney modular driveline, transfer case and steering system. As Badak uses a unique front mounted transfer box and front axle drive, a custom design will be prepared. As has become standard practice in Indonesia much of the work will be accomplished in-country. This is part of a plan to establish a domestic defence industry, gain economic value, and to position itself as a supplier to militaries within the region.

Republic of China (Taiwan)

The US developed M113 design makes up much of the fleets of the Philippine and Taiwanese armies. With the later the CM-21 is a locally manufactured version from the Ordinance Readiness Development Centre (ORDC) using ROC subsystems such as the Perkins TV8.640 diesel engine and torsion bar suspension. It is also configured with firing ports for the eight embarked infantry. A CM-21A1 with additional all local automotive improvements has been introduced.

Philippines

The Philippines has acquired numbers of surplus M113s. It awarded a contract to Elbit Land Defense System in mid-2017 to upgrade 44 of these vehicles with the 12.7mm machine gun Remote Controlled Weapons Stations (RCWS). In 2016 Elbit, through its subsidiary Sabiex International, reportedly delivered 28 former Belgian M113A2+s with 25mm Remote Weapon Stations, 90mm Scorpion and 76mm turrets with improve fire controls, and the .50 RCWS.

Republic of Korea

The Republic of Korea (ROK) has one of the most capable armoured forces in Asia. Its defence industry has transitioned from license production to development of some of the most advanced combat vehicles available. The K200 tracked Korean Infantry Fighting Vehicle developed and built by Doosan DST (now Hanwha Defence Systems) in 1986 was a hybrid of these two approaches. It drew on early M113 work combining new features requested by the ROK Army and licensed produced subsystems such as the MAN D2848T engine and Allison Transmission X200-5K gearbox resulting in a new IFV design. Although production ended in 2006, a firepower upgrade was presented in 2016 by Doosan in cooperation with CMI Defence. It provided the Cockerill Protected Weapon Station (CPWS) to replace the manual .50 open mount. CPWS can mount a range of auto-cannon from 20-30mm including the M242 25mm Bushmaster and Oerlikon KBA. In 2017 Hanwha unveiled a proposal at ADEX 2017, the international aerospace & defence exhibition in Seoul, for a stretched K200 modified with a flat rear area that would accept various mission modules. This multi-purpose vehicle could swap modules for communications, ambulance, refuelling or other roles.

Malaysia

As *AMR's* Dzirhan Mahadzir reported in June 2017, Malaysia's focus is on fielding its new AV-8s. However, they will retain the Condor armoured 4x4 APCs originally designed by Thyssen-Henschel of Germany and manufactured by Henschel Wehrtechnik in the 1980s. As a result, Malaysian company DefTech has an upgrade programme for the Condors. It involves replacing the vehicle's power with a 300hp Cummins engine and Allison automatic transmission, air conditioning, improved armour and a blast resistance Vee- hull. It is introducing a digital electrical harness that allows the integration of perimeter video cameras and multi-function displays. A prototype was shown at Defence Services Asia expo 2016 in Kuala Lumpur and again at the Defence & Security 2017 expo in November 2017 in Bangkok. A DefTech spokesperson at the event indicated that 'trials are underway and that up to 300 Condors could be upgraded with the schedule dependent upon funding'.

Thailand

The Royal Thai Army (RTA) has an aging combat vehicle inventory, a portion of which will be replaced by new MBTs and IFVs being supplied by NORINCO from China through recent deals. However, there will remain a significant number of vehicles in service that are candidates for upgrade and modernisation. These include the Cadillac Gage Stingray tank, the M60A1 MBT, the V150 Commando and a large number of M113s. A number of presentations have been made to the RTA particularly by Israeli firms which have included a reported fire control upgrade in 2016 by Elbit. Recently, as reported by AMR in October 2017, a project detailing engine, suspension, protection and firepower (including a 120mm cannon up-gun) was proposed by Israeli Military Industries. As yet the status is of this last upgrade/modernisation t is not clear.

The Thai company Panus Assembly has, on its own effort, developed and provided to the Thai Navy an upgraded/modernised model of the V-150 Command 4x4 called the HMV-150. The HMV-150 is longer at 6.5m and can carry up to ten infanty. It has a 350hp, 8.9 litre Cummins ISL engine Euro 3 with an Allison 4500 automatic transmission. In response to new threats its armour protection has been increased against both blast and ballistic fires. As both the Thai Marines and Army have around 300 V-150s acquired in the late 1970s, a locally contacted upgrade could be welcome considering the Thai government's stated desire to build a defence industry base. It is also possible that this could be an opening to a large market outside Thailand since other Asian-Pacific V-150 users include Vietnam, Indonesia, and the Philippines.

Peoples Republic of China

The Peoples Republic of China's reverse engineering of the Russian BMP-1 resulted in the Type 86 which is manufactured by NORINCO. Like the BMP-1 it used the 73mm low velocity cannon. However, the Type 86G has been introduced by NORINCO which replaces the 73mm turret with a one man turret mounting a 30mm auto-cannon and HJ-73 ATGM launcher. This new IFV is replacing previous Type 86's across the Peoples Liberation Army (PLA).

