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Front Cover Photo:
Fast jets have an enviable collection of precision guided weapons to choose from, the latter of which are examined in this issues' *Alternative Options* article.

















Catch up on all the latest defence radio frequency news and analysis in *Thomas Withington's* regular *Pulse* column.

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# Editorial

## THE CAUTIOUS HAWK

That Japan inhabits an increasingly restive neighbourhood is no secret. The country is a missile-throw across the Sea of Japan from the Democratic People's Republic of Korea; making this the geopolitical equivalent of living next door to a biker gang. Meanwhile, the South and East China Seas regularly reverberate to the restless rattle of resplendent rapiers, as Beijing bullies and belittles in a seemingly ceaseless mini Cold War waged against several of its neighbours, near and far, for the control of maritime and territorial interests in these stretches of ocean.

Japan is barred from pursuing war as politics by other means, to paraphrase the Prussian strategist Carl Von Clausewitz. This is the result of its hastily written constitution drafted in the wreckage of the Second World War's aftermath by the victorious United States. Article Nine pledges the country to forever renounce the use of war and the maintenance of military forces. Japan gets around the latter restriction by keeping 'defence forces'; a navy, army and air force in all but name, the latter of which comes under scrutiny in our *Will the Sun Set on Air Superiority?* article in this issue. Yet these defence forces could finally be acknowledged via a potential constitutional change.

In early May, Shinzo Abe reiterated his wish for Article Nine to change, and to explicitly refer to the existence of the country's defence forces, so as to avoid any charge that their continued existence could be unconstitutional. He added that he would like to see this change enacted by 2020. Mr. Abe will have a fight on his hands: Two thirds of both of Japan's houses of parliament would need to back the change, as would a majority of the country's voters in a referendum. Since the end of the Second World War, Japan has maintained a strongly pacifist tradition in a significant part of its polity; any proposed change is likely to enrage this part of civil society.

Yet amending the constitution could send out an important message to foes and friends alike that Japan's highly trained and enviably equipped defence forces are here to stay, potentially having an important deterrent effect *vis-à-vis* future tensions in the country's *locale*. Constitutions should be 'rigidly pliable'; robust on one side to guarantee political stability while flexible enough to accommodate changing domestic and international trends. Japan's strategic realities have changed since the end of the most costly conflict in human history, it might be time for its constitution to do the same.

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*HForce provides Airbus Helicopters' commercial rotorcraft range with a weapon integration capability, and the FZ-275 will be tested on-board the H-145M using HForce in 2017.*

Airbus Helicopters

# ALTERNATIVE OPTIONS

**Whatever the political stance taken on the conduct of air strikes in Iraq and Syria, if they are going to be performed in the same fashion and to the same degree that they have been for almost three years now, reducing any risk posed to civilians is a must.**

*by* **Beth Stevenson**

Despite the use of the GBU-43/B Massive Ordnance Air Blast 21600 pounds/lb (9800 kilogram/kg) weapon, or 'Mother of All Bombs' as it was nicknamed by the media, by the US Air Force (USAF) to attack caves suspected to be used by ISIS (Islamic State of Iraq and Syria) in the Achin district of eastern Afghanistan on 13th April, most air strikes against the Islamist militia have tended to involve far smaller air-delivered weapons. This weapon was designed by the US Air Force Research Laboratory, with Dynetics as the systems integrator. On a daily basis air strikes are carried out by a coalition of nations under US command organised under the Combined Joint Task Force Operation INHERENT RESOLVE (CJTF-OIR). The *raison d'être* of CJTF-OIR is to: "militarily defeat (the Islamic State of Iraq and Syria) in the Combined Joint Operations Area (Iraq and Syria) in order to enable whole-of-coalition governmental actions to increase regional stability," according to the mission's website.

Since Operation INHERENT RESOLVE commenced on 15th June 2014, both inhabited and unmanned aircraft have been used to support the air campaign. While surveillance is very much part of the mission, the ability to perform effective attacks against ISIS is the ultimate aim. So far as the US is concerned, one of the prime weapons used in this operation is the Lockheed Martin AGM-114 Hellfire laser-guided/semi-active radar homing air-to-surface missile family. This is the primary weapon in the 100lb to 108lb (45.4kg to 49kg) class used by the USAF in this conflict, and also by a number of US allies in the Asia-Pacific notably Australia, India, Indonesia, Japan, Pakistan,


Airbus Helicopters

*Thales announced in March 2017 that its FZ-725 will be integrated onto the H-145M using Airbus Helicopters' HForce system, which might pave the way for the integration of the laser-guided rocket on more rotorcraft in the future.*

BAE Systems

*BAE Systems says that the Asia-Pacific is a key market for its APKWS laser-guided rocket system, for which production is ramping up under an contract awarded by the US government in 2016.*

the Republic of China, the Republic of Korea and Singapore. In terms of offensive USAF operations in the Iraqi and Syrian theatres, the AGM-114 family is used alongside the Lockheed Martin/Raytheon GBU-12 Paveway-II laser-guided bombs or Boeing GBU-38/B Joint Direct Attack Munition satellite-guided bombs on the General Atomics MQ-9 Reaper unmanned aerial vehicle, a platform often used to carry out strikes, for example, and if a full weapons set is used over one sortie, this comes at a hefty price: Four AGM-114 weapons can be carried by an MQ-9, and while the exact cost is unknown, it is estimated that the aircraft itself costs in the region of circa $15 million, with each AGM-114 costing around $100,000 according to publicly-available figures.

While the cost of war is never low, there is work being carried out to provide a lower cost precision strike capability for these types of missions, which could benefit users with high defences budgets and high international commitments such as the US, or militaries with lower defence budgets that want a precision attack capability, but which cannot afford more expensive weaponry. Another trend is the offer of alternatives to US-made weapons, which have for some years dominated NATO (North Atlantic Treaty Organisation) operations. One way of lowering the cost is to turn a rocket into a more precise weapon by adding a guidance kit. Many services have stores of unguided rockets for use across a whole host of platforms, so retrofitting a weapon that is already available to them with a guidance package is far cheaper than buying a missile that already has this capability. For example, in March 2017, Thales announced that it had been awarded a contract from Airbus Helicopters to integrate its FZ-275 Laser Guided Rocket (LGR) onto the rotorcraft manufacturer's H-145M light utility helicopter. Thales was previously selected to provide rocket systems for use across the family of helicopters, which are being integrated using Airbus' HForce weapon management system, which provides rotorcraft with a plug and play weapons capability: "Drawing on experience with the Tiger attack helicopter, Airbus Helicopters has developed an off-the-shelf solution to address customers' armament needs," Airbus says about HForce on its website: "Conceived as a plug and play system, HForce's core hardware is interchangeable from one helicopter to another. Software is specific to each helicopter, as are fixtures for the weapon pods. Armament can be exchanged between helicopters."

## Rockets

The manufacturer adds that a weapon installation kit with its own dedicated computer can provide any military version of an Airbus Helicopters commercial derivative with a weapons capability. The architecture permits retrofits of any available armament, Airbus adds, which includes the FZ-275. Once the FZ-275 is deployed on the H-145M with a twelve-tube rocket launcher, known as the FZ-231, it will be the first armed commercial helicopter of Airbus rotorcraft with a laser-guided rocket capability, Thales said in a March statement. Other candidate Airbus Helicopters aircraft for the integration of LGRs include the H-225M medium-lift utility helicopter and H-125M light utility helicopter. Nevertheless, a decision on when this integration will take place will be related to Airbus Helicopters' market requirements and internal integration programme, a Thales spokesperson told *AMR*. Testing due to take place under the March contract will be carried out in a number of locations in Europe

Boeing

*The Taurus missile equips the Republic of Korea Air Force's Boeing F-15K fighter, and planning is in place to integrate it onto the Eurofighter Typhoon family.*

Crown Copyright

*MBDA's ASRAAM was the first non-US manufactured weapon to be dropped from the F-35 during testing that began in 2016. It will be integrated onto the UK's fleet of F-35B Joint Strike Fighters.*

and the Asia-Pacific, the spokesperson added. For now, this system is just being marketed to the rotary-wing domain, and several proposals have been presented to potential customers, the spokesperson noted. In parallel, qualification of the weapon on different platforms is being evaluated. As the FZ-275 uses standard 70mm launchers, the rocket system does not require modifications and enables the use of existing rockets subject to the addition of a lens protection kit, Thales says: "With more than 60 years of experience providing rocket systems, Thales' ammunitions portfolio guarantees the compatibility of (LGRs) on existing rocket systems," the firm stated in an official press release: "Through this contract, Thales enlarges its supporting rocket systems integration within platforms and enables Airbus Helicopters to reinforce its vast weapon portfolio on armed helicopters," the press release continued.

Another similar offering is BAE Systems' Advanced Precision Kill Weapon System (APKWS), which converts the same-sized rocket into a precision-guided weapon. BAE Systems has been proactive in its marketing of the APKWS, having tested it on a number of fixed- and rotary-wing aircraft, including an unmanned system in the latter category. In 2015, it was tested from an Airbus Helicopters' EC-665ARH Tiger attack helicopter belonging to the Australian Army's 16th Aviation Brigade: "The Australia experience has been interesting," Rachel Guill, programme director for precision guidance solutions at BAE Systems, told *AMR*. "(W)hen the Australian Army called on us in April 2014, they were looking for us to qualify the APKWS rocket on the Tiger platform … This presented us with the first opportunity to integrate (the) APKWS with a foreign rocket, launcher and platform. Based on our system's modularity and ease of integration, we were able to successfully demonstrate over the course of just four months, ultimately (scoring) a perfect 29 for 29 over air and ground tests." The APKWS has not yet been contracted for use on the EC-665ARH, but Ms. Guill said that the company has: "seen additional interest from Australia and discussions are ongoing." The company has proven the system on in excess of 14 fixed and rotary wing platforms, Ms. Guill noted, including platforms that are well represented in the Asia-Pacific region. This includes the Bell Helicopter AH-1 family, Sikorsky MH-60R/S and Boeing AH-64D rotorcraft, and the General Dynamics./Lockheed Martin F-16 family fighter: "The bottom line is that our APKWS rocket is highly versatile and as we've proven several times, it can be integrated on fast jets and rotary wing aircraft and virtually anything in between," she said.

In addition to inhabited aircraft, the system has been tested from a Northrop Grumman MQ-8B Fire Scout unmanned helicopter, which is used in the Asia-Pacific by the US Navy to support its deployments there: "While we can't discuss the specifics, what we can say is that we are seeing tremendous demand for our APKWS rocket from this region," Ms. Guill added, noting that the first indefinite-delivery, indefinite-quantity contract from the US government was awarded in October 2016, will facilitate a near-tripling of production output on the weapon, and will cover sales to the Asia-Pacific as well as other regions: "To give an example of the ongoing demand without referencing specific countries…in October (2016), we announced a new three-year

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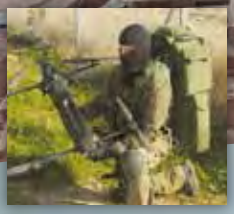

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*WHEN RESULTS MATTER*


*The Royal Air Force's future UAV fleet will be integrated with MBDA's Brimstone missile, replacing the AGM-114 family that is used on its incumbent fleet of MQ-9 Reapers.*

(circa) $600 million contract that will allow us to greatly increase production levels to meet the increased US government and international demand," Ms. Guill said: "In addition, our new facility that will allow us to manufacture 10000 to 20000 units per year, (and)…we can also say (that) currently we have requests from over a dozen countries looking to acquire units. The Asia-Pacific region is well represented in that demand."

Following the signing of the October 2016 contract, a $130 million first order was made shortly after, and Ms. Guill noted that while delivery dates are sensitive, the company can confirm it has delivered units against that order, and "in fact, delivered ahead of schedule." The company could not talk to any planned or ongoing testing: "but due to the nature of our 'plug and play', easy to adapt system, we continue to expand into new mission spaces and additional platforms."

## Game-Changing

One company providing competition to US-made weaponry is European armament manufacturer MBDA. It has seen successes in its domestic markets that include France, Germany, Italy, Spain and the UK, but is also pitching further afield, with the Asia-Pacific being the second largest export market after the Middle East: "The cost to integrate air-launched weapons on combat aircraft is generally quite high, hence, instead of facing a direct competition from US made weapons, the rule of the game is more 'how European missiles can make European aircraft more capable than their US competitors," an MBDA spokesperson told *AMR*. The spokesperson said that the company's beyond visual range air-to-air Meteor missile is a particular "game-changer" because of its ramjet engine, which provides a "no escape zone" three times larger than its competitors. This feature has created interest among export countries looking to acquire one of the three fighters it is integrated on, namely the Saab JAS-39 Gripen, Eurofighter Typhoon and Dassault Rafale families. He added that weapons such as the SCALP/Storm Shadow and Taurus satellite/terrain profile matching guided air-to-surface missiles: "are also setting the standards for deep strike in many countries."

Providing alternatives to customers that have typically operated US weaponry is another area in which MBDA is progressing. Its Brimstone active radar homing/laser guided air-to-ground missile has been selected as the weapon of choice for the Royal Air Force's Protector programme that will see the service operate General Atomics' Predator-B to replace its ten-strong fleet of MQ-9 Reaper UAVs. Brimstone will replace the AGM-114 family missiles that are integrated on the MQ-9. The UK Army Air Corps could also use Brimstone on its future AgustaWestland/Boeing Apache AH Mk.1 helicopter gunship fleet, having demonstrated the ability for it to be integrated and dropped from the Boeing AH-64E Guardian variant currently being acquired by the US Army, during testing that took place in 2016. This will help promote the benefits of integrating the weapon on the UK's future AH-64E fleet. Boeing won a contract to supply 50 AH-64E aircraft to the British Army in July 2016 with an expected service entry of 2022 for the aircraft, according to media reports. MBDA's Advanced Short Range Air-to-Air Missile (ASRAAM) will also be the first British missile (MBDA is part-owned by BAE Systems) to enter service on the Lockheed F-35A/B/C Lightning-II fighter, and live firings have taken place, marking the first non-US built weapon to be dropped from the type. The ASRAAM is being certified for use on the fighter in line with the UK's acquisition of the weapon for use on its F-35Bs, and "more than one" firing has taken place to date, Dave Armstrong, managing director of MBDA's UK division, told reporters in London on 15th March: "We are pleased to announce that ASRAAM has been fired off the F-35 for the first time ... We've carried out more than one (firing) and the results so far have been great." Testing is being carried out at the US Navy's Patuxent River airbase in Maryland and the US Air Force's Edwards airbase in California, and so far, flight trials and air-launched firings have taken place, although Mr. Armstrong noted that only limited information on the trials could be revealed at this point.