Future Trends

There is a clear push by militaries in the Asian-Pacific to enhance the capabilities of their forces with considerable emphasis on combat vehicles. Although they recognise this often requires acquisition from foreign sources they are increasing requiring participation of local industry in these projects. Doing so has permitted many of these countries to undertake improvement and upgrades to existing combat vehicles using their own firms. In any case upgrade and modernisation provides an effective tool for maintaining combat vehicle capabilities and enhancing reliability rejuvenating existing fleet assets with moderate investment. AMR

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Controp

Controp has developed the 3D Guard persistent surveillance system, which is already in operation in an Asia Pacific country.

COASTAL WATCHKEEPERS

Unmanned systems are making the monitoring of coastal borders a less labour intensive.

by **JR Ng**

Although the Asia Pacific region has remained free from major conflicts in recent decades, border and coastal security is increasingly a cause for concern for many regional nations. With their economies vulnerable to vast stretches of porous land and maritime borders that result in illegal entry and smuggling activities, a recent hightening of focus on longstanding territorial disputes has elevated the importance of border security.

Rapid economic growth and military modernisation, combined with growing resource demands, has exacerbated the potential for conflict. Non-traditional threats such as weapons proliferation, illicit trafficking, piracy, and natural disasters pose significant challenges with grave implications for national security. It is no surprise, then, that the Asia Pacific is projected by some market research firms to top the global border and maritime security market with cumulative expenditure of over $110 billion out till 2027 (source: MarketsandMarkets).

Border surveillance

The Asia Pacific is home to some of the most dangerous land borders in the world, with the Korean Demilitarized Zone (DMZ), India-Pakistan and Sino-Indian borders having been prominent for decades. With such enduring requirements, it is no

surprise that reconnaissance and surveillance equipment developers have identified significant market opportunities in the region.

Developed in 2014 in response to a customer requirement, Controp Precision Technologies' 3D Guard is an unattended day/night-capable video surveillance system that is designed to provide persistent observation capabilities for the protection of national borders as well as military facilities and critical infrastructure.

The 3D Guard weighs 25kg and comprises two stationary fixed field-of-view (FoV) cameras – dual uncooled infrared imagers or dual daylight television cameras – mounted one metre apart in parallel on a fixed pedestal and both staring in the same direction. According to Controp, this configuration creates a 'triangle' that forms a stereoscopic image of the object of interest, enabling precise calculation of distance and movement.

Each 3D Guard system has a maximum range of 1,000m and is usually installed on fixed structures such as masts or towers, but can also be employed as part of a mobile security system. It is designed to function reliably in environments where humidity can be as high as 95 percent, making it particularly suitable for the tropical conditions found in Asia. The company reports sales of 'a few dozen' systems to an unspecified launch customer in Asia Pacific.

Controp has also developed the Speed-ER, a multi-sensor observation system designed for extended-range surveillance applications in day and night conditions. The company is pitching the Speed-ER for a range of land-based requirements, including border and coastal surveillance, air defence, and force protection.

Speed-ER combines a cooled Gen 3 medium-wave infrared (MWIR) indium antimonide (InSb) camera and a shortwave infrared (SWIR) indium gallium arsenide (InGaAS) camera outfitted with a continuous optical zoom lens, as well as a pair of colour CCD cameras. These cameras are specifically optimised for narrow and wide fields of view (FoVs) respectively. The system also includes an eye-safe laser rangefinder and a laser pointer.

A key feature of the Speed-ER system is its 4-axis gyro-stabilised electro-mechanical sensor head, which has a 360-degree continuous horizontal field-of-regard capability. The stabilisation ensures that vibrations encountered by the multispectral camera array do not degrade video quality at longer ranges, especially when the system is capable of detecting targets at distances of over 40km.

Unmanned Observation

The Singapore Armed Forces (SAF) has adopted comparable technologies in its newly announced Unmanned Watch Tower (UWT) solution, the first of which is expected to be operational by March 2018 with two more systems deployed by September. Designed and built by Singapore's state-owned defence technology agency, DSO National Laboratories, the UWT will support the SAF's coastal surveillance operations on the strategically vital Jurong Island, where most of its petroleum, petrochemical and specialty chemical industries are based along with underground storage spaces for such products.

Indonesia's TNI-AU Integrated Maritime Surveillance System (IMSS) centre.

Singapore Ministry of Defence

The Singapore Armed Forces unveiled its Unmanned Watch Tower in March 2018, with the first system deployed on a strategically vital installation.

The Philippine Navy has received a TCOM-made aerostat from the United States to boost its coastal and maritime surveillance capabilities.

The UWT is equipped with a suite of advanced sensor systems comprising multiple high-resolution low-light electro-optical cameras to cover a wide surveillance area, centralised remote monitoring of multiple camera systems, and video analytics for the automatic detection of targets. The UWT is also equipped with a long-range acoustic device to warn-off intruders. According to the Ministry of Defence, the system will save manpower by up to 30 percent and is also rapidly redeployable – given that it is built around a standard shipping container that can be easily transported – to support surveillance operations elsewhere.

IMSS in Indonesia

With vast territorial waters and complex geography which includes around 17,000 islands, Indonesia has invested considerable resources into growing its

coastal surveillance capabilities. Under a 2006 deal with US company Techno-Sciences, it acquired at least 12 surveillance radars worth over $16 million to monitor its southern Makassar Strait. Indonesia has also been advancing indigenous research and development into coastal surveillance systems with the support of the Indonesian Institute of Sciences, as well as state-owned firms including PT Len Industri and PT Dirgantara.

In 2012, the country acquired two coastal radar surveillance systems based on Kelvin Hughes' solid-state SharpEye radar sensor technology to monitor the waters around Maluku province and the eastern Merauke Regency in the Papua province. The package included the supply of the SBS-800-51 system, S-Band solid-state SharpEye radar transceiver and antenna, as well as the installation of the systems on radar masts.

According to Kelvin Hughes, the SBS radar systems are fully remote-controlled and is designed for continuous operation with high detection accuracy and target discrimination at long range. The company also claims that the systems automatically adapt to changes in the weather and environmental conditions without the need for any operator intervention.

Indonesia has also benefited from international support such as the Integrated Maritime Surveillance System (IMSS), which was funded by the United States (US) Department of Defense (DoD) to the tune of $57 million between 2006 to 2008. Handed over to the Indonesian Navy (Tentara Nasional Indonesia-Angkatan Laut, TNI–AL) in October 2011, the IMSS comprises 18 coastal surveillance stations, 11 ship-based radars, two regional command centres and two fleet command centres in Jakarta and Surabaya covering the Malacca Strait, Sulawesi Sea, and Moluccas Strait. However, although the US provided an additional $4.6 million to sustain the IMSS through 2014, recent reports indicate that the IMSS was deemed too costly for the TNI-AL to operate.

Elsewhere in the region, the Philippines has likewise received aid from the US to bolster its coastal surveillance capabilities. In August 2017, the Philippine Navy formally accepted a 28 metre-class Tethered Aerostat Radar System (TARS), which is expected to boost its ability to monitor maritime and air traffic amid continuing concerns in the West Philippine Sea. The TARS also includes a weather station that transmits data on ambient temperature, pressure, wind speed, and other aids for the safe operation of the system.

Manufactured by TCOM, the TARS is based at the Naval Education and Training Command (NETC) in San Antonio, Zambales. According to the company, the aerostat can carry up to 386kg of mission equipment up to a maximum period of 14 days. It is capable of operation in wind speeds of 92 km/h.

Malaysia is also actively seeking to improve the security of its Eastern Sabah Security Zone (ESSZONE) – a special security area that covers over 1,400km of coastal areas in eastern Malaysia – and has reportedly set aside around $59 million from its 2018 national budget. The fund is also expected to include about $12 million to acquire new coastal surveillance radars for Sabah and Sarawak. AMR

USMC

Force Protection Industries provided the first mine protected vehicles manufactured by US industry in its Cougar. The US Marines introduced it for use by Explosive Ordnance Disposal Teams as the HEV.

THE MRAP STORY: LEARNING FROM HISTORY

The sudden and widespread use by insurgents of IEDs in Iraq caught regular forces off-guard, and triggered the urgent need to look back at past solutions with led to the creation of the MRAP

by **Stephen W. Miller**

The employment of Improvised Explosive Devices (IED) came as a surprise to the coalition ground forces occupying Iraq in 2003. It also developed into the most serious and deadly threat to coalition operations around the country which, for a number of years, proved difficult to counter adequately.

The insurgent's abilities to continuously adapt IED designs and employment techniques became a lethal hallmark of the Iraq conflict. Its success their further spawned the adoption and employment of IEDs by other insurgents, revolutionaries, and terrorists across the globe. Today the capability to defeat attack by an IED is an essential requirement of most combat vehicles and often a serious consideration in other tactical vehicle designs as well. The innovation that eventually challenged the IED's unqualified effectiveness and, thereby, altered the tactical balance away from its mastery of ambush style engagements was the Mine Resistant Ambush Protected vehicle, or MRAP.

Enter the MRAP

Mines and explosive devices are hardly new to warfare. Massive mine fields were emplaced in every theatre during World War II and the Korean War while locally manufactured booby-traps were a common hazard faced by patrols in the jungles and rice paddies of Vietnam. Generally these were un-attended and passive with their detonation triggered by the action of the vehicle or soldier that happened upon them. They were unexpected and deadly with adverse affects on troop morale which caused them to move more cautiously. They also were extensively used in Rhodesia and against the South African Defence Forces

(SADF) in its incursions into Angola, Namibia and Zambia in the Border Wars from 1966 to 1990. In fact, the use of mines was adopted as the principle tactic of thePeople's Liberation Army of Namibia (PLAN) against the SADF. Mines came to define the conflict.

This tactical aspect of the South African conflict received little international attention by the major armies but it forecast the dominating role that mines and IEDs would take on in coming conflicts. It also offered some ready-made solutions for protecting against these threats though SADF's development and fielding of armoured V-hull vehicles. South African developers, including the company OMC that perfected the monocoque hull, developed designs that resisted the blast of an explosion under the vehicle belly or wheels. Combining an angled belly, unencumbered hull form, increased ground clearance and breakaway suspension components, its designers were able to provide a series of vehicles that reliably protected the vehicle's occupants. A key part of the design's effectiveness was in directing


USMC

The MRAP focused on assuring the safety and survival of the vehicle occupants. This Marine Crops Cougar hit an IED suffering extreme damage yet all the occupants were uninjured.