Integration of MBDA's Meteor active radar homing guided air-to-air missile and SPEAR (Selective Precision Effects At Range) air-to-surface missile integration is also planned for the F-35B, which will further MBDA's, and UK industry's, presence on the type: "(The) Meteor missile has been assessed as compatible with all F-35 variants and is (a) low risk for integration, and MBDA is working with the (F-35) programme to finalise the details for integration on the Block-4 version of the aircraft," the weapons manufacturer told *AMR*. Additionally, the US could be a market for Brimstone, as a study to assess it as an option for the US Navy's McDonnell Douglas/Boeing F/A-18 family fighter "is progressing well," the company spokesperson said: "The US has a clear capability gap in low collateral precision guided munitions capable of hitting moving targets from fast jets, and Brimstone could fill that gap," they added. The MBDA spokesperson noted that cooperation between different nations is key to its success, and: "thanks to this legacy, MBDA has a thorough understanding of the mechanisms of cooperation and transfers of technology." The company considers this as a decisive selling point when answering the requirements of export customers for transfer of technology: "as we understand, better than our competitors, how to do it to the best benefit of both parties," the spokesperson continued: "Some countries in the world clearly express their ambitions to become active players on the world scene for armaments, and MBDA has with these countries an active strategy of cooperation and alliance with the local industries." Of note, in 2017 the company signed a partnership with PGZ in Poland and created a joint venture with Larsen and Toubro in India, both of which aimed at covering developments of a range of technologies.

## Diversity of Supply

The US has dominated the precision-guided weapons market for sometime, but alternatives in terms of geography and technology are increasingly gaining popularity. While strike missions will inevitably continue to be performed in both the Iraqi and Syrian theatres, and in support of future warfare, the way this is approached seems negotiable. If the same mission can be carried out at a lower cost, for example, it seems sensible for nations to adopt new technologies that can offer precision-guided ordnance with less impact on defence budgets. On the other hand, if development of this technology can be internally provided by a country, either via its own domestic industry or through offset and technology transfer agreements that enable domestic development, there are benefits in terms of ownership and control of this technology. For whatever reason, these new trends are becoming more appealing to customers worldwide, as they look for alternatives to traditional weapon acquisition routes. Ultimately, precision-guided weapons have been, and continue to be, paramount for the responsible elimination of enemy targets, and if a customer can do this in a more beneficial way from an economic and sovereignty standpoint, then this seems the obvious course of action. AMR

# PULSE

*by* **Thomas Withington**

**Amid tensions in the Korean Peninsula, Seoul announced the development of a new weapons locating radar, Russian suppliers share details of their new tactical radios, Singapore enhances its airborne electronic warfare capabilities and US SATCOM takes an important step forward.**

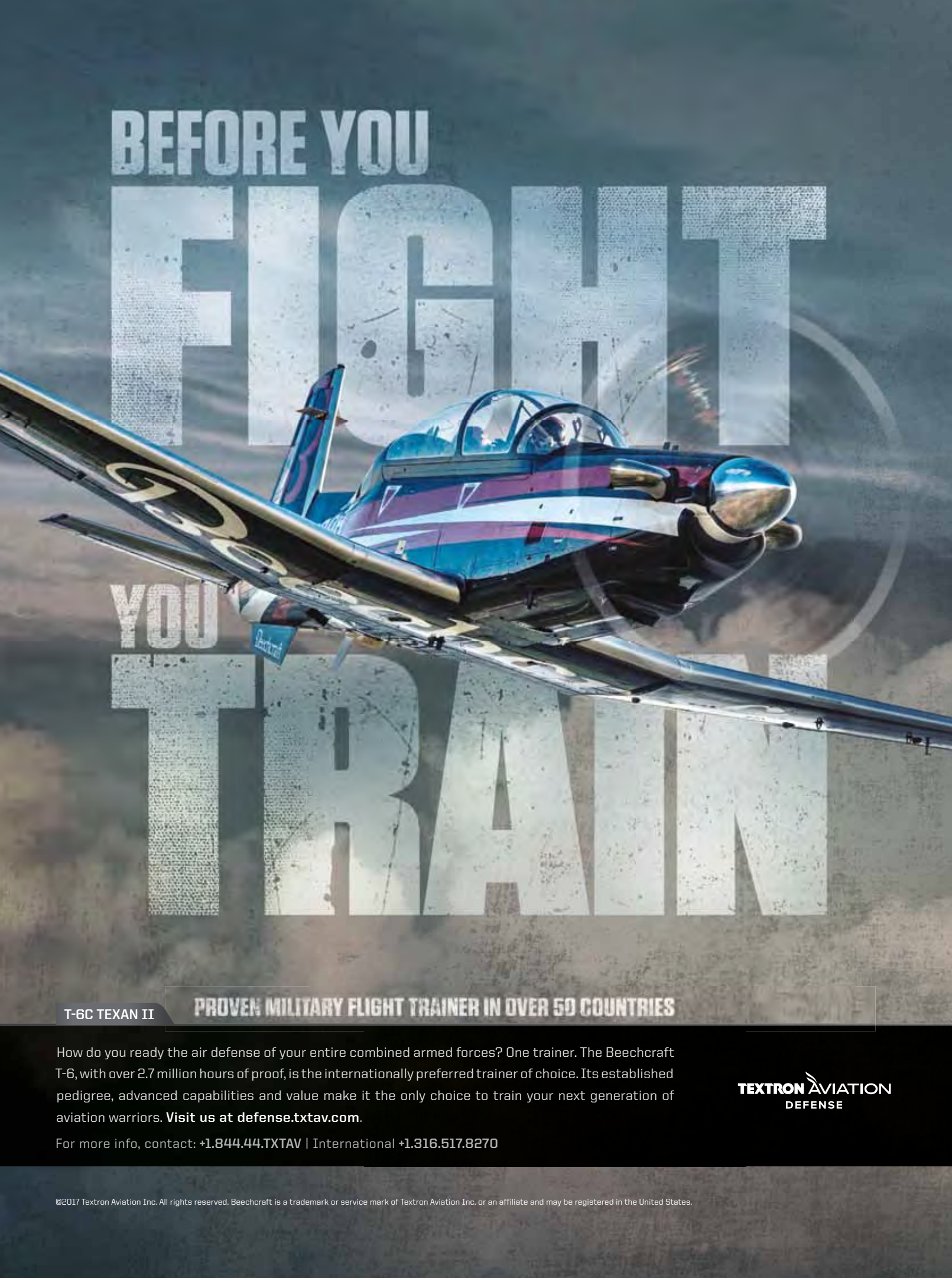
US Army

*The US Army is set to receive new AN/TPQ-53 radars following a contract award to this effect in late March. Singapore is also acquiring the radar.*

## Radar

On 24th April the Republic of Korea (ROK) announced that it had developed a new Weapons Locating Radar (WLR) to detect incoming artillery fire from the Democratic People's Republic of Korea (DPRK). According to media reports, development of the radar commenced in 2011 and has cost $47.7 million. The new radar, known as the Counter Artillery Detection Radar-II (CADR-II) is expected to enter service in 2018, according to the Defence Acquisition Programme Administration (DAPA), the ROK government agency which supervises the country's defence procurement. Development of the radar was reportedly performed jointly by the country's Agency for Defence Development and local contractor LIG Nex1. Few details have been released regarding the radar's performance, with the exception that it has a reported range of 32.4 nautical miles/nm (60 kilometres/km). Once in service, the radar is expected to join the Republic of Korea Army's other WLRs, namely its Saab ARTHUR-K C-band (5.25-5.925 gigahertz/GHz) WLRs; 16 of which were acquired between 2009 and 2015, following two orders in 2007 and 2011 respectively for a total of $190 million. These are supplemented with circa eleven Northrop Grumman/Raytheon AN/TPQ-36 Firefinder S-band (2.3-2.5/2.7-3.7GHz) radars purchased in 1992, and supplied between 1994 and 1995.

Meanwhile, as of late March, the US Army awarded Lockheed Martin a $1.6 billion contact for up to 170 AN/TPQ-53 WLRs. This latest contract award follows earlier contracts covering the delivery of over 100 systems, 95 of which had been supplied between 2010 and the first quarter of this year. Alongside the US Army, media reports stated that Singapore has acquired the radar, with six being procured, this being confirmed by an October 2013 US Defence Security and Cooperation Agency press release. The AN/TPQ-53 is an S-band radar that can track incoming rounds

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*The RSAF is expected to upgrade its AH-64D attack helicopters with Leonardo's HIDAS product to improve their self protection.*

at 32nm (60km) scanning 90 degrees of azimuth, or up to eleven nautical miles (20km) when scanning 360 degrees of azimuth, according to its manufacturer. Having been used to support the US deployment in Afghanistan, as of June 2016, the radar proved that it could detect and track UAVs. The force is now considering adding this capability, which has been developed as a result of modifying the radar's software, to the AN/TPQ-53 systems it retains in service. However, the US Army told *AMR* in February that it had yet to define the quantity of radars that would receive this modification, and that decisions on numbers would only occur once testing is completed, although no date has been announced as to when this could occur.

### Tactical Radio

RUAG has confirmed to *AMR* that its Tactical Access Node (TAN), which it has developed in conjunction with Rohde and Schwarz, is currently undergoing testing, which the firm has stated is expected to be completed by the end of the third quarter of this year. Launched in the second quarter of 2016, the TAN family offers several stand-alone routers which can handle High Frequency (three megahertz (MHz) to 30MHz), plus Very/Ultra High Frequency (V/UHF: 30MHz to three gigahertz) traffic. The company continued that the system is "radio agnostic" with the router being configurable according to the communications systems it will host. The product uses Internet Protocol (IP) architecture to host the network which, the firm adds with one of the attractions of the system being that the stand-alone router can rapidly activate a network which can include conventional tactical radios, alongside cellphones and Terrestrial Trunk Radio (TETRA) style UHF transceivers used by civilian first responders in North America and Europe. The router can be configured to recognise the communications devices which wish to join the network. A PIN (Personal Identification Number) is then entered by the user and the TAN recognises that user. They are then hosted on the network. RUAG told the author that it anticipates demand for the TAN not only from armed forces, whom can use the equipment to establish a network hosting different communications devices on the battlefield, but also for operations where the military maybe working alongside civilian emergency services during humanitarian assistance/disaster relief missions.

RUAG's official literature states that three separate products comprise the TAN family; the TAN-5, Rapid, TAN-T and TVS. The TAN-5 has a semi-ruggedised design and is intended for use at headquarters level, or for fixed installations. The Rapid provides similar capabilities using a man-portable stand-alone system and is designed to be used in areas where existing communications are either non-existent or unreliable. Meanwhile, the TAN-T is semi-ruggedised in construction and intended to be used as a node to connect disparate tactical radio networks to a mobile


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*A USAF General Dynamics/ Lockheed Martin F-16CJ Viper Weasel air defence suppression aircraft is about to be loaded with a pair of AGM-88B missiles. Australia has recently ordered a batch of these weapons.*

command post. Finally, the TVS is designed for installation on vehicles to provide a mobile node linking disparate tactical radio networks to other deployed echelons.

NPO Angstrem has provided *AMR* with details regarding its Azart R-187-P1E tactical radio which is equipping Russia's armed forces. This V/UHF (27MHz to 520MHz) handheld system provides communications security through frequency hopping rates of 20000 hops-per-second, according to the company's official literature. In VHF, the radio has channel spacings of one kilohertz, 6.25KHz and 8.33KHz (VHF) and 25KHz (UHF). Offering ranges of up to four kilometres (2.5 miles), the radio can carry 256 kilobits-per-second (kbps) of data when operating in an encryption-free mode. This reduces to 28.8kbps when operating in a frequency-hopping mode and thence to 7.2kbps when transmitting using the radio's encryption mode. In terms of waveforms, the firm continues that it offers simplex, half duplex and full duplex voice communications, and can receive information across the Russian GLONASS and US Global Positioning System geolocation satellite constellations. The firm has told *AMR* that it is already planning a number of enhancements to the radio which will include extending its frequency band and the radio's output power so as to extend its range. More waveforms are also in the offing alongside increased data transfer speeds and the ability to host a larger number of users on a single network than the radio handles at present.

In mid-March, Rheinmetall and Rohde and Schwarz announced that they had partnered for two major German armed forces communications programmes known as MOTAKO (Mobile Tactical Communications) and MOTIV (Mobile Tactical Information Network). In a written statement provided to *AMR*, Rohde and Schwarz stated that both programmes were intended to: "modernise and digitise the communications and networking" of the *Heer* (German Army). The MOTAKO initiative, the statement continued, will extend IP capable communications to the lowest tactical level, chiefly to infantry troops using handheld radios. The MOTIV initiative, the statement continued, is intended to provide the software and networking necessary for the MOTAKO network, and also to ensure the necessary integration *vis-à-vis* German Army vehicles to allow them to access MOTAKO. Ultimately, the MOTAKO network will be rolled out across individual troops, vehicles and deployed command posts, the firm added. Rohde and Schwarz continued


The Bell AH-1Z is the most flexible, most effective multi-mission attack helicopter in the world. A fully integrated flight deck provides an unequaled targeting system and digital data link capability while reducing pilot workload. Ready and capable in austere environments, the AH-1Z is highly survivable and combat proven. All while offering a low acquisition price and life cycle costs.

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United Launch Alliance

*The third MUOS satellite thunders aloft on 19th December 2014. The fifth spacecraft is now providing UHF SATCOM services to the US armed forces.*

that the challenge incumbent in realising the MOTAKO initiative is, on the one hand, providing IP communications, while ensuring that those communications are both robust and secure: "The delay-free transmission of information via voice is, and remains, the primary requirement at the tactical level," the company emphasised. In addition, the statement continued that MOTAKO will add: "a parallel data stream containing direct, mission-critical services and contents." Rohde and Schwarz is fulfilling the *Heer's* SVFUA (*Streitkräftegemeinsame Verbundfähige Funkgeräte-Ausstattung*/Joint Radio System) initiative which is delivering the next generation of tactical radios to the German Army as part of a comprehensive overhaul of the force's communications.

### Electronic Warfare

It was reported on 20th April that the Republic of Singapore Air Force (RSAF) will upgrade its 20 McDonnell Douglas/Boeing AH-64D Apache attack helicopters with a new self protection system, the installation of which is expected to be completed by the middle of 2016, according to reports. While it has not been officially confirmed by the RSAF, it is thought that the force's helicopters will receive Leonardo's Helicopter Integrated Defensive Aids System (HIDAS). According to Leonardo's official literature, this includes radar, laser and missile warning systems, plus a chaff and flare dispenser and a defensive aids management system. In addition, the literature continues, an optional directional infrared countermeasures system can outfit the HIDAS.