OMC's RG-31 was extensively employed in Afghanistan due to manoeuvrability relatively lower weight and demonstrated survivability. It was manufactured by OMC in South Africa and by GDLS-Canada. Here an RG-31 with a remote weapon station used by Special Operations leaves a post.

the blast forces away from the vehicle's welded armoured crew compartment (which became known as its 'citadel'). The initial Casspir Mine Protected Vehicle (MPV) design was introduced in 1980 and remains in service with over 22 nations. The design concept was further perfected by TFM Industries as Mamba and later expanded by OMC as the RG-31Nyala MPV. The value of these mine protected vehicles was well recognised and they were acquired and employed in various United Nations peacekeeping operations.

Command Detonation IEDs and Over-Matched

The US Army entered Iraq equipped for a war with defined front lines and rear areas. Its tactical vehicles were largely either heavily armoured M1 tanks and Bradley fighting vehicle or unprotected 'soft skin' light, medium and heavy trucks. The AM General High Mobility Multipurpose Wheeled Vehicle (HMMWV, or more generally Humvee), its most widely used vehicle, even in its armoured version, only provided protection against small arms and not IEDs. As the insurgency grew it was these Humvees, in their patrol and security operation roles, that had their vulnerability to the mines and IEDs quickly exposed as casualties mounted. Despite concerted efforts to harden vehicles to these attacks, insurgents recognised and targeted this weakness. In addition, just as the SADF had found, the widening use of mines and IEDs forced attention toward tedious mine sweeping activities, diverting resources and limiting manoeuvre. It also escalated the human cost of the campaign as insurgents sought to undermine public support for the US presence.

The magnitude of the IED threat and the inadequacy of up-armouring efforts became evident and a team from the US travelled to South Africa where it viewed a Casspir successfully cross a live mine field. Less known is that the British Royal Engineers had earlier in 2002 acquired Tempest Protected Patrol Vehicles (PPV), a Technical Solutions Group (TSG) design built by Supacat, for route clearance in the Balkans. Using the urgent needs requirements of Explosive Ordnance Disposal (EOD) as a justification, the US Marines placed an order with TSG's Force Protection (FPI) for a Hardened Engineer Vehicle (HEV) that incorporated the mine/IED resistance characteristics of these earlier South African designs but refined with lower centre-of-gravity and other improvements. It was based on South Africa's designs but utilised commercial off-the-shelf components and 54 vehicles provided for in a 2004 contract were delivered. Once fielded, the HEV was an immediate success virtually eliminating Marine EOD team deaths. This caused the Marines to push for more mine protected vehicles focusing on the FPI Cougars, derived from the HEV.

The US Army, which had experience with a handful of RG-31s used in Bosnia, had also acquired nine of this vehicle in 2003 for route clearance. It continued to acquire and field these but in limited numbers and strictly in mine clearance. It was the British Army that led the fielding of mine protected vehicles for general troop carrying duties and not simply these specialty roles, like EOD. Their Mastiff 6x6 and Ridgeback 4x4were Cougar derivatives that were configured for patrol and tactical employment by combat troops. BAE Systems also won a contract at this time to provide another Cougar version, the LAV, to the Iraqi Army in a license from FPI.

By early-2006 the Marine Corps' leadership was convinced that a wide fielding of mine protected vehicles was essential to operate in Iraq. Facilitated by the attention and support of a new US Secretary of Defence, Dr. William Gates, they moved to rapidly acquire 1,022 vehicles, now being referred to as MRAPs. A survey indicated that for them the FPI Cougar, which was also to

A new M-ATV mine-resistant, ambush-protected all-terrain vehicle, built specifically for the mountainous Afghan terrain, parks next to a larger MRAP, MaxxPro Dash in 2009.

be manufactured in collaboration with General Dynamics Land Systems, was the most available. The Marines, feeling they could best move the programme forward, insisted on managing the acquisition.

The US Army remained uncommitted to the MRAP even though the Marine programme approach was structured to anticipate the Army requirement and its acquisition reflected this belief. As a result contracts were issued to five companies each with entirely different designs. This was reasoned by acquisition officials to offer faster production and delivery, as well as alternatives if any company experienced development or production delays. This approach also had long term support impacts due to lack of standardisation which complicated logistics.

MRAP models fielded included the RG-31 in a contract with General Dynamics Land Systems Canada (which had the production license from OMC for North America) with vehicles manufactured at multiple US sites and at OMC in South Africa. The RG-33, an OMC design, was provided by BAE Ground Systems (as BAE now owned OMC). IMG/Navistar produced the MaxxPro, a design that returned to the earliest Mumba approach which placed the protected capsule on top of a chassis (rather than the latter integrated monocoque design). The company also capitalised on its commercial heavy truck supplier network utilising these commercial components as had early Rhodesian and SADF models. It even used bolt-on rather than welded armour.

Armour Holdings (which became BAE Tactical Vehicle Systems) provided the Caiman which was designed with components common to the US Army FMTV, its standard medium truck. In fact, Caiman was produced on the FTMV assembly line. Force Protection Industries (FPI) of Charleston, SC, produced Cougars. FPI also produced the Buffalo which was strictly not an MRAP but rather a special mine/IED clearance vehicle for EOD but managed by the MRAP office. Mike Aldrich, a former vice president at FPI stated that the company "recognising the scope of

UKMoD

The British Army quickly embraced the mine protected vehicles and acquired versions of the Force Protection Cougar adapted to its requirements. Called Mastiff 6x6 (shown with counter-RPG 'Bar Armour') and Ridgeback (4x4) these successfully operated in both Iraq and Afghanistan.