Elsewhere in the Asia-Pacific region, Australia announced in late-April that it plans to purchase stocks of anti-radiation missiles to enhance its airborne electronic warfare capabilities. The Australian government wishes to purchase $137.6 million worth of Raytheon AGM-88B HARM (High Speed Anti-Radiation Missiles), obtaining a total of 70 examples to this end, alongside 40 Orbital ATK AGM-88E AARGM (Advanced Anti-Radiation Guided Missiles), in addition to accompanying training equipment and spare parts. According to an official statement announcing the planned acquisition, these missiles are being purchased to equip the Royal Australian Air Force's (RAAF) forthcoming Boeing EA-18G Growler electronic warfare aircraft. The Australian government announced its decision to purchase up to twelve of these aircraft in February 2009. All twelve aircraft are expected to be delivered to the RAAF by the end of 2017, following the initial delivery of the first EA-18G example in July 2015. The aircraft will be operated by the RAAF's 6 Squadron based at Amberley airbase on the eastern coast of Australia. In terms of the differences between the AGM-88B and AGM-88E weapons, the former's software

can be reprogrammed without having to change the missile's hardware, and the guidance capabilities of the missile are improved compared to the baseline AGM-88A weapon. The AGM-88E design adds a number of improvements to the AGM-88C HARM variant. This includes an improved radar homing seeker and the addition of a millimetric wave radar sensor. The new radar homing seeker improves the field-of-view of the seeker used in the legacy AGM-88C HARM variant, and sharpens its detection capabilities for hostile ground-based air surveillance radars, and the AGM-88E's hostile emitter detection range. The millimetric wave radar sensor, meanwhile, provides high resolution imagery of the missile's 'end game' during which it hits its target, which will provide a useful analytical tool for post-sortie analysis of the accuracy of the attack. Should the sale for the weapon be authorised by the US Congress, the RAAF will become the latest in a series of customers, which also includes the *Aeronautica Militaire* (Italian Navy) and the US Navy. Meanwhile, Poland has been muted as a potential AGM-88E customer following reports to this end in August 2016. As well as the EA-18G of the US Navy (plus that force's Boeing F/A-18C/D/E/F fighters) and, potentially, the RAAF, the AGM-88E will outfit the Panavia Tornado-ECR air defence suppression aircraft of the Italian Air Force and, should the Polish acquisition occur, *Siły Powietrzne* (Polish Air Force) General Dynamics/Lockheed Martin F-16C/D fighters.

## SATCOM

Lockheed Martin announced on 24th April that the fifth US Navy Mobile User Objective System military communications satellite, imaginatively known as MUOS-5, was now delivering Ultra High Frequency (240MHz to 270MHz) satellite communications (SATCOM) services to the US armed forces. The MUOS constellation, which comprises five spacecraft, is equipped with a legacy UHF payload in common with the US Navy's UHF Follow-On (UFO) constellation which the MUOS programme will eventually replace. According to the US Navy, the intention is for MUOS to provide a smooth transition from the UFO system to the new constellation, by enabling legacy SATCOM terminals operated by the US armed forces, which had used the UFO constellation to also use the MUOS constellation. The second UHF communications package equipping MUOS is the Wideband Code Division Multiple Access (WCDMA) payload which allows users to benefit from smartphone-style connectivity. The WCDMA payload converts standard third-generation civilian mobile phones which can use the WCDMA waveform for voice and data services into military UHF SATCOM traffic allowing the provision of smartphone-style services in *locales* where conventional military radio communications could be frustrated. This could include environments where obscurants to the line-of-sight such as forest canopy or high buildings are present. AMR

# RUGGED LOOKS GOOD

**Battle Management Systems (BMS) for land forces are increasingly migrating to the lowest tactical echelons, thanks to reductions in the size of the computer technology required to host BMSs, placing such capabilities in the hands of dismounted troops.**

*by* **Andrew White**

Andrew White

*C4i Systems displayed an All Terrain Vehicle battle management system at the Special Operations Forces Innovation Network Seminar (SOFINS) event in France.*

Discussing this spread of BMSs across the battlefield, industry sources described to *AMR* how the dismounted close quarter battle and special forces communities globally were leading developments in BMS technology. As an example, C4I Systems, a UK-based company is offering up its BMS capabilities onboard Polaris Government and Defence's Ranger four-wheel drive all terrain vehicle.

## Latest EUDs

Unveiled at the Special Operations forces Innovation Network Seminar (SOFINS) at Camp Souge, France, on 28th March 2017, the solution illustrates the direction the market is heading with demand for BMS services down to the lowest tactical level, defence sources explained to *AMR*. Elsewhere, company executives from Getac UK have launched the latest addition in their tactical handheld EUD (End User Device) rugged laptop and tablet family, designed for dismounted and special forces situational awareness and BMS applications. Speaking to *AMR* at the launch of the MX50 EUD on 7th March Chris Bye, president of Getac UK, described how the technology represented a "must have" capability for mobile computing challenges faced by dismounted soldiers: "There is a trend toward consumer grade mobile devices for use in the military because they're lightweight and familiar. But these devices are not built to withstand harsh environments, or deliver the power, reliability and functionality today's soldiers need," he explained while referring to potential applications for the MX50 ranging from BMS and C2 (Command and Control) through to more specialist roles such as joint fire control and support, and the dissemination of Intelligence, Surveillance and Reconnaissance (ISR) data: "With the MX50, we're delivering the best of both worlds; a rugged device that meets real military needs, that is compact, lightweight and intuitive. Perfect for the already overburdened infantryman," Mr. Bye added.

Jackson White, Getac UK's business development manager for defence and security customers, described how the MX50 was being procured by launch customers from across the NATO (North Atlantic Treaty Organisation) special forces community, providing assault teams and special reconnaissance teams with a dismounted and mobile BMS

capability down to the lowest tactical level. Capable of supporting multiple types of operating systems running BMS software, including Android and Windows, the MX50 also includes USB (Universal Serial Bus) and Bluetooth connectivity based on user feedback from infantry and special forces teams as well as the UK's Defence Science and Technology Laboratory, and industry partners including SEA, which were consulted during the MX50's design process.

According to Mr. White, current trends are seeing the 5.7 inch (144.8mm) EUD carried in a chest mount and integrated into plate carriers or load carrying equipment, allowing soldiers to quickly glance down and view BMS and SA (Situational Awareness) information. Defence sources associated with the NATO special forces community, informed *AMR* that such a capability represented a lower cost and interim solution to armed forces ahead of the more widespread proliferation of Augmented Reality (AR) software into head- and helmet-mounted night vision devices. Put simply, AR projects computer-generated images onto a user's field-of-view: "The human-machine interface is very important for Getac to allow for full functionality," Mr. White explained while highlighting how the EUD features a two mega-pixel and eight mega-pixel camera on the front and rear of the device respectively for the dissemination of stills photography across BMS networks. Powered by an Intel mobile system-on-chip processor, the MX50 is capable of providing soldiers with: "high processing speeds and low power consumption so they can quickly view, manipulate and send/receive data, access battlefield applications, disseminate blue and red forces tracking, fire control orders and mission command information," Mr. White continued: "The device has undergone rigorous testing and is certified to (the US Department of Defence's) Military Standards 810G and 461G (covering environmental and electromagnetic interference characteristics respectively). Security is paramount for defence and stringent standards are required for devices to be accepted and used by personnel. The MX50 meets the Common Criteria ISO/IEC 15408 computer security requirements of the International Organisation for Standardisation which works closely with the United Nations Economic and Social Council, as well as US National Security Agency requirements, Mr. White continued.

Additionally, the EUD weighs just 400 grams (0.9 pounds) as a response to ongoing calls from the user community to reduce the burden on dismounted personnel, Mr. White explained while describing how the device was being considered by both the US Army's Nett Warrior soldier modernisation programme; the US Special Operations Command's (USSOCOM) Tactical Local Area Network (TACLAN) iniitiative; and the UK Ministry of Defence's Distributed Situation Awareness concept. All of these efforts require a BMS capability with a capacity to process, exploit and disseminate ISR intelligence across secure voice and data channels via tactical radios. Highlighting the USSOCOM's TACLAN programme as an example, Mr. White explained how the Tampa, Florida-based command was seeking a ruggedised EUD using the Android operating systems capable of being integrated with Harris tactical radios, such as the firm's RF-335M Very High Frequency/Ultra High Frequency (30 megahertz/MHz to three gigahertz) handheld radios which are expected to commence deliveries to USSOCOM in September 2017, according to reports. The TACLAN concept is designed to provide the lowest tactical echelon in the special forces with a dismounted BMS capability including the capacity to conduct real-time and secure 'battlefield chat' as well as other specialities previously mentioned including Joint Terminal Attack Controller (JTACs) tasks: "The latest Android operating system makes it easy for third party applications and soldier systems such as BMSs to be loaded onto the device as required. The rugged nature of the device means it can withstand drops and other impacts, operate seamlessly in extreme weather conditions from -21 degrees to 60 degrees Celsius," Mr. White concluded.

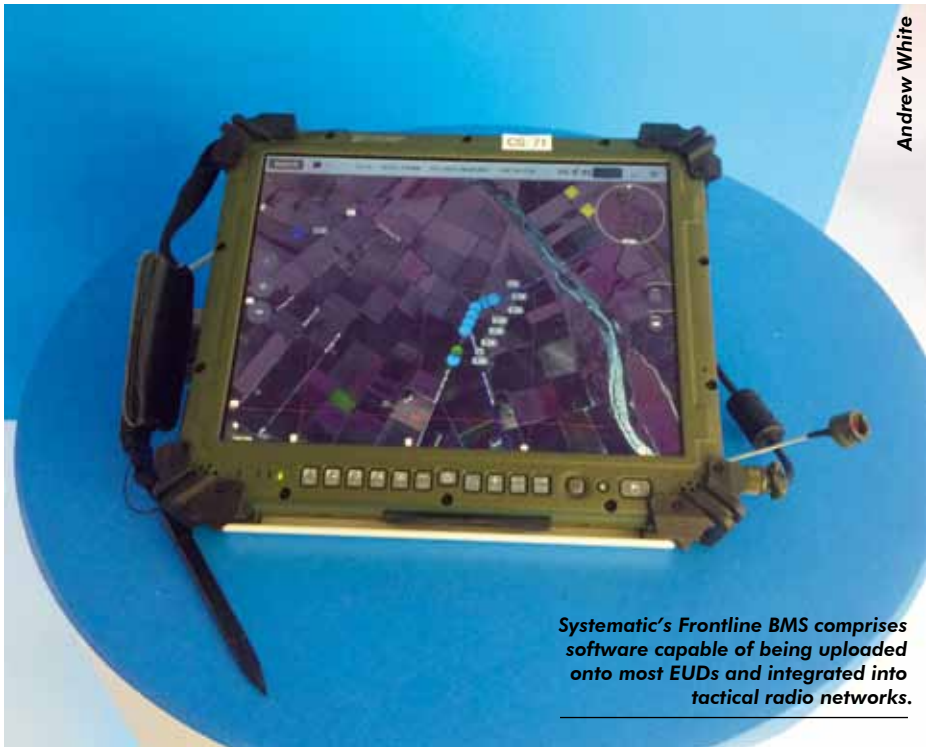
Australian DOD

*The contemporary operating environment, illustrated here with Iraqi and coalition special forces working together, continues to demand mature solutions capable of providing mounted users with battle management, C2 and situation awareness capabilities.*

## International Exposure

BMS technology remains prevalent across the international community with significant programmes being undertaken in not only Europe and North America but also in the Middle East and the Asia-Pacific.

On 20th February, the UAE armed forces contracted Harris in a $189 million deal to deliver an integrated BMS for its ground forces. According to Harris officials, the move is designed to further develop the "operational battlefield management capability" of the armed forces as combat elements begin to transition towards more "digital operations," the company stated in a press release announcing the news. The UAE's solution falls under the country's overarching Emirates Command and Control System Land Tactical System programme, which is being executed to "…integrate, coordinate and maximise the combined efficiency of UAE armed forces assets," a Harris spokesperson informed *AMR*: "Harris Battlefield Management Systems offer military customers a cutting-edge, continuous operations platform for situational awareness and staff functions.



Andrew White

*Systematic's Frontline BMS comprises software capable of being uploaded onto most EUDs and integrated into tactical radio networks.*

Through a combination of sophisticated technology and high-value systems integration services, military users can effectively track hostile and blue forces, develop and execute tactical operations and integrate personnel, intelligence, local weather, planning, and other data into battlefield operations," the press release continued: "This Land Tactical System project represents a major milestone in the advancement of battlefield management and staff function capabilities for the UAE armed forces. It will help ensure that the UAE land forces brigades are equipped to succeed on the modern battlefield," Ed Zoiss, the president for Harris electronic systems, articulated in the press release. According to *AMR* sources, an initial tranche of 800 UAE armed forces personnel will begin training on the BMS system later in 2017 as the technology is rolled out to provide information exchange between the lowest tactical echelons up to division command structures.

The BMS will feature a series of technologies provided by sub-contractors include Leonardo's DRS subsidiary, Saab and Systematic. These include DRS' Data Distribution Unit which provides ground forces with the ability to integrate C2 and electronic warfare systems under the control of a single workstation, allowing for the dissemination of information across a battlefield network in near real-time. As DRS' literature explains: "Using this workstation, users can monitor, control and interact with the entire system simultaneously." The Data Distribution Unit is capable of being integrated into wider C2 networks to control disparate radios and sensors, for example. Finally, Systematic has been tasked with equipping command and frontline forces with C2 technology, based around its SitaWare C2 software suite: This includes SitaWare Headquarters, Frontline, Friendly Force Tracking, Tactical Data Communication and Coalition Interoperability products, according to a company spokesperson, and they added that this software can be integrated onto any end user device connected to a tactical radio: "With so much information to be processed, it's vital that operational headquarters staff have the most advanced command and control tools available to filter out irrelevant information and get a full appreciation of the battlespace," SitaWare sources highlighted to *AMR*. Already in operational use with 15 nations. This allows for air, naval, land and special operations centres to be networked into a Joint Operations Centre from which command can be exercised, as well as forces from coalition partners, other government and non-government agencies.

Elsewhere, industry continues to position itself for the *Heer* (German Army) Mobile Tactical Information Network (MOTIV) programme which, according to industry sources, comprises a BMS requirement for mounted and dismounted users on the battlefield. Companies vying for the programme include Systematic as well as Rheinmetall which is promoting its own TACNET BMS system. Speaking to *AMR* at the AFCEA (Armed Forces Communications and Electronics Association) exhibition in Bonn, western Germany in late April. Timo Burger, Rheinmetall sales director explained how TACNET was available in headquarters, mounted and dismounted versions although the company's strategy for the MOTIV programme focused on the latter two variants.

Additional options could include Kongsberg's ComBatt C2 Information Product Suite which features a BMS capability for company, platoon and squad-level operations. According to company literature, the ComBatt BMS networks C2 technology to EUDs: "The ComBatt BMS software can be installed on computers where size, capacity and performance are based upon operational requirements and physical space. Because the physical space available in most vehicles is limited, the ComBatt BMS utilises a touch screen," Kongsberg's official literature states. The BMS relies upon low bandwidth communication channels to exchange information between ground vehicles and other BMS nodes, including the firm's own remote weapons station products, company literature added: 'This integration increases safety and optimises the use of sensors and effectors. The risk for blue-on-blue incidents is significantly reduced and warnings are issued if own units are within the sensor's field of view … Every vehicle may send cals for fire, enemy observations and receive weapon slew requests," the literature concluded.

## Asia-Pacific Growth

One of the largest BMS programmes currently being undertaken globally is taking place in the region with an Indian Army concept already lagging behind schedule, industry sources suggested to *AMR*. Having signed contracts with Tata Power and BEL (Bharat Electronics Limited) consortia in February 2015 for the design and development of a BMS Technology Demonstrator for the army, progress remains slow with the second phase of the effort, designed to equip force elements with BMS capabilities, pushed back from 2017 to 2021, sources confirmed. Once fully integrated across the Indian Army's communications networks, including

infantry battlegroups, mechanised and armoured infantry units as well as special forces, the BMS technology will be further upgraded from 2026 onwards, according to *AMR's* Indian Army sources. The BMS will be carried across the networks developed as a result of the Indian Army's Tactical Communications System which is replacing its legacy Army Radio Engineered Network (AREN).

Sources explained to *AMR* how the BMS will supplant AREN by integrating ground command centres with airborne Indian Air Force networks to allow the army to exploit three-dimensional airborne and satellite Imagery Intelligence (IMINT). To this end, both consortia are developing static and mobile image exploitation systems for the interpretation of such data, expected to be operated by IMINT analysis teams in vehicle-mounted and headquarter installations, which will also be procured as part of the BMS roll-out.

Meanwhile, the BMS programme continues to focus on Signals Intelligence (SIGINT) with India's Defence Research and Development Organisation (DRDO) partnering with local company Samyukta concentrating on the development of an electronic warfare system covering the 1.5MHz to 40GHz frequency bands, which will allow it to collect intelligence and jam high band tactical radios, satellite communications and military radars. Work includes the design of a stand-alone jammer which can also be networked into the wider BMS with the addition of other electronic countermeasures. The DRDO was unable to provide further details to *AMR* due to operational security concerns although industry sources confirmed to *AMR* that several candidate solutions remained under evaluation. Such a capability is expected to provide the army with an ability to collect, process, exploit and disseminate electronic intelligence, as well as protecting vehicle-mounted, headquarters and dismounted units from electronic attack.

## Korean Offerings

Elsewhere in Asia Pacific, Hanwha Systems used the International Defence Exhibition (IDEX) in Abu Dhabi in February 2017 to promote its latest solutions in the BMS sphere. Designed for the Republic of Korea Army, the firms' Vista BMS software comprises a tactical C2 capability for battalion battlegroup forces and below, company sources explained to *AMR*. Technology, which completed operational evaluation in 2016, has been designed to be integrated onboard a variety of man-portable and vehicle-mounted EUDs including the Vista-PL (Portable Laptop) and Vista-VM (Vehicle Mounted) respectively. The device is also available in a handheld (Vista-HH) configuration, company officials confirmed. The Vista package will provide mounted and dismounted troops with situational awareness, which more specifically comprises blue force tracking, battle management, ISR and other C2 applications. The Vista-VM model provides commanders with a common operating picture as well as target management, decision support; mission planning and management; messaging; digital mapping and position display; and after action review analysis industry sources explained to *AMR*. The Vista-PL variant has been designed to provide: "optimal situational awareness to the user by displaying the position of troops in real-time; provide C2 functions by transmitting and receiving formatted messages and short text messages; and support various connectivity through tactical radio data ports , wifi and USB," the firm added.

Finally, the Vista-HH has been designed to provide a BMS capability down to the lowest tactical level allowing dismounted troops to transmit and receive formatted and short text messages in a secure environment. This includes wifi-generated 'combat bubbles' for assault teams conducting military operations in urban terrain in particular, defence sources highlighted to *AMR*. Weighing just 550grams (1.2 pounds), the Vista-HH EUD uses the Android or Windows operating system and can be carried on a chest-mount or grab bag, sources concluded. Finally, industry sources described to *AMR* how the ROK Army is expected to begin fielding an undisclosed number of Vista family EUDs towards the end of 2017, including a helicopter-mounted system for airborne operations.

Andrew White

***Systematic is working in collaboration with Black Diamond to design an integrated dismounted battle management system, illustrated for the first time at the AFCEA exhibition in Bonn this April.***

## Conclusion

The critical importance of BMS technology will mean that it continues to proliferate across the armed forces of the Asia-Pacific and beyond as greater requirements for tactical situation awareness and C2 is demanded at the lowest tactical levels. However, industry must deliver products which will not inhibit such operations which are by their very nature, dynamic, congested and contested. AMR


*Sapura's tactical radio products include a manpack transceiver which is in service with the Malaysian Army.*

# TO THE LOWEST ECHELON

**Acquisitions are afoot in the Asia-Pacific of new tactical radios. While much activity is kept out of the headlines, a picture of energetic competition involving new and existing products from local and international suppliers is emerging.**

***by* Thomas Withington**

Both the International Defence Exhibition (IDEX) held in Abu Dhabi in February, and the Langkawi International Maritime and Aerospace (LIMA) exhibition held in late March in the eponymous Malaysian island provided a veritable *smorgasbord* of opportunities to take stock of the tactical communications market in the Asia-Pacific. Not only had companies brought their wares to exhibit at both events, but several were keen to discuss with *AMR* their activities in the Asia-Pacific region.

For example, LIMA hosted Japan's NEC, itself heavily involved in the provision of tactical communications to the Japan Ground Self Defence Force (JGSDF). Representatives of the firm shared that the company had commenced deliveries of its Very High Frequency (VHF) and Ultra High Frequency (UHF) (30 megahertz/MHz to 512MHz) Wideband Multipurpose Radio-Vehicle product, and its Wideband Multipurpose Radio-Mobile Type-II handheld and Wideband Multipurpose Radio-Mobile Type-I manpack transceivers all of which form vital components of the JGSDF Field Communication System tactical communications modernisation initiative. The company stated that it commenced deliveries of these radios to the JGSDF in 2012, and that, as of 2017, deliveries were continuing. In terms of data rates, company representatives continued that these radios handle circa 600 kilobits-per-second. A spokesperson added that these radios carry VHF/FM, UHF/FM, VHF/N-CHR and the option of an *ad hoc* UHF waveform, and are certified to the United States National Institute of Standards and Technology's AES-256 encryption level, with the ability to add customer-specified

encryption and waveforms as and when required.

Although all of these radios are certified to the US Department of Defence's SCA V2.2.2 software communications architecture standard. The company added that the tactical radio products it is supplying to the JGSDF at present do not have any ability, via the use of waveforms, to communicate directly with the tactical radios used by US military units which are deployed to Japan. Nevertheless, the spokesperson added that this is a capability that could equip the radios at some as-yet-undefined point in the future. In addition, the firm stated that it is searching for export customers in the Asia-Pacific region, although it has not as yet enjoyed any sales of its tactical radios beyond Japan. It is possible that the Wideband Multipurpose Radio-Mobile Type-I may be replacing the Mitsubishi JPRC-F70 manpack radio, which has been in JGSDF service for some time.

## Sapura

Also exhibiting their wares during the LIMA exhibition was local tactical radio specialists Sapura Thales Electronics. The company displayed a number of its tactical radios, including its TRC-5200 and TRS-5102 VHF handheld radios. Representatives of the firm told the author that the latter radio, along with being in service with the Malaysian Army, is also used by the Indonesian and Moroccan armies. Official literature provided by the company states that the radio offers digital, encrypted voice and data communications (as opposed to its TRC-5101 and TRC-5103 siblings which offer analogue voice and unencrypted voice and data communications respectively). The literature continues that the waveforms offered by this radio includes an advanced fixed frequency analogue mode, advanced digital secure modes for voice and data, fixed frequency secure mode and a frequency-hopping secure mode. Moreover, the radio can accommodate 100 channels with 25 kilohertz of spacing. The company added that it had commenced field trials of its new TRC-5200 VHF handheld radio with the Royal Malaysian Navy's PASKAL naval special forces in April 2016, and is awaiting a decision on whether the product will be acquired by the force to support naval commando operations. As yet, the firm has revealed no further information regarding the design or performance of the TRC-5200.


Harris

*Harris has supplied its RF-7800V radios to the Philippine Army following a contract award to this end in 2015.*

More information is forthcoming regarding the Philippines. In February 2016, Harris announced that it had received a contract worth $12 million to supply RF-7800V-HH VHF handheld radios for use with *Hukbong Katihan ng Pilipinas* (Philippines Army) dismounted elements, while the vehicles used by the force's 1st Mechanised Infantry Division will be outfitted with RF-7800V vehicular radios integrated with the firm's RF-7800I vehicle intercom system, thought to be furnishing the force's BAE Systems/United Defence M-113A1/2/2+ tracked armoured personnel carriers. The February 2016 order is the latest in a long line of tactical radio acquisitions from the Philippines. For example, in June 2007, the US Defence Security Cooperation Agency announced a request by the country to procure 6356 VHF handheld radios (thought to be RF-5800V-HH transceivers) and 2019 RF-5800H-MP HF manpack radios from Harris with an expected total value of up to $96 million. It was reported that deliveries of these radios to the Philippines were completed in 2009. Other nations which have procured the RF-5800V-HH in the Asia-Pacific include Brunei-Darussalam, with Pakistan having acquired the RF-5800H-MP in two purchases worth a total of $144 million in 2005 and 2007.


Harris

*Harris' provision of tactical radios to the Philippines include the company's RF-7800V-HH handheld transceivers.*

## Home Grown

Staying in Pakistan, the country's National Radio and Telecom Corporation (NRTC) is supplying its SDR-96X family of Very High Frequency (VHF: 30 megahertz/MHz to 300MHz) and Ultra High Frequency (UHF: 300MHz to three gigahertz) radios to domestic and international users. Three radios comprise the family: a multiband handheld transceiver, manpack multiband radio and a vehicular multiband transceiver. Each offers data rates of up to 64 kilobits-per-second and accommodates six waveforms, notably the Combat Net Radio (CNR), ACNR, WBNR (Wideband Networking Radio), NBNR (Narrowband Networking Radio), air-to-ground and ground-to-air waveforms, in addition to a waveform that allows users to communicate with public safety officials such as civilian first responders.

Deliveries to the Pakistan armed forces,

Wikimedia Commons

*The AN/PRC-77, although now somewhat long in the tooth, remains in service in Pakistan and Saudi Arabia, and has been upgraded by NTRC.*

which include the country's navy, army, air force, marines and paramilitary forces are currently ongoing. NRTC has told the author that deliveries had commenced in 2011, and are expected to conclude in 2020. Regarding export customers, these radios have been delivered to the Nigerian and Saudi Arabian armies, with deliveries commencing in the next two years to the Egyptian Army. Meanwhile, the firm has performed recent upgrades of the AN/PRC-77 VHF manpack tactical radio with a new back end which will give it another 15 years of life. Modifications being performed on this radio include the ability for it to handle between 19 and 65 kilobits-per-second (kbps) of data and provide up to 1840 channels at 25 kilohertz-per-channel. Although NTRC provides proprietary encryption for the radio, users can add their own encryption if so desired. The firm has delivered upgraded AN/PRC-77 radios to the Pakistan Army. In addition to the order from Pakistan, NTRC has supplied upgraded AN/PRC-77s to the Saudi Arabian armed forces.

Also during IDEX, Aselsen informed *AMR* that tactical radio technology transfer agreements that the company had concluded with Pakistan and Saudi Arabia were now bearing fruit. Officials from the firm stated that technology transfer agreements it signed with Pakistan and Saudi Arabia towards the end of the last decade allowed both countries to produce the firm's 9661 V/UHF tactical radio family, which includes the 9661 V/UHF Vehicular, 9661 V/UHF Manpack and 9661 V/UHF handheld transceivers. The company explained that it had provided the know-how to firms in both countries to produce these radios, which are also in service with the Turkish armed forces, and to develop and implement national encryption standards and waveforms for use therein. In Pakistan these radios, waveforms and encryption software have been produced by NTRC, while in Saudi Arabia, they are produced by Taqnia and the country's Military Industries Corporation (MIC). The firm continued that deliveries of these transceivers to the armed forces of both countries has now commenced.

In terms of the basic configuration of the 9661 V/UHF family, these radios use a number of Aselsan proprietary waveforms including a VHF/FM low band waveform offering 16 kilobits-per-second (kbps) data rates in fixed frequency and frequency-hopping modes; a VHF/FM high band mode providing fixed frequency and encrypted voice and data at rates of 48kbps and an UHF wideband networking radio waveform giving data rates of up to 51kbps on each individual channel, with this waveform supporting up to 32 channels. Furthermore, this latter waveform has the possibility for the data rate to be extended to 64kbps.

Meanwhile, a V/UHF AM waveform provides fixed and encrypted voice communications, with a Narrow Band Networking Waveform transmitting across V/UHF with 15kbps data rates using fixed frequency and frequency-hopping transmissions. A UHF/FM mode transmitting across a bandwidth of 406MHz to 470MHz provides fixed frequency and encrypted voice and data communications with 4.8kbps data rates, while fixed frequency and frequency-hopping clear and encrypted voice and data communications are possible using the A-CNR waveform. Finally, the addition of an APCO-25 waveform provides a gateway for users to communicate with civilian first responder radios. In addition, the radio family can accommodate the HAVE QUICK-I/II NATO (North Atlantic Treaty Organisation) air-to-air/air-to-ground/ground-to-air waveform.

## Energetic Acquisition

Furthermore at IDEX, LIG Nex1 revealed to *AMR* that it hopes for the government of the Republic of Korea (ROK) to make a decision by the end of 2017 on which tactical radios it is expected to procure for the Republic of Korea Army (ROKA). Company representatives disclosed that it is offering several products to fulfil this requirement. These are organised under its Tactical Multiband Multirole Radio (TMMR) product family and include its SDR-H V/UHF handheld, SDR-V vehicular and SDR-P manpack radios. It terms of the ROKA's concept of operations for new radios, the firm stated that the vehicular radio requirement should cover the entirety of the ROKA's armoured vehicle fleet, with company commanders being equipped with the manpack radio, and platoon commanders receiving the handheld. In terms of specifications, the company representatives added that data rates in the region of two megabits-per-second are achievable across the TMMR family, with up to seven waveforms, including air-to-ground/ground-to-air and ground-to-ground waveforms equipping the transceivers. Confusion surrounds the status of the TMMR family: Some published sources state that the firm's radios have already been selected to equip the ROKA, however, company representatives told the author that the firm was waiting for a decision from the ROK government as to whether the order will be finalised. It is possible that the existing TMMR radios said to be in service with the ROKA may have been acquired for evaluation purposes.

Looking towards south Asia, in June 2015 it was revealed that the Nepalese Army would receive $1.4 million worth of tactical radios, notably Barrett

Communications' PRC-2090 HF manpack radios, PRC-2091 VHF vehicular radios, PRC-2081 VHF manpack radios and PRC-2082 VHF vehicular radios. According to the reports, the radios completed delivery at the end of April 2015 with up to 120 transceivers being supplied to this end. Additional reports noted that the company's PRC-2040 HF manpack was supplied to the Timor-Leste Defence Force as of 2008. Staying in the HF domain, new radars have been forthcoming over the past twelve months from Codan, which unveiled its new product in September 2016. The Sentry-H supplements the company's range which was further enhanced by the new Sentry-V VHF handheld radio launched during the Eurosatory defence exhibition held in Paris in June 2016. This was the first radio to be unveiled as part of Codan's Sentry product line. No information has been provided as to whether sales of these radios have been achieved, or the identify of the customers.