USMC

Mine Resistant Ambush Protected All Terrain Vehicles with upgrades, armour improvements and await road testing at Production Plant Barstow, Marine Depot Maintenance Command, Marine Corps Logistics Base Barstow, California, 12 January, 2017.

the MRAP needs and its manufacturing limits arranged Cougar production with other companies including General Dynamics Land Systems (the supplier of the M1 tank), Spartan Motors, Armour Holdings (which became BAE Tactical Vehicles), Textron, and the Marine Corps Logistics Centre."

In addition to vehicles acquired under the MRAP programme itself, a large number of mine protected and counter mine vehicles/systems were acquired as part of the US Army's Assured Mobility Systems (AMS) effort. These, like Buffalo, were specifically equipping counter-mine and route clearance teams. A number of RG31s and other vehicles including highly specialised mine detection systems like the Husky and Meerket VMMD were acquired and fielded separately under AMS.

Secretary Gates, after being in office for only a few months realised the importance of the MRAP and in 2007 directed it to be not only a Joint Programme which would include the Army. He also made it a priority effort which allowed its rapid expansion. The first MRAPs ordered by this now Joint Programme Office (JPO) were delivered to Iraq in July 2007. Each service in the end preferred different designs. For the Marines and Navy it was the Cougar. The Army primarily used MaxxPro. The SOCOM and the US Air Force preferred the RG-33. The majority of RG-31s were used in Afghanistan where its manoeuvrability was welcome. The value of the MRAP is evident by the fact that as it was widely fielded in country, IED casualties and particularly deaths dropped and 95 percent of those involved in an attack were back in action the next day.

MRAP Lessons

The return of the mine/IED and MRAP response offers both military system development and vehicle survivability technical design lessons. Firstly, the objective from inception was to field an available solution as rapidly as possible. An 80 percent solution initially was deemed acceptable if it met set essential requirements. However, even as it was fielded a spiral development was undertaken identifying, validating and implementing improvements. This necessitated an aggressive and continuous testing programme and a system to capture and act on field feedback. It also required transparency across the programme including users, the programme office and industry participants. The result was that MRAPs were continually improving by determining short comings and then seeking and applying solutions. This approach allowed better understanding of IED destructive forces and application of blast resistance seats, shock mitigating floors, independent suspensions, and other items. The MRAPs fielded in 2013 were vastly more capable with enhanced survivability than those introduced just a few years earlier. This spiral fielding and development worked far better than its alternative that would attempt to jump from one system to a completely new and theoretically better one.

The MRAP efforts provided a deeper understanding of the mine/IED threat and offered the ground work for addressing it in other vehicles. The application of mine/IED protection as a standard criterion in current tactical and combat vehicles draws closely from these efforts. The development and introduction of Stryker 8x8 with its Double V-hull is an example. Lessons of the MRAP have allowed for new designs that incorporate their protection levels into vehicle types not specifically focused on mine protection. Rather than being a driving factor as in MRAPs, it is now one in a combination of characteristics that make up a vehicles mission role capabilities, in that mine resistance is now a requirement in infantry fighting vehicles, reconnaissance vehicles, and even tactical trucks.

But Imine protection is a characteristic not a mission. Not being fielded toward specific roles – like motorised infantry carrier, or patrol vehicle – found most MRAPs without an advocate. The lack of any substantial numbers of MRAPs in force structure and lines of MRAPs in storage attest to this. Clearly the programme was successful in meeting its narrowly defined goals yet this might be qualified by the US military's lack of foresight in considering at some point it's broader and future roles and force integration. AMR

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GREATER POTENTIAL PENDING

Dzirhan Mahadzir

The ACV-30 variant of the AV8 Gempita AFV during a firing display at the Army's Gemas firing range.

The Malaysian Government continues to have ambitious plans for all branches of its armed forces, but more focus needs to be applied to budgetary commitment and acquisition prioritisation.

by **Dzirhan Mahadzir**

With a general election to be held in 2018, it was expected that the defence budget for that year, announced at the end of October 2017, would not be geared towards making any significant defence procurement. To some extent this was largely true but approval was given for the Royal Malaysian Air Force (RMAF) to start proceedings towards the purchase of four maritime patrol aircraft while the Malaysian Army was given the go-ahead to carry out the acquisition of 29 surplus M109A5 155mm Self-Propelled howitzers from the United States and purchase a small quantity of 105mm howitzers.

A key naval programme, the requirement for at least two Multi-Role Support Ships (MRSS) for the Royal Malaysian Navy (RMN), was not funded though for 2018 leaving the RMN to continue with an amphibious capability gap that has existed since 2009 when the Newport class LST KD *Sri Inderapura* was lost due to a ship fire. The Royal Malaysian Air Force (RMAF) did however get approval to carry out long overdue upgrades and life extension programmes for the C-130 Hercules, BAE Hawks and Sikorsky S-61 Nuri helicopters. As per normal practice, no details were given out regarding the exact funding for these programmes. In fact, the 2018 defence budget only addressed a small portion of the Malaysian Armed Forces requirement, aside from the MRSS, a replacement for the RMAF's MiG-29 fleet has yet to be decided upon, the Army has an eventual need for a new tactical transport helicopter over the stopgap measures of transferred S-61 Nuris from the RMAF, a new lead-in fighter trainer is needed by the RMAF, as well as anti-submarine warfare helicopters for the RMN and the replacement of the Seawolf missiles on the Lekiu class frigates. All these requirements are pending with uncertainty as to if and when they will be funded.