Elsewhere in the region, some of the most significant acquisitions of tactical radios in recent years have been performed in Afghanistan. For example in late August 2016, Datron was awarded a contract through the US Army to provide up to $495 million worth of communications equipment by 2021. Open sources note that, previously, the Afghan Army had employed AN/PRC-77 radios, which can trace their lineage back to the late 1960s, plus a clutch of Russian systems including R-130 and R-123 transceivers. The company also benefited from an earlier contract exercised through the US Army in May 2016 when it was tasked to provide $13.4 million worth of radios and spare parts to the Afghan National Army, with the contract to be completed this year. Chalking up additional successes in Afghanistan, Datron had earlier been awarded a contract worth $25.4 million in August 2009 to provide PRC-1077 VHF manpack, HH-7700 VHF handheld and PRC-1099 HF manpack radios. No information appears to have been published regarding the radios to be supplied to the ANA as a result of the two 2016 contracts. Alongside Datron's radios, Harris was tasked in June 2016 to provide a host of tactical radios to Afghanistan (and several other unnamed nations), which the company stated will mostly be drawn from its Falcon-III tactical radio family. The contract, worth $1.7 billion was awarded via a US Foreign Military Sales initiative. Other notable procurements over the last twelve months have occurred in Bangladesh. In October 2016, it was reported that the country's ministry of defence had procured $11.5 million of HF and VHF base station, vehicle and manpack radios, the exact type of which was not disclosed. Moreover, it is also known that Bangladesh, alongside Sri Lanka uses NTRC's PRC-9600 V/UHF manpack radios.

## India

One of the most interesting tactical radio programmes to watch in the Asia-Pacific is the Indian Army's Tactical Communications System (TCS) programme which involves two consortia led by Bharat Electronics Limited, and Larsen and Toubro to construct one TCS *ensemble* each for $150 million. Media reports have stated that prototype construction is expected to take 18 months, with each TCS prototype then being handed over to the army for testing, with a decision then being made on which consortia will go ahead with production. The TCS is built around a fourth-generation, long-term evolution wireless network with accompanying switching, routing; network management and security systems; software and hardware. The goal, according to Indian ministry of defence sources is to facilitate a network capable of carrying data at rates of circa 100 megabits-per-second. The TCS will replace the army's legacy Army Radio Engineered Network (AREN) in service since the early-to-mid-1990s. The AREN was intended for deployed formations, according to open sources, and their headquarters. However, the AREN's challenge has been in supporting the demands for increasing bandwidth to move ever-higher amounts of data, hence the need for the potential bandwidth offered by the TCS undertaking. Furthermore, the TCS is envisaged to provide corps headquarters (HQ) to battalion HQ coverage, whereas the legacy AREN system only furnishes corps HQ to brigade HQ communications. Confidential *AMR* sources believe that, presuming a trouble-free development of the TCS prototypes, the network could be introduced into the Indian Army in the next five to ten years. The Indian Army is planning a wholesale enhancement of its tactical radios. In January 2017, the force announced that it was inviting responses to two separate Requests For Information (RFI) which it has issued regarding the acquisition of new handheld, manpack, vehicular and airborne tactical radios. Companies interested in satisfying the RFI were asked to submit their responses by mid-February.

This article has illustrated that, while armies throughout the Asia-Pacific continue to procure tactical radios from traditional suppliers in Europe, Israel and North America, local suppliers notably in Australia, India, Japan, Pakistan and the Republic of Korea are increasingly making their presence felt. Ostensibly, many of these suppliers are concerned at present with satisfying the domestic requirements of their armed forces. However, as firms like NRTC have illustrated, such local demand can act as a springboard to other international markets. Quiet disruption, then, seems to be the order of the day for the Asia-Pacific tactical radio market; a disruption which maybe set to continue. AMR


***Sapura is enhancing its tactical radio product line which already includes handheld receivers with new products expected to equip Malaysia's naval commandos.***


David Oliver

*An Italian Air Force Agusta-Bell AB-212 supporting the United Nations Interim Force in Lebanon (UNIFIL) to monitor the cessation of hostilities and helping ensure humanitarian access to the civilian population.*

# CARE FROM THE AIR

**One of the world's largest operators of aircraft in conflict zones is the United Nations. Relying on the provision of aircraft from member states and from the private sector, such aircraft provide lifelines for civilians caught up in hostilities around the world.**

*by* **David Oliver**

The United Nations' (UN) peacekeeping budget for 2016 to 2017 is $7.9 billion, according to the UN's own figures. This budget helps to pay for existing UN peacekeeping operations such as UNMISS (UN Mission in the Republic of South Sudan), UNAMID (United Nations/African Union Mission in Darfur), MONUSCO (*Mission de l'Organisation des Nations Unies pour la Stabilisation en République Démocratique du Congo*/Stabilisation Mission of the United Nations in the Democratic Republic of Congo), MINUSCA (*Mission Multidimensionnelle Intégrée des Nations Unies pour la Stabilisation en Centrafrique*/UN Integrated Multidimensional Mission for Stabilisation in the Central African Republic) and MINUSMA (*Multidimensionnelle Intégrée des Nations Unies pour la Stabilisation au Mali*/UN Multidimensional Mission for Stabilisation in Mali).

In 2014 the UN spent more than $800 million on air chartering services, using more than 150 helicopters and 50 fixed-wing aircraft and has been looking at new ways of procuring aviation support for its agencies, according to a UN press release published in May 2016. For peacekeeping missions, aviation support is provided by the armed forces of member nations or sourced from contracted commercial operators.

Examples of aircraft provided by UN member states for peacekeeping operations include a flight of *Fuerza Aérea Argentina* (Argentine Air Force) Bell 212 family and Hughes/MD Helicopters MD-500D light utility helicopters that serve with the UN Force in Cyprus (UNFICYP) while *Aeronautica Militaire* (Italian Air Force) AgustaWestland/Bell HH-212A light utility helicopters work in support of the UN Interim Force in Lebanon (UNIFIL). After a protracted development and entry into service, South African Air Force (SAAF) Denel Rooivalk-Mk.1 attack helicopters proved to be a successful asset to the UN during peacekeeping operations in the Democratic Republic of Congo (DRC) when they were first deployed in support of MONUSCO in November 2013 along with a flight of SAAF Denel Oryx-Mk.I/II medium-lift utility helicopters. The depleted Ethiopian Air Force has also deployed three of its Mil Mi-35 helicopter gunships to support UNMISS.

## Private Sector

Alongside the government provision of aviation to support peacekeeping operations, the private sector is involved in its provision. The US Company AAR Airlift is a certified commercial aviation provider to the UN and operates a fleet Sikorsky S-61Ns and S-92s and Eurocopter/Airbus Helicopters AS-330J

Pumas. On 29th March 2015, AAR Airlift announced that it had been awarded a three-year $19 million contract by the UN for airlift services in Central Africa to provide passenger and cargo air charter services in support of the MONUSCO operations.

However, there is growing shortage of military helicopters supporting UN peacekeeping operations in Africa, especially with the MINUSMA. In October 2016 Indonesian Army Aviation withdrew its three Mi-17V5s that were deployed in Timbuktu for twelve months. The aim of a suicide attack on Gao airport in eastern Mali on 29th November 2016 was to destroy the UN aircraft at the airport, specifically several chartered civilian Mil Mi-8 helicopters and a Ghana Air Force Airbus C-295 turboprop transport. The four *Koninklijke Luchtmacht* (Royal Netherlands Air Force) McDonnell Douglas/Boeing AH-64D Apache attack helicopters and three Boeing CH-47D/F Chinook heavy-lift helicopters deployed to Gao were operated from a different part of the UN base at the airport. Nevertheless, earlier this year the Netherlands began to withdraw these aircraft from Mali. To fill this capability gap, the first *Luftwaffe* (German Air Force) NH Industries NH-90TTH medium-lift helicopter configured for medical evacuation was flown to Bamako, south-west Mali, on 27th January by an Antonov An-124-100 turbofan freighter of Volga-Dnepr Airlines. This aircraft will be followed by three more NH-90TTHs and four Eurocopter/Airbus Helicopter EC-665UHT Tiger attack helicopters, according to media reports, which added that they will perform their missions from Gao.

The UN only awards contracts through its procurement division for long-term air charter and short-term passenger movements to air operators in possession of an Air Operator Certificate (AOC). An AOC is typically awarded by a national aviation authority to permit a company to use aircraft for commercial services. The UN stipulates that helicopters operating on its behalf must possess the United Nations Aviation Global Satellite Tracking Solution (UNAGSTS) which is built around a satellite data link which can provide details of an aircraft's location, velocity, bearing and altitude. According to official UN documents: "The UNAGSTS provides a necessary tool that allows United Nations personnel to observe, analyse, and report real-time flight activities." Other UN regulations require helicopters to be outfitted with an Enhanced Ground Proximity Warning System/Helicopter Terrain Awareness and Warning System (EGPWS/HTAWS).

One of the largest UN aviation providers since 2005 is Ukrainian Helicopters that has a fleet of 28 Mi-8MTV1s that have supported in peacekeeping operations in Cote d'Ivorie, DRC, Haiti, Sudan and South Sudan; humanitarian missions in Burma, Kenya, Mozambique, Pakistan, Somalia, South Sudan and Uganda; and relief operations in Portugal, Turkey and Ukraine. Ukrainian Helicopters was the first organisation to fly missions in full compliance with the new UN regulations regarding aircraft specification with the installation of UN-certified Iridium SkyTrac ISAT-200A Global Positioning System/Iridium transceivers, Sandel ST3400H HTAWS and Honeywell TCAS-II CAS-67A traffic collision avoidance system. Ukrainian Helicopters took the decision to the rebuild its fleet of Mi-8MTV1s into a truly multi-role platform, largely with Western technology and equipment. This included the installation of FLIR Systems' UltraForce 350HD optronics and a night vision goggle-compatible with new avionics including a Garmin GTN-650/GTN-695 navigation system and multifunction displays. Additional equipment included a Spectrolab SX-16 IFCO Nightsun searchlight, a Bird Aerosystems AMPS-M airborne missile protection system, ballistic protection and a medical module, according to Ukrainian Helicopters.

*Ukrainian Helicopters' fleet of Mi-8TV1 helicopters was the first to have the UNAGSTS and EGPWS/HTAWS equipment fitted.*

*South African Air Force Rooivalk-Mk.1 helicopters supporting the United Nations' MONUSCO mission have been used to assist peace enforcement operations.*

Another helicopter operator to comply with the UNAGSTS directive is Valan ICC of Moldova. Its fleet of eight Mi-8MTV1 helicopters operates in compliance with the requirements of the Civil Aviation Authority of the Republic of Moldova which are based on those of ICAO (International Civil Aviation Organisation), the UN body codifying the techniques and principles of global air navigation, to provide air support to clients such as the UN and World Food Programme, the UN's food assistance branch. In November 2014 the company began upgrading its MI-8 MTV helicopters to meet the UN latest requirements and updates on the technical specifications for


UN

*The backbone of the UN helicopter fleet is the ubiquitous Mil Mi-8/17, seen here supporting the UN Mission in Sudan.*

the aircraft and in 2015, Valan ICC was awarded a UN contract for humanitarian aid operations with UNMISS.

Notwithstanding the extensive modernisation programmes that the Mi-8/17 family are subjected to, as illustrated by the upgrade programmes discussed above, some operators are looking to replace these ageing helicopters. Ukrainian Helicopters commercial director Andril Nebret told *AMR* he has looked at the S-92 but considers its performance and payload is reduced in the hot and high conditions that the Mi-8/17 family thrives on, and also the Eurocopter/Airbus Helicopters AS-332C1E Super Puma, which has the required performance but its high acquisition cost rules it out until pre-owned aircraft come on the market. The impact of the United Nations revised procurement procedure (*see above*) for its future aviation requirements remain to be seen but it is more than likely that its long-term rotary-wing charters will largely be met for at least the next decade by the Mi-8/17 family.

## WFP

The WFP manages the United Nations Humanitarian Air Service (UNHAS) that transported more than 285,000 passengers and nearly 6000 metric tons of cargo to 317 regular and one-off destinations in 34 countries in 2015 according to the WFP.


David Oliver

*The WFP Il-76 lines up on the runway of Jordan's Marka airport for a high-level airdrop mission of food and medical supplies to the besieged Syrian city of Deir Ezzor.*

The top UN agency users of UNHAS were UNICEF (United Nations Children's Fund) and UNHCR (United Nations High Commissioner for Refugees) while the top three NGO (Non-Governmental Organisation) users were MSF (*Médecins Sans Frontiers*/Doctors Without Borders), Save the Children and the International Rescue Committee. The UNHAS has a fleet of some 70 chartered aircraft, the organisation states, most of which are fixed-wing types. including Beechcraft 1900 family turboprop transports, Bombardier/De Havilland Dash-8 family turboprop freighters, Dornier Do-228 family turboprop transports, Embraer EJR-135 family turboprop transports and Antonov An-74 family turboprop freighters.

The WFP has a long history of food airdrops that go back to 1999 when the first humanitarian airdrops were completed successfully in East Timor, with the delivery of desperately needed food and blankets to tens of thousands of people hiding in the mountains fleeing


UN

*Mil Mi-24/35 attack helicopters have been deployed to numerous United Nations missions in Africa and the Middle East including the United Nations Mission in South Sudan (UNMISS).*

UNMISS

*A World Food Programme Il-76 dropping food in Bentiu's Unity State in support of the United Nations Mission in South Sudan*

political violence following the country's independence from Indonesia. The food airdrops were performed using two Royal Australian Air Force Lockheed Martin C-130H/J turboprop freighters lent to the WFP. The WFP also executed a unique air delivery system developed in conjunction with the South African aviation company, Safair. During the provision of aid to East Timor, a C-130H/J was deployed to drop 350,000 plastic seven ounce (200 gram) packets of high-energy biscuits, packed in such a way that they floated and circled as they fell to ensure a soft landing.

Not all air carriers can perform these types of airdrop missions. WFP Aviation charters aircraft from accredited air carriers, which are duly licensed for this type operation by the national aviation authority of the country of aircraft registration via the obtention of an AOC (*see above*) Aircraft preparation for the mission is the responsibility of the carrier, and the aircraft used are normally equipped with a roller system to allow loading and gravity extraction of pallets in flight. The aircrew and loadmasters are required to have necessary training and flight experience to be able to perform airdrop operations.

During humanitarian air drop operations, the Drop Zones (DZ) are marked out by white food bags with a cross in its centre. The area is secured with a 200-metre/m (645-feet/ft) perimeter outside the DZ and it is the ground controller who clears the aircraft to release its cargo. The drops are generally made from just 645ft (200m) above the ground to reduce the impact on the food bags as they land. The drop sequence is down to the loadmasters with the cargo arranged in either a single or double row configuration. If it is single row, it is released in a single drop.

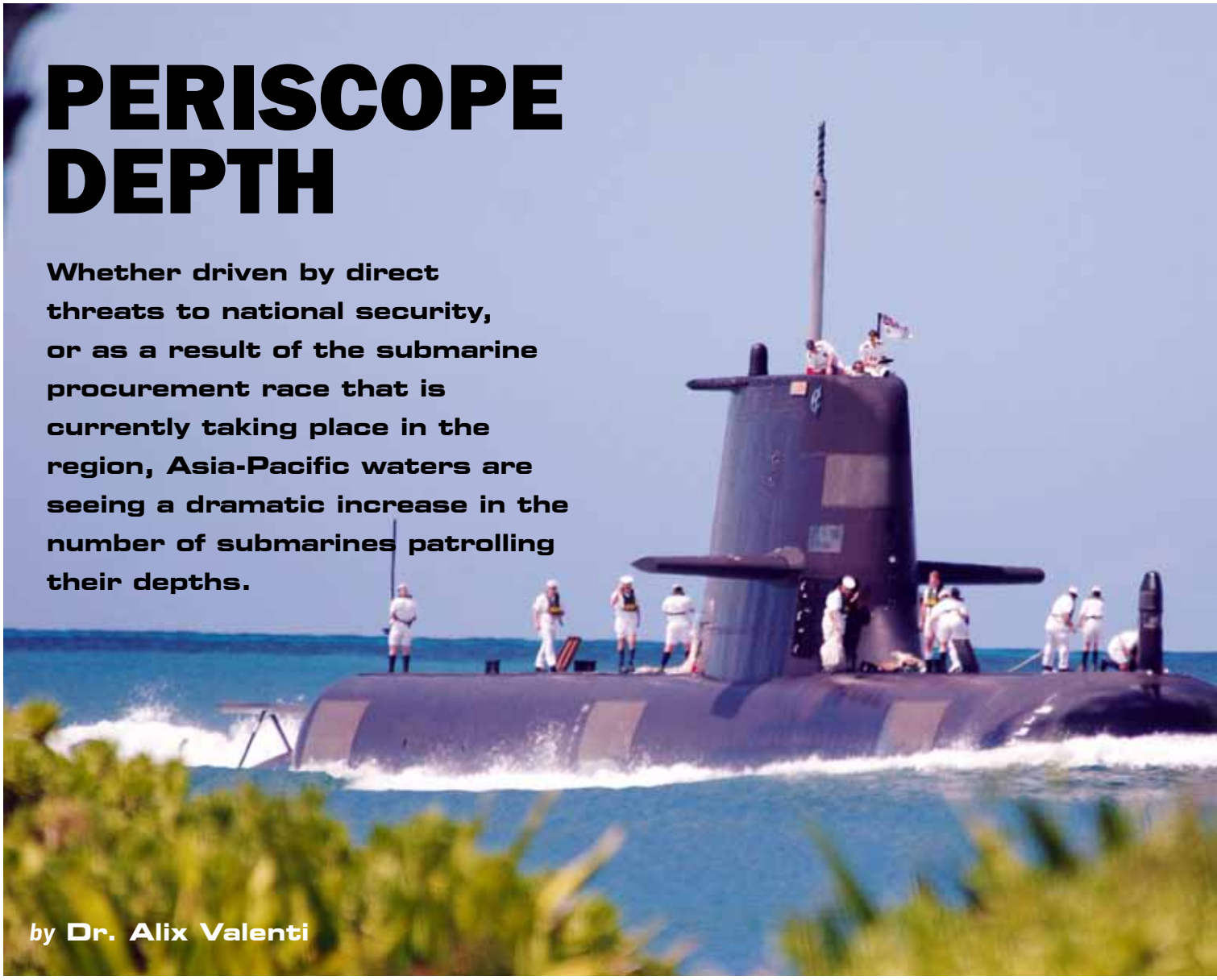
In 2015 the WPF carried out 1636 airdrop flights to deliver 45200 metric tons of food. It supplied urgently needed relief items to people in otherwise impossible–to–reach locations across South Sudan where between January 2016 and June 2016, it conducted more than 960 airdrops from two domestic locations as well as from airfields in Uganda and Ethiopia.

For the first time, in April 1916 the WFP began high level airdrops of food and essential supplies to Deir Ezzor in eastern Syria, a city of more than 100,000 people besieged by the Islamic State of Iraq and Syria (ISIS) insurgent group According to *AMR* sources, the operation is based in Jordan at Amman's Marka airport and the first test drops from 22500ft (7000m) took place at a Jordanian military range in mid-March 2016, but were unsuccessful due to the use of time-expired Russian parachutes which failed to open on release. Further tests using new parachutes proved successful and the WFP carried out its first successful high-altitude airdrop over Deir Ezzor on 10th April 2016 to deliver 20 metric tonnes of food aid. Single Russian parachutes for the bags of food weighing between 1775 pounds/lb (800 kilograms/kg) and one tonne mounted on collapsible pallets, are rigged at Marka, along with three US parachutes used for dropping cooking oil containers that require a slower descent rate. The WFP has a small number of GPS-guided parachutes used for precision drops of vital medical supplies.

The Russian airline Abakan Air was contracted to provide an Ilyushin Il-76T/TD to fly two missions a day to drop up to 26 pallets in three runs. The planners use the United Kingdom Meteorological Office weather forecasts for the flights and Jordanian air traffic control handles the flight until it reaches the Syrian-Jordanian border, after which the crew is in contact with the Damascus Area Control Centre while it is in Syrian airspace as far as Very High Frequency (30 megahertz/MHz to 300MHz) radio range covers. However, the flight keeps to the same route using a recognised corridor to the DZ. The total flight time of the missions to Deir Ezzor is typically 2 hours and 45 minutes.

While the Il-76T/TD's aircrew has no direct communications with US Central Command, the US combined combatant command in charge of the US-led coalition's military efforts against ISIS, Russian Air Force Sukhoi Su-30 family fighters have been providing unofficial escorts to the aircraft while in Syrian airspace. In March the 200th WFP airdrop marked a delivery of 3500 tons of humanitarian aid to more than 90000 people still trapped in the besieged city.

With ongoing conflicts, humanitarian crises and natural disasters continuing to plague Africa, the Asia-Pacific and the Middle East, government-furnished and chartered aviation will continue to be in the frontline of the UN peacekeeping and relief efforts for the foreseeable future. AMR



# PERISCOPE DEPTH

**Whether driven by direct threats to national security, or as a result of the submarine procurement race that is currently taking place in the region, Asia-Pacific waters are seeing a dramatic increase in the number of submarines patrolling their depths.**

*by* **Dr. Alix Valenti**

An article from *Channel NewsAsia* published on 21st May 2015 reports that during the 2015 International Maritime Security Conference, held in Sydney, Australia, the chief of the Republic of Singapore Navy (RSN) Rear Admiral Lai Chung Han proposed the development of a regional framework for submarine operations safety. The framework would build on a memorandum agreement on Joint Standard Operating Procedures for mutual submarine rescue support the RSN signed with the US Navy on 19th May 2015, and would be modelled after the Code of Unplanned Encounters at Sea that was ratified in 2014 by 25 Asia-Pacific countries. The proposal for a set of protocols was tabled by the RSN in June 2016. Similarly, in January 2017, the Royal Malaysian Navy was finalising three Malaysia Submarine Exercise Areas in the South China Sea to enhance submarine operating safety in the region.

These proposals come at a time when the Asia-Pacific region is witnessing a significant increase in the number of national submarine procurement programmes. From Australia to India, whether defence budgets have increased or are set to plateau due to national financial constraints, Stéphane Meunier, DCNS' submarines marketing director indicated: "submarines represent an asset for countries willing to ensure their sovereignty and protect their territorial waters and Exclusive Economic Zones (EEZs), as they play crucial roles such as surveillance and reconnaissance, intelligence gathering, patrolling and securing maritime borders and trade routes."

## Australia

Although Australia does not face any imminent threat to its security, its 2016 *Defence White Paper* which outlined the country's strategic and defence procurement priorities stated that: "by 2035, around half of the world's submarines will be operating in the Indo-Pacific region where Australia's interests are most engaged. Australia has one of the largest maritime domains in the world and we need the capacity to defend and further our interests from the Pacific to the Indian Oceans and from the areas to our north to the Southern Oceans. Submarines are a powerful instrument for deterring conflict and a potent weapon


US Navy

HMAS Waller is the third of the Royal Australian Navy's 'Collins' class of SSKs. This fleet will eventually be replaced with the new SSKs which the RAN is acquiring from France.


Ajai Shukla

The Indian Navy's INS Chakra 'Akula' class SSN. Since 2008, she has been leased from the Russian Navy to the service, and was commissioned to this end in April 2012.

should conflict occur."

In this context, in April 2016 the Australian government announced that DCNS of France had won the contract for the construction of twelve conventional hunter-killer submarines (SSKs) under the Future Submarine Programme, also known as the Sea-1000 initiative. According to Mr. Meunier: "Australia's future submarine will … share common systems with the 'Barracuda' class (nuclear-powered attack submarine) DCNS is currently designing and building for the French Navy." Within the same programme, on 30th September 2016, Lockheed Martin's Australian subsidiary was selected as the future submarine combat systems integrator, while the combat system specification should be completed by the second half of 2018, *AMR* sources have stated.

The Future Submarine Programme is progressing at a healthy pace. On 30th September 2016, DCNS and the Australian government signed a design and mobilisation contract, which marked the start of the programme. An Australian defence spokesperson indicated that the design and mobilisation programme would include: "design, detailed programme planning, detailed planning for build, test and integration facilities and infrastructure, Australian industry involvement, ongoing identification, definition and development of transfer of technology to Australia, and development of further agreements and contracts". In December 2016, the Australian and French governments also signed a framework agreement concerning cooperation on the Future Submarine Programme. The spokesperson continued that: "construction of the first submarine is expected to commence in the 2023 to 2024 financial year, with the first submarine expected to enter service in the early 2030s and construction of the twelve new submarines to continue into the late 2040 and 2050s".

## People's Republic of China

In the past decade, the People's Republic of China (PRC) has adopted an increasingly robust military stance in the Asia-Pacific region. Both in the East China Sea, where it has ongoing conflicting territorial and maritime claims with Japan over the Senkaku/Diaoyu islands, and the South China Sea, where it has competing claims with the Philippines over the Scarborough Shoal, and with Brunei-Darussalam, Malaysia, Taiwan and Vietnam over the sovereignty of the Paracel and Spratly archipelagos. To this end, the People's Liberation Army Navy (PLAN) has intensified the number of ships patrolling the waters. Submarines are no exception. The PLAN continues to build 'Type-093/Shang' class nuclear-powered attack submarines (SSNs), of which there are five in service and two known to be under construction, and which are replacing the Cold War-era 'Type 091/Han' class SSNs. Collin Koh, research fellow at the maritime security programme of the S. Rajaratnam School of International Studies in Singapore, stated that: "the new 'Shang' class was thought to have incorporated insights gleaned from the Soviet/Russian 'Victor-III' class SSN and, compared to the 'Type-091/Han' class, it has better quieting characteristics and better combat systems." Mr. Koh added that the newest version of the 'Type-093/Shang' class is said to possibly be capable of carrying long-range submarine-launched cruise missiles. The PLAN also continues to develop its 'Type-095' class nuclear-powered ballistic missile submarines (SSBNs), which are substituting the sole Cold War-era 'Type-092/Xia' class SSBN, and is building a newer 'Type-095/Tang' class SSBN. Mr. Koh indicated that this latest iteration of the 'Type-096/Tang' class: "is supposed to carry 24 Submarine-Launched Ballistic


US Navy

*The Pakistan Navy's PNS Ghazi 'Albacora' class SSK was decommissioned in 2005. The fleet is now looking towards the delivery of new SSKs which will be procured from China in the near future.*

Missiles (SLBMs), as opposed to the 'Type-095' class' twelve missiles, and might also be carrying the improved JL-2C/JL-3 SLBM, which would possibly allow its launch from the South China Sea that has long been speculated to have been designated by Beijing as the 'SSBN bastion'."

With fifteen already in service, the PLAN also continues to build 'Type 039A/Yuan' class SSKs. Little is known as to the developments of the latest iteration of this class, but Mr. Koh indicated that the propulsion is likely to be an indigenously-developed Air-Independent Propulsion (AIP) system. He specified, however, that there are indications that the indigenous AIP may not have yielded the desired results, in particular the fact that Beijing recently promulgated a nationwide blueprint to promote science and technology innovation, including areas of propulsion for both air and sea platforms. He also indicated that: "it is possible that, instead of Stirling-type AIP, the Chinese are experimenting with fuel-cell technology and that … they might also seek to develop lithium-ion batteries for future generation SSKs." Basically, Stirling-type AIP burns a combination of fuel and liquid oxygen to drive an electric motor, whereas fuel cell AIP combines fuel with an oxidizing agent to convert chemical energy into electricity.

## India

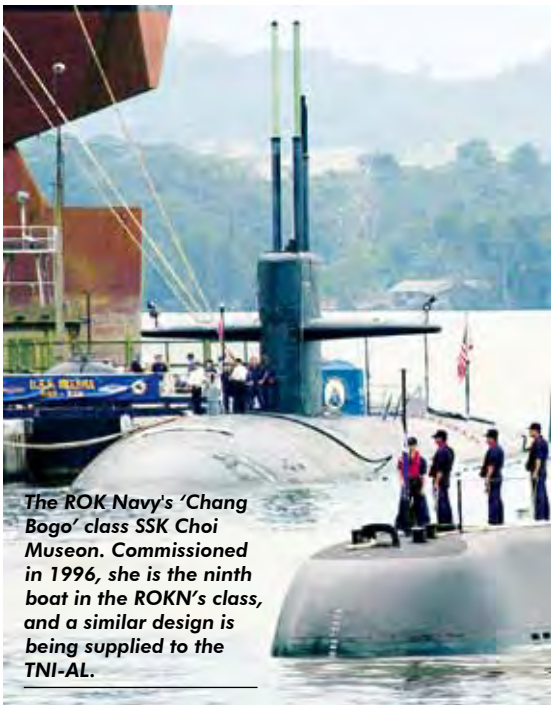
India's growing security concern is the presence of PLAN submarines in the Indian Ocean. Indeed there are a number of key trade routes in the Indian Ocean on which India relies significantly for its economy, including routes heading towards the Strait of Malacca, one of the most important routes for seaborne trade. As such, in order to reassert its sovereignty over the waters of the Indian Ocean, the Indian government commenced the 'Kalvari/Project 75' class SSK initiative in 2005, which aimed to build six submarines. DCNS won the contract, in partnership with Mazagon Dock Limited (MDL), to build six 'Scorpene' class submarines; the programme started in 2010 and all the submarines are being built in MDL through a transfer of technology. The first-of-class, INS *Kalvari*, is currently undergoing sea trials and should be commissioned in the next few months, according to Mr. Meunier. It successfully conducted its maiden firing of an MBDA SM-39 Exocet active radar homing anti-ship missile in the Arabian Sea in early March. Mr. Meunier added: "the second ship, INS *Khanderi*, was launched earlier in January and will undergo the same process of demanding trials at harbour and at sea," he concludes: "MDL is expected to deliver them every nine months."

In 2008, the Indian government also issued a request for information to a number of international shipbuilding firms for the construction of submarines equipped with AIP systems. This is known as the 'Project 75I' class initiative with the Ministry of Defence (MOD) selecting MDL to build three of these new SSKs, Hindustan Shipyard for the last of the six submarines, while the foreign partner has yet to be selected.

## Indonesia

While Indonesia faces no direct security threat from the PRC, its main security challenge is the increasing level of maritime piracy witnessed in its *locale*. According to the *Review of Maritime Transport* published by the United Nations Conference on Trade And Development (UNCTAD) in 2016: "The areas most affected (by piracy) were the Strait of Malacca and Singapore (134 occurred or attempted acts of piracy and armed robberies), the South China Sea (81) and the Western Indian Ocean with 38 in total." As such, Indonesia's 2008 *Defence White Paper*, outlining the government's defence spending and strategic priorities, noted a strategic shift for the *Tentara Nasional Indonesia-Angkatan Laut* (TNI-AL/Indonesian Navy) from functioning within an army-centric paradigm to a more maritime-focused posture.