A clearer picture may emerge post election, though even then it will be subject to the leadership changes in 2019 as a number of senior military officers all reach the mandatory retirement age of 60 in that year. Armed Forces Chief General Raja Mohammad Affandi has already been extended past the retirement age and it remains to be seen if he will be extended beyond 2019. Both Army Chief General Zulkiple Kassim and RMN Chief Admiral Ahmad Kamarulzaman will be at the mandatory retirement age in 2019 and Malaysia generally does not provide an extension of tenure for service chiefs in contrast to the Chief of Defence Force. There are also a number of three star and

Dzirhan Mahadzir

A Royal Malaysian Air Force MiG-29, no funding for a replacement MRCA has been given and the RMAF is mulling the possibility of upgrading the MiGs.

two star officers in all three services who are due to retire in late 2018 and 2019 and thus it remains to be seen that in 2019, the new leadership within the Malaysian Armed Forces may choose to embark on a different path of development. While the Malaysian Armed Forces as a whole and its three services does have long term strategic and development plans, these are all subject to modifications so as to allow the Malaysian Armed Forces and the three services to have the flexibility to adjust to shifting situations and circumstances rather than being wedded to a development plan that has become obsolete to irrelevant due to time, hence the new MAF leadership in 2019 may wish to readjust current plans for developments when they assume command.

The following is a summary of the current and future key programmes of the Malaysian Armed Forces.

Malaysian Army

The current key ongoing programme of the Malaysian Army is the ongoing delivery of 257 AV8 Gempita AFVs built by Malaysia's DefTech. Over a hundred vehicles have been delivered so far and when all vehicles are delivered, eventually two armoured regiments and one mechanised battalion will be equipped with the AV8s. The main configurations are: the IFV-25 variant with a one-person FNSS Sharpshooter turret armed with a stabilised ATK Armament Systems M242 25mm dual-feed cannon and an FN MAG 58M 7.62mm co-axial machine gun (46 vehicles) for the mechanised regiments; and the AFV-30 variant for the armour regiments with a Denel Land Systems (DLS) two-person LCT-30 turret, DLS stabilised 30mm GI-30 external dual-feed linkless cannon and an FN MAG 58M MG (68 vehicles). A third varient is the anti-tank guided weapon (ATGW)

A Malaysian Army PT-91M Main Battle Tank, 48 of these form the Malaysian Army's sole tank regiment.

vehicle which will be distributed to all three units, having a Denel LCT turret fitted with the GI-30 and two Denel Dynamics Ingwe laser-guided missiles either side (54 vehicles). The remaining 89 vehicles consist of support, command and communications vehicle variants in seven types.

Currently it is known that the 19th Battalion Royal Malay Regiment (mechanised) and 1st Regiment Royal Armored Corps (Kor Armor Diraja - KAD) are equipped with the vehicles but the second armored regiment to be equipped has yet to disclose its status. The AV8 replaces the 4x4 Condor APCs operated by 19th RMR as well as the 6x6 Sibmas Fire Support Vehicles operated by the 2 KAD regiments. However, other mechanised battalions and two other KAD regiments will continue using the Condors and Sibmas respectively as funding for the time being precludes additional orders of the AV8 for full replacement. The Malaysian Army is still assessing whether to carry out a upgrade programme for the Condor 4x4s to enable them to continue service. About half of the 459 vehicles purchased in the 1980s are estimated to be in service. Malaysia's sole tank regiment, the KAD's 11th regiment, continues operations with the PT-91M main battle tank. Long term army plans following the deliveries of the 48 PT-91M from 2007-2009 called for a second tank regiment (though not necessarily additional PT-91Ms) but this has slipped in priority over the years.

Malaysia is expected to formalise acquisition of 29 surplus M109A5 155mm howitzers from the United States under the US Excess Defense Articles programme. A letter of intent was signed at the Defence Services Asia 2016 exhibition and a formal agreement expected for the purchase and transfer is expected to be signed at the Defence Services Asia 2018 exhibition. A contract for the purchase of an estimated 18 Nexter LG1 105mm howitzers is also expected to be signed there. There has been little movement towards acquisition of additional Multiple Rocket Launchers systems to form a third regiment to add to the two existing regiments of Astros II MRLs despite Army plans calling for a third regiment of MRLs.

The Malaysian Army Air Corps is expected to take delivery of the first two of a total of six ordered MD-530G light attack helicopters by late 2018, which will be deployed to the eastern part of the East Malaysian state of Sabah to assist in the ongoing security operations there against cross border attacks from armed groups operating in the Philippines. The recent takeover of the city of Marawi in the Philippines by a combination of Daesh affiliated/inspired groups has raised concerns in Malaysia that such groups will spill out to Eastern Sabah which is separated from the Philippines by the Sulu Seas - a distance close enough to allow raids using small boats. Meantime ithe Air Corps has received four out of a planned 12 S-61 Nuri helicopters from the RMAF though eventually the Army Air Corps hopes to obtain a more suitable helicopter for the tactical transport role though no funding has been forthcoming.