Within this context, in December 2011 Daewoo was awarded a contract to build, in partnership with indigenous PT PAL, three 'Chang Bogo' class SSKs. The first-of-class, built in the Republic of Korea (ROK), is currently undergoing sea-trials and was scheduled for delivery in March 2017, although at present there is no further news as to whether this has taken place. The second vessel was launched in October 2016 in Daewoo's ROK shipyard. PT PAL, which received the submarine's modules from the ROK in December 2016, will build the last vessel and is expected to have completed the work by the end of



*The ROK Navy's 'Chang Bogo' class SSK Choi Museon. Commissioned in 1996, she is the ninth boat in the ROKN's class, and a similar design is being supplied to the TNI-AL.*

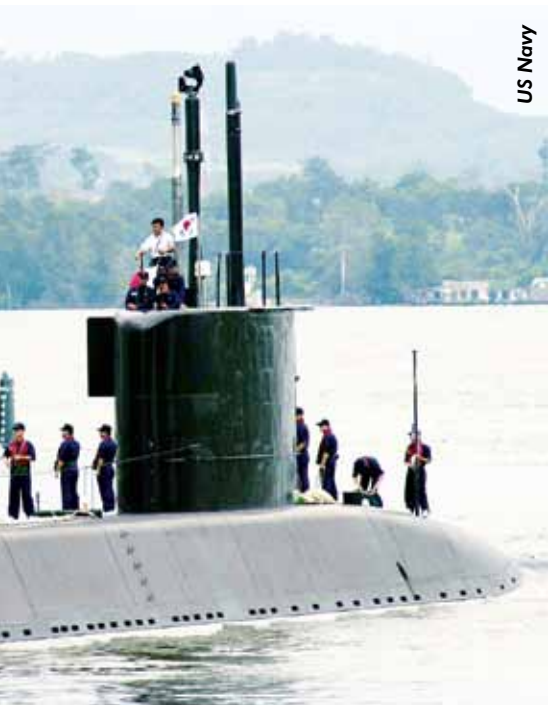

US Navy

*The Japan Maritime Self Defence Force has one of the largest submarine fleets in the Asia-Pacific region with 17 vessels, and five more to be commissioned in the coming years. An example from the 'Oyashio' class is shown here.*

2018, according to media reports.

## Pakistan

Pakistan's key security threat is its tense relationship with its Indian neighbour. In August 2016, Pakistani newspaper *The Express Tribune* reported that the head of Pakistan's submarine programme and senior naval officials confirmed to the National Assembly's Standing Committee on Defence, which exercises parliamentary scrutiny on the government's defence policy, that the PRC will supply eight modified SSKs to the Pakistan Navy (PN) by the year 2028. According to Mr. Koh, the future submarine is likely to be an export version of the 'Type-039A/Yuan' class SSK. The China Shipbuilding Trading Company (CSTC) will build the first four submarines, which are scheduled for delivery by the end of 2023 according to the article in *The Express Tribune*, while the remaining four will be assembled in Karachi, at the Karachi Shipyard and Engineering Works by 2028.


US Navy

## Republic of Korea (ROK)

With the Democratic People's Republic of Korea (DPRK) on its doorstep, the ROK's main security concern is ensuring that it has an efficient and effective ROK Navy (ROKN). In this context, the ROKN has awarded contracts to both Daewoo and Hyundai for the construction of nine 'Son Won-II/Type-214' class SSKs. Hyundai delivered the first three submarines between 2007 and 2009, while all submarines are expected to be operational with the ROKN by 2019. In 2012, Daewoo won the contract for the construction of the first two 'KSS-III' class submarines. The state-run Agency for Defence Development (ADD) is also developing an SLBM to be deployed by the 'KSS-III' class submarines, according to media reports in June 2016. The first-of-class is scheduled for delivery by the end of 2020 and the second one in late 2022.

## Singapore

Singapore shares the same concerns as Indonesia (*see above*) regarding the increase in maritime piracy in the Strait of Malacca, the Indian Ocean and the South China Sea. As such, William Lambert, vice president for sales in the Indian and Asia-Pacific regions at Thyssenkrupp Marine Systems (TKMS), told *AMR* that: "The contract for the delivery of two 'Type-218SG' class SSKs to Singapore was awarded in 2013." For confidential reasons, TKMS has shared very little information regarding the specifics of the RSN's future submarine. Mr. Koh indicated that local specialists believe that: "the Type-218SG is neither a variant of 'Type-214' class or (the firm's) 'Type-216' class design, it's rather a crossbreed of the two, fully customised to the needs of the RSN." An anonymous local expert also shared a couple of assumptions with *AMR*: "The 'Type-218SG' class is about the same size as the 'Type-214' class, maybe slightly larger, with better sea keeping, endurance and range than the existing old RSN 'Challenger' class or 'Archer' class SSKs, hinting at fuel-cell propulsion for enhanced submerged endurance."

## Thailand

Although Thailand is not currently facing any direct security threats, the Asia-Pacific submarine procurement race has arguably prompted the government to revive plans to acquire three SSKs from the PRC. On 24th January, Thailand's defence minister Prawit Wongsuwan confirmed the government has approved $380 million to acquire the first submarine, which Mr. Koh believes will be the export variant of the 'Type-039A/Yuan' class. According to the *Straits Times*, the total cost of the programme is expected to reach $1 billion and payments will be made under a ten-year instalment plan.

## Looking ahead

According to Mr. Meunier: "We believe that the rising number of maritime conflicts and increasing tensions in the South China Sea as well as the Pacific and Indian Oceans, added to the need for resources supply security and civilian safety, will encourage countries in the region to develop and modernise their submarine fleets." This article has made it clear that Asia-Pacific navies are not only seeking foreign partners to modernise and upgrade their submarines, but also to secure transfers of technology. In terms of features, AIP is clearly becoming a key element for the latest generation of submarines to ensure underwater endurance and stealth. According to Mr. Lambert, this could be achieved also by further developing high energy power sources like lithium ion batteries. AMR


US DOD

*The JASDF F-15J fleet is heavily tasked with the patrol of Japan's airspace. Current increases in PLAAF and Russian Air Force activity in Japan's vicinity is taking its toll on the fatigue life of these aircraft.*

# WILL THE SUN SET ON AIR SUPERIORITY?

**Japan possesses one of the most capable air forces in the Asia-Pacific alongside the People's Republic of China (PRC) and the United States. Its force of around 370 fast jets is mostly comprised of up-to-date and effective fourth generation types.**

*by* **Justin Bronk**

The Japan Air Self Defence Force (JASDF) is focused on a core of 200 formidable McDonnell Douglas/Boeing F-15J/DJ Eagle fighters. Furthermore, its pilots are well trained and frequently conduct high-level training with the US Air Force and other allied air forces to keep their tactical edge. However, in the PRC's People's Liberation Army Air Force (PLAAF) and Navy (PLAN), Japan faces a formidable, and increasingly modern, threat in close proximity to its borders, including active territorial disputes, especially over the Senkaku/Diaoyu Islands in the East China Sea under Japan's control with their sovereignty disputed by the PRC and the Republic of China. In the face of Chinese (and Russian) air force and air defence modernisation, Japan's combat fleet is increasingly facing operational obsolescence and technological overmatch. For the JASDF which is restricted in size by Japan's constitutionally-limited defence budget and has, therefore, been reliant for many decades on technological advantage to adequately defend against a much more numerous PLAAF, the future presents serious challenges. The USAF is also facing its own problems with force size, modernisation and pilot shortages relative to global commitments which is likely to contribute to a long term reduction in the longstanding American capability to establish air superiority over the PRC in the Asia-Pacific; a trend which only increases the requirement for a strong JASDF.

In recent years, the JASDF has seen air defence sortie scramble rates increase greatly over those witnessed in the decade and a half following the end of the Cold War. Both Russia and the PRC regularly probe Japan's declared airspace over the Senkaku/Diaoyu and Kuril Islands, northeast of Japan and under Russian control, and launch strategic bomber, surveillance and maritime patrol aircraft sorties which skirt Japanese airspace. From around 300 or fewer scrambles per year up to 2012, scramble rates have steadily increased to 571 in 2015 and more than 1100 in 2016 which is the highest annual total in JASDF history. This level of air defence activity is well above the defence planning assumptions which were place when the JASDF procured its

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USAF

*Despite the impressive nature of the F-2A's original design, the aircraft is increasingly outclassed by rival Chinese and Russian designs used by the PLAAF.*

current fighter fleet and places a heavy burden on squadron readiness and fleet airframe fatigue management, especially given the relatively small number of F-15Js on whom the majority of this tasking falls. If such rates continue in the medium to long term, this will force an earlier replacement or at least a total overhaul of the JSADF F-15J fleet earlier than envisaged.

## The Threat

In the strike and anti-shipping roles, the JASDF and air component of the Japanese Maritime Self-Defence Forces (JMSDF) are faced with severe challenges in maintaining credible capabilities against the increasing technological and numerical strength of the PLAN and PLAAF. The JASDF stands out among modern air forces in that it has traditionally taken the anti-shipping role fairly seriously. The Mitsubishi F-2A and McDonnell Douglas/Boeing F-4EJ Phantom-II fighters are both equipped to launch Mitsubishi ASM-1 and ASM-2 active radar homing Anti-Ship Missiles (AShMs) and have a doctrinal anti-ship role. However, imports of Russian Surface-to-Air Missile (SAM) systems such as the Almaz-Antey S-300PMU/PMU1/PMU2 have not only given the PRC use of these formidable systems to defend land installations; they have also allowed PRC engineers to reverse engineer many features of the system. The PRC has combined many of the best features of Russian long range SAM technology with Western technical information stolen on an industrial scale to produce its own indigenous long range SAM systems in the form of the China Precision Machinery Import Export Corporation HQ-9 SAM system family. These include the HHQ-9A/B and HQ-26 for PLAN vessels, which together with rapid advances in Chinese active electronically scanned array radar production for naval vessels, fighters and Airborne Early Warning (AEW) assets, makes getting within AShM launch range of PLAN major surface combatants a very dangerous prospect in the event of hostilities for any aircraft which is not either low-observable or capable of heavy and frequency-agile jamming.

Furthermore, whilst the HHQ-9A/B series have inferior capabilities at present to intercept AShMs that fly extremely low for their entire approach and terminal flight phases, the ASM-1 and ASM-2 are higher flying in their approach phase than missiles such as the MBDA Exocet and Saab RBS-15 AShM families and are not stealthy like the Lockheed Martin AGM-158C LRASM (Long Range Anti-Ship Missile). Furthermore, because the F-2A and F-4EJ use indigenous Japanese avionics and mission systems, it is harder for the JASDF to integrate promising foreign missiles onto these aircraft. The new supersonic Mitsubishi XASM-3 is in development for the F-2A but is still some way from service and does not satisfactorily increase launch platform survivability against major surface combatants. As a result, the existing aerial capabilities of the JASDF based on the F-2A and the F-4EJ, and JMSDF in the shape of the Kawasaki P-1 and Lockheed Martin P-3C/D family maritime patrol aircraft are unlikely to provide significant deterrence against major PLAN surface combatants even before the nascent but unmistakably ambitious PLAN aircraft carrier programme becomes a serious threat.

Given these difficulties in executing the strike and particularly anti-shipping roles which are a core part of the JASDF remit to deter incursions into Japan's territorial waters, the JASDF has an urgent need for more capable aircraft for this mission. The most immediate priority for the JASDF must be the replacement of its three remaining squadrons of F-4EJ fighters. The F-4 Phantom family was a world beating aircraft in the 1970s and remains a potent, almost fourth generation platform when equipped

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*Despite having given admirable service in the JASDF for several decades, the F-4EJ is increasingly obsolete in the face of the PRC's enhancements to its PLAAF and PLAN fighter fleets.*

with modernised radar, electronics and missiles. However, it is outclassed by China's Sukhoi Su-27 family derivatives in radar performance, kinematics and missile payload. Against the modern air defences which the PRC deploys on its islands, mainland and naval vessels, the F-4EJ presents a huge Radar Cross Section (RCS) and has limited manoeuvrability for evasion once targeted, meaning it is increasingly obsolete in the strike role.

The Lockheed Martin F-35A Lightning-II fighter (*see below*) has been identified as a replacement for the F-4EJ. However, Japanese procurement funding constraints, as well as the decision to assemble 38 of the 42 aircraft currently on order in Japan at Mitsubishi's facilities means that the acquisition rate is likely to be limited to a few examples each year at best, and it will take some time to replace all three F-4EJ squadrons. The much higher combined acquisition rate of Chinese fourth generation Chengdu J-10A/B, Shenyang J-11 family, J-15 family and now a trickle of early-production Chengdu J-20A fifth generation fighters means that Japan's limited quantity and acquisition rate of F-35As alone is not ever going to be sufficient to keep pace with PLAAF and PLAN fighter modernisation.