Royal Malaysian Navy

The Royal Malaysian Navy (RMN) launched the first Littoral Combat Ship (LCS) *Maharaja Lela* on 24 August 2017, at the Boustead Naval Shipyard. Despite the LCS tag, the ship is actually a corvette based on the Naval Group's Gowind design. The 3,100 tonne ship incorporates stealth characteristics with an armament of a single BAE Mk3 57mm gun in a stealth copula, two MSI Seahawk 30mm guns, two launchers for the Kongsberg Naval Strike Missile anti-ship missile (each with four missiles), a 16 cell SYLVER Vertical Launch System for the MBDA Mica surface to air missile and two J+S Marine triple torpedo launchers. Electronics systems includes the Thales Smart-S Mk 2 3D surveillance radar, Rheinmetall TMX/EO Mk 2 fire control radar, Rheinmetall TMEO Mk 2 electro-optical tracking systems and the Thales Captas Mk 2 variable depth sonar with the Combat Management System being the Naval Group SETIS system. Six ships are to be built with the keels of the second and third ships having been laid down in 2017. LCS *Maharaja Lela* is scheduled to be delivered in April 2019 with the whole fleet of six ships due to be delivered by 2023. The RMN's '15 to 5' Development Plan calls for an additional six of this class to be built once the initial six are completed.

The '15 to 5' Plan seeks to pare the RMN's existing ship classes from a current 15 classes of ships to five classes, namely the Maharaja Lela class Littoral Combat Ship, the Kedah Class Next Generation Patrol Vessel (of which six are already in service), the Littoral Mission Ship (LMS), the conceptual Multi-Role Support Ship (MRSS) and submarines (with the RMN currently operating two Scorpene class). The targeted goal by 2045 would be a fleet of 12 Maharaja Lela class LCS, 18 Kedah class NGPVs though the additional 12 ships are envisaged to be armed with anti-ship and anti-air missiles, 18 Littoral Mission Ships (of which four are contracted), three MRSS and four submarines. It remains open to question how many of the ships required under the plan will be funded and the long end goal of 2045 likely means the plan will end up being modified. While the MRSS programme has yet to be funded, industrial sources say that shipbuilders from Holland, Turkey, France, China and Indonesia have made proposals towards fulfilling this requirement.

On 23 March 2017, the RMN dispatched a project team to to China

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RMAF F-18 Hornets, the RMAF is looking at the possibility of obtaining legacy Hornets from Kuwait should the country phase out theirs.


Dzirhan Mahadzir

The Lekiu class frigate KD Jebat, the future of the two Lekiu class frigates remain uncertain with the RMN's 15 to 5 plan.

to monitor the design and construction of its LMS. The Malaysian government formally signed a contract on 23 March 2017 with Malaysian company Boustead Naval Shipyard for four LMSs in which Boustead is partnered with China Shipbuilding Offshore and International Corporation on the programme. Two LMS will be built at Wuchang Shipyard in Wuhan, China with the first ship delivered in 2019 and the second ship in 2020, while the remaining two are scheduled to be built at the Boustead Navy Shipyard facilities in Lumut, Malaysia and completed by 2021. The LMS, as conceptualised by the RMN will be 68m long with a 45 personnel crew, a displacement of 780 tonnes, a maximum speed of 22 knots (kts) and a range of around 2000 nautical miles (nm) with an endurance of 15 days at sea. A maximum of three mission module containers, each with a maximum payload weight of six tons can be carried on the ship with projected mission modules being a UAV operations module, a HADR operations module, mine warfare and a hydrographic survey module.

The RMN's 15 to 5 plans leaves open to question as to whether replacement of the Seawolf surface to air missile will be carried out on the two Lekiu class frigates in service as 15 to 5 targets both ships to be phased out though no time frame has been set. MBDA has been proposing the replacement of the Seawolf with CAAM and Bae, the manufacturer of the ships, has also proposed a service life extension and upgrades to the ship. It is expected that this issue will be addressed by the next RMN Chief when he takes over in 2019. Another pending program is the requirement for six anti-submarine warfare helicopters to operate off the Maharaja Lela class LCS, a total of six is sought rather than a larger total partly due to costs and partly also that the RMN operational practice is to assign an onboard helicopter on a ship only when the ship's mission or deployment requires the presence of one. No funding has been announced by the government for such for the time being but it is on the RMN's request list that has been submitted to the government.

Royal Malaysian Air Force

While the RMAF received the go-ahead under the 2018 Defence Budget to begin evaluations towards an eventual purchase of four maritime patrol aircraft, it is expected that an actual contract is unlikely to be signed until 2019 or later. Still, a number of aircraft manufacturers are aiming to fulfill this requirement, namely Leonardo with the ATR 72MP, Airbus with its C295 and Indonesia's IPTN's CN-235 MPA. Japan has also offered surplus P-3 Orions but the RMAF is said to be not keen on this offer owing to the age of the aircraft.

Meanwhile, the replacement for the MiG-29 by a multi-role combat aircraft continues unfulfilled with a 2020 timeframe now said to be the time for a decision to be made. France, the United Kingdom and the United States continue to market the Rafale, Typhoon and Super Hornet respectively for this requirement. The RMAF is also looking at other possibilities including an upgrade of the MiG-29 or the possibly obtaining Kuwait Air Force legacy Hornets should these become available following Kuwait's purchase of the Super Hornet. A requirement for lead in fighter trainers also exists but the RMAF would rather wait until the MRCA purchase is signed as this would partly determine which lead in-fighter trainer would be compatible. The UK is offering the BAE Hawk AJTs as an add on package with the purchase of the Typhoon.

The RMAF has received funding for the upgrades and service life extension programs for the C-130 Hercules, BAE Hawk and S-61 helicopters. The contracts for these have yet to be signed this is expected during the Defence Services Asia 2018 Exhibition in April. Malaysian company Airod, the in-country MRO for all three RMAF aircraft type will be given the contract for all three aircraft though it will work with various foreign partners on the work, one of which will be BAE Systems, which is the OEM for the Hawks. The upgrades will address the avionics, communications and sub-systems on the aircraft allowing them to continue service with the RMAF for an additional decade or more. AMR

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INDIA'S CAREFUL APPROACH TO CHINA CONTINUES

by **Veerle Nouwens**

The speculation of Chinese dominance in the Indo-Pacific region has been well documented in the Indian press. The Belt and Road Initiative (BRI) has raised New Delhi's fears that Beijing's infrastructure projects will bring more than economic prosperity to host countries. New Delhi is carefully monitoring China's activities in the Indian Ocean Region (IOR) and along its northern border at Doklam. Despite its concerns, it will need to find a balance between engagement with China and ensuring that its own national interests and security are not undermined.

One need only look at the list of Chinese Belt and Road projects in India's immediate neighbourhood to understand where the perception of encirclement by Beijing-friendly governments stems from. To India's West, the China-Pakistan Economic Corridor cuts through disputed Jammu and Kashmir territory that is claimed by India. But Nepal, Bangladesh, Myanmar, Sri Lanka and the Maldives have also seen Chinese investment and infrastructure projects as part of the BRI.

The projects in and of themselves are not necessarily contentious and in fact fill an infrastructure investment gap in Asia. Indeed, the Asian Development Bank in 2017 estimated that infrastructure needs in developing Asia and the Pacific require roughly $1.5 trillion per year until 2030. However, there has been increased speculation over the terms and conditions for the financing of China's BRI projects. The financial debt resulting from some of these projects has resulted in fears over 'debt trap diplomacy'.

The potential strategic locations of BRI deep water ports across the IOR has led some observers to highlight a resemblance to the geopolitical 'String of Pearls' theory. First coined in 2005, it predicted that Chinese commercial and military facilities in countries bordering the Indian Ocean would result in a network on which Chinese maritime dominance could be achieved. The commercial ports under BRI that encircle India have caused concern, not least because the Chinese-operated container terminal at Colombo Harbour in Sri Lanka, received two Chinese submarine calls in 2014.

These visits alone are not proof that the String of Pearls strategy is alive and well. However, China has been expanding its military footprint in recent years. In November 2017, China opened its first overseas naval base in Djibouti, which according to official reports, is a logistics facility to support its international humanitarian obligations such as anti-piracy missions. However, other reports have emerged over a potential Chinese naval and air base opening in Jiwani, located between Chabahar Port in Iran and the Chinese-built Gwadar Port in Pakistan. It is no secret that Beijing seeks to transform into a maritime power. As stated in its 2015 National Defence White Paper, the People's Liberation Army Navy (PLAN) plays a central role in China's ambition to shift to 'open seas protection' instead of its previous prioritisation of 'offshore waters defence'.

Although India's suspicion over Chinese ambitions in its immediate neighbourhood continues to rise, New Delhi is carefully continuing to pursue a policy of strategic engagement including infrastructure investment, such as the expansion of Chabahar Port in Iran. Working more closely with like-minded partners, such as Japan, on jointly delivering alternative sources of investment to countries in the Indo-Pacific is another facet to India's outward economic investment policy. Although measuring up to Chinese levels of investment will be difficult, the value of the investments that India engages in will lie in its transparency, sustainability and adherence to recognised international rules and norms.

India will also, however, continue to work with China and other states on managing regional connectivity projects through its membership of the Chinese-led Asian Infrastructure Investment Bank (AIIB), which helps finance infrastructure projects, including in India. Indeed, India is a founding member of the AIIB, its second-largest shareholder (behind China) and is set to host the annual AIIB meeting in Mumbai in June of this year.

However, India is also investing more in its defence and security foreign policy through bilateral relationships with IOR countries to promote collective maritime security and ensure its access to strategic facilities in the IOR. In January 2018, India signed an agreement with the Seychelles to develop, manage, operate and maintain military infrastructure on the island as part of its bilateral defence and security cooperation. An agreement was also signed in February that will allow the Indian Navy to access Oman's Duqm port for logistics and support. More recently, India and France agreed reciprocal access to each other's naval facilities, including the French facilities in La Réunion, Mayotte, and the French Southern and Antarctic Lands.

While India's strategic engagement will continue to evolve, it will seek to avoid the military and economic consequences of a conflict with China. Over the past week, both Indian and Chinese foreign ministry spokespersons have signalled the importance of maintaining a positive bilateral relationship, with the latter noting that 'the Chinese dragon and Indian elephant must not fight each other, but dance with each other.' The question is, to who's tune?

Note: *Veerle Nouwens is a research analyst, Asia Studies at the Royal United Services Institute for Defence and Security Studies, Whitehall, London. E-mail: VeerleN@rusi.org*

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