## F-2A

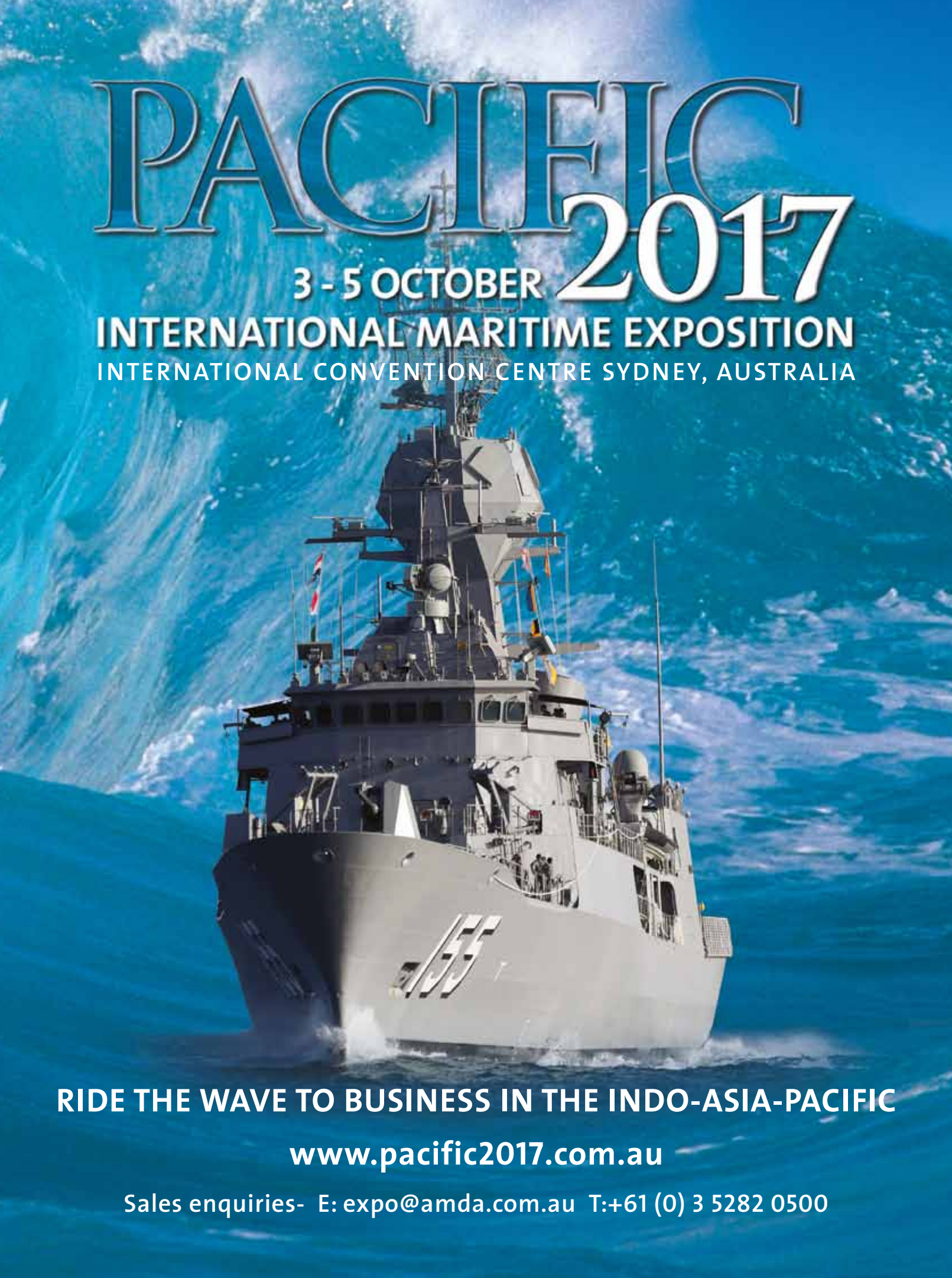
The JASDF's second fast jet fleet which also presents challenges is its multirole and primary anti-ship fighter, the Mitsubishi F-2A. Developed at great cost and over more than a decade between 1987 and its introduction into service in 2000, the F-2A is externally similar in appearance to the General Dynamics/Lockheed Martin F-16 fighter family, but with a 25 percent greater wing area, larger control surfaces, engine intake and framed canopy. Internally, the F-2A was a significant advance over the late 1980s F-16 design from which is was developed, incorporating many indigenous Japanese electronic systems including the Japan's first operational Active Electronically Scanned Array (AESA) radar, the Mitsubishi J/APG-1 X-band (8.5-10.68GHz) system. However, the F-2A was extremely expensive as a result of a limited production run of 94 aircraft. Due to Japan having to pay development costs as well as setting up its own production line, the F-2A was more than four times as expensive as a comparable F-16C/D Block-50/52 fighter which was the latest US standard when the F-2A finally entered service in the year 2000. The F-2A is also much more problematic in terms of integrating non-indigenous advanced payloads due to its heavy use of Japanese electronic systems which were state of the art when designed but are now an expensive and complex challenge in terms of system capacity growth to meet future challenges.

Furthermore in the fighter role, the F-2A was an aerodynamic upgrade over the original F-16 family in terms of operational altitude and wing loading, but is still at best on a par with the latest Chinese Su-27 derivatives regarding beyond visual range performance and inferior to both the former and the J-10 family during visual range combat due to the latters' superior agility and the lack of a helmet mounted display for the F-2A. The F-2A has some advantages with the latest Mitsubishi J/APG-2 X-band radar and miniature AESA-seeker equipped Mitsubishi AAM-4B active radar homing air to air missiles. However, it is available in far smaller numbers than the PLAAF can field, will show up at long range on PRC radars due to its lack of modern RCS features or latest generation electronic warfare jamming pods, and carries substantially fewer missiles than the Su-27/J-11 family. As a result it is adequate at present but cannot provide any new long term answers to Japan's increasing air defence challenges.

However, the F-2A is not the core of the JASDF air defence mission, that honour falls to Japan's modernised F-15J which is still at least a match for the PRC's fourth generation fighters. The venerable but flexible and reliable F-15J design will remain viable as the core of Japan's air defence capabilities for the next decade in spite of limited numbers of J-20s entering service in China, so long as they can be properly integrated with the small number of F-35As entering service during that period. The F-15J is also an excellent platform to conduct routine air policing scrambles, being fast and possessing a long range, with few RCS secrets worth exploiting by PRC and Russian electronic intelligence aircraft during such encounters. Its manoeuvrability in the visual range arena is respectable. Nevertheless, the Japanese standard Raytheon AN/APG-63V1 X-band radar and AAM-4B combination, coupled with the F-15J airframe's inherent high altitude supersonic performance, makes it a formidable beyond visual range fighter even today.

## Lightning Bolts

In terms of future viability, advanced fourth generation fighters like the F-15J which are designed around powerful radars, missile loadouts and high performance at altitude work extremely well alongside the F-35 family and the USAF's Lockheed Martin F-22A Raptor fighters. The ability to fly extremely high and extremely fast with a large loadout of AAM-4Bs will make the F-15J indispensable to the nascent Japanese F-35A force as the latter starts to build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*Japan's forthcoming F-35A fleet, the first example of which is shown here, should help the JASDF to maintain at least parity with the PLAAF, while achieving overmatch could necessitate the acquisition of a new fighter.*

up over the next decade. The F-35 is a formidable low-observable flying sensor and strike platform, but it carries a limited internal weapons load. The F-35A will, therefore, be significantly dependent on sensor-to-shooter integration with other fighters in any hypothetical clash with the numerically superior PLAAF. On the flip side, the F-35A even in small numbers could get much closer to potential air and ground-based threats than the F-15J force before being detected, and provide the latter with track quality target information on threats within a large operational area to allow the F-15J/AAM-4B combination to even the odds for the F-35As.

Even coupled with the F-15J force, however, the F-35A is not a perfect fit for the JASDF. In simple terms, the JASDF needs a fighter capable of deterring the PLAAF's best types with enough technological overmatch to at least partially offset its inevitable numerical disadvantage. This is why Japan was so keen to be allowed to purchase the F-22A and why Japan has re-prioritised its own fifth generation technology demonstrator, the Mitsubishi X-2 Shinshin, since the F-22A's production cancellation in 2009. The F-35A will give the JASDF a greatly increased capability against ground targets and ships protected by modern SAM systems, and if tactical datalinks receive proper investment, can significantly boost the combat capability of the F-15J fleet against large numbers of modern aerial threats. Nevertheless, its limited range on internal fuel and limited missile loadout makes it inefficient in the air defence role except in the comparatively large numbers which Japan is unlikely to be able to afford. Furthermore, as already discussed, the very heavy scramble rates which have become the 'new normal' since 2012 are using up the fatigue lives of the JASDF F-15J fleet much faster than planned which will inevitably result in a need to replace or at least augment this core asset by around the late 2020s.

## X-2 Shinshin

Therefore, Japan has placed its long term fighter hopes in a fighter derivative of the X-2 Shinshin which first flew in April 2016. The ATD-X programme under which the X-2 has been developed aims to produce a sixth generation fighter tentatively called the F-3 in the late 2020s with an advanced low RCS, significant internal weapons payload, advanced airframe-embedded AESA radar, thrust vectoring and super-cruise capabilities. It remains to be seen whether Japan can actually produce such a fighter alone given its annual one percent of gross domestic product defence spending limit and the many other requirements for finite resources in the country's armed forces. Yet Japan is actively reaching out to potential international partners for cooperation on engines, airframe design and other aspects of the F-3. Whether Japan succeeds in building the first successful non-US air dominance fighter capable of matching or even surpassing the capabilities of the F-22A or not will likely have a huge effect on the balance of airpower in the Asia-Pacific in the 2030s and beyond. AMR

Images courtesy of www.defencephotography.com

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*On 16th January 2016, world leaders met to discuss implementation of the JCPOA, including the then-US secretary of state John Kerry and Iran's foreign secretary Mohammed Javad Zarif.*

# BACK IN BUSINESS

**Iran is coming in from the cold. The lifting of sanctions regarding that country's clandestine nuclear weapons programme has implications for the Asia-Pacific as the Islamic Republic looks to revitalise its military.**

*by* **Beth Stevenson**

On 16th January 2016, a Joint Comprehensive Plan of Action (JCPOA) that facilitated the relief of economic and financial sanctions previously placed on the Islamic Republic of Iran came into force. The JCPOA was signed by the government of Iran and representatives from the governments of France, Germany, the People's Republic of China (PRC), Russia, the United Kingdom, the United States and the European Union (EU). Some six months in the making, the day marked the point at which Tehran could again begin to trade with a number of key world powers, after restrictions were placed on the country in 2006 as a result of its clandestine nuclear weapons programme.

Verified by the International Atomic Energy Agency (IAEA), the United Nations organisation which works to promote the peaceful uses of nuclear energy and to fight the proliferation of nuclear weapons technology, Iran had, at that point of the JCPOA's signature, successfully implemented: "key nuclear-related measures described by the JCPOA," according to a statement released by the US State Department. The achievement was backed by the US government and the EU, both of which agreed that Iran was no longer developing military-grade nuclear-related technology: "On this historic day, the International Atomic Energy Agency has verified that Iran has implemented its key nuclear-related measures described in the JCPOA, and the secretary of state has confirmed the IAEA's verification," the US government said in a statement confirming the implementation of the JCPOA in January 2016: "As a result of Iran verifiably meeting its nuclear commitments, the United States is today lifting nuclear-related sanctions on Iran, as described in the JCPOA."

To some degree, economic sanctions

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date back to the start of the Iranian Revolution in 1979. These sanctions were imposed by the US administration of President Jimmy Carter. However, it would be in 2006 with the UN's passing of Resolution 1696 which called upon the Iranian government to halt its enrichment of Uranium; a vital part of nuclear weapons production. At the point of the resolution's signature, the IAEA could not be assured that Iran would cease its uranium enrichment programme to the extent that the agency required, so sanctions were implemented. Since Iran had been largely excluded from economic and financial access to the world stage for ten years when the JCPOA came into effect, it almost immediately took advantage of its access to international trade in exchange for its greatest commodity: oil.

Despite ranking sixth according to the US Energy Information Administration in 2016 in terms of barrels-per-day production of Brent Crude, Iran was significantly impacted by the imposed sanctions which hampered the Islamic Republic's ability to sell oil on the international market. Nevertheless, the price of oil is again on the rise, and the Citigroup financial company announced in April that it expects Brent Crude to reach circa $65 per barrel by the end of the year.

Iran Air

*The first significant technology delivery into Iran was an A321 airliner that was delivered in January 2017. The commercial sector was quick to jump on new opportunities with Iran, but the defence market has so far been more cautious.*

## Strategic Considerations

Iran is going to want to partner with countries regionally and internationally for several strategic reasons: These include improved trade relationships, which includes direct investment into Iran, mainly via the sale of domestically-produced oil and gas, that will help the economy, Dan Darling, senior military markets analyst for Europe and the Asia-Pacific Rim at Forecast International, told *AMR*. He continued that this would also help defer focus away from the pressure being laid on Tehran from the West for political reform.

The so-called 'siloed approach' Iran had previously taken was both as a result of the sanctions and the political standpoint: Crucially the country is one of the few Muslim states in the Persian Gulf region which is not a monarchy, also the country follows the Shia branch of Islam as opposed to the Sunni branch predominantly followed by many of Iran's neighbours. Both of these factors have arguably differentiated Iran from other nations in the Middle East. The country may use its uniqueness in these socio-political aspects to develop a larger presence on the world stage. This may result in Iran targeting memberships of supranational organisations that will bolster its position both in the Middle East and beyond such as the Shanghai Cooperation Organisation, Mr. Darling says, which is an intergovernmental body comprising Kazakhstan, Kyrgyzstan, the PRC, Russia, Tajikistan, and Uzbekistan.

One significant post-sanction relief deal that Iran entered into came in December 2016, when Boeing signed an agreement with Iran Air for the provision of 80 aircraft worth some $16.6 billion. This was made up of 50 B737-MAX-8, 15 B777-300ER and 15 B777-9 airliners, and will replace an antiquated mixed fleet of Boeing, Airbus and Fokker airliners, some of which date back to the 1980s. The Boeing deal was followed in early April with a deal worth $3 billion with Iran's Aseman Airlines for 30 B737-MAX-8 airliners, with options for a further 30 aircraft. A boost in technology transfer between Iran and Europe has also followed the lifting of sanctions with a contract in December for 100 Airbus commercial airliners (A320 family, A330 family and A350 family) worth a reported $18 million. This deal was subject to the US government's Office of Foreign Assets Control (OFAC) which requires a granting export licences for sales containing ten percent or more US technology, these licences being achieved in September 2016 and November 2016: "Airbus coordinated closely with regulators in the EU, US and elsewhere to ensure understanding and full compliance with the JCPOA," Airbus said in a December 2016 statement: "Airbus will continue to act in full compliance with the conditions of the OFAC licences." Notably, the required OFAC authorisation demonstrates that while sanctions were lifted by the US government, there are still certain restrictions on trade. Essentially, the US government will have to approve all trade deals with Iran, but in terms of defence exports, this is often the case with any international sale.

While Europe and the US were notably vocal in their support of the JCPOA being adhered to, and have since made trade deals with Iran as a result of it, the effect that the JCPOA's lifting will have on Iran's trade with the Asia-Pacific remains speculative, although it is expected to be significant: "While commercial trade ties may (likely will) improve with Europe provided Tehran does not violate its treaty obligations, the tectonic shift in global power, demographically, economically and militarily, favours (the Asia-Pacific) over regions such as Latin America, Africa and Europe," Mr. Darling said.

Trade between the Middle East the Asia-Pacific in general is already strong and growing, he continued, and this should continue as global wealth shifts as it is doing from the developed West to the still-developing East, regardless of Iranian sanctions being lifted. A report entitled *The World in 2050: Will the Shift in Global Economic Power Continue?* published in February 2015 by the professional services firm PriceWaterhouseCoopers stated that:

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*The export version of the Shenyang J-6 was derived from the Soviet MiG-19 family fighter, and used by Iran during the Iraq-Iran War, with the Islamic Republic having received the type from China in the 1980s.*

"The global economic power shift away from the established advanced economies in North America, Western Europe and Japan will continue over the next 35 years. China has already overtaken the US in 2014 to become the largest economy in purchasing power parity."

Although the Asia-Pacific is generally more of an arms-importing region rather than an exporting one, the continent is still a key export market for Iranian trade, Mr. Darling said, noting that the PRC in particular will be an opportune seller: "China is a willing arms seller that places few, if any, political conditions on a buyer," he noted: "In this respect, it is attempting to sweep in and steal some of Russia's longstanding market share: "Other arms-exporting Asia-Pacific nations such as the Republic of Korea, Singapore and now Japan are less likely to provide Iran with weaponry at the risk of upsetting the United States." He continued that: "Iran will still seek European investment, energy trade and diplomatic support…but in terms of a more like-minded approach to geopolitics provided Iran remains under control of the clerical regime it will tilt towards the Asia-Pacific," Mr. Darling said, noting that on 15th November 2016 Iran and the PRC agreed to enhance bilateral military cooperation, having shared interests in gaining strength over the US: "Both consider the United States meddlesome (hostile from Iran's view) and an impediment to attaining their own respective regional hegemony," he added.

## Materiel

Following the 1979 Revolution and subsequent restrictions laid on military and technology exports into Iran as a result of sanctions, Tehran began to rely upon *materiel* from the Democratic People's Republic of Korea, Russia and the PRC. That said, it has notably become more independent during the intervening years as it sought to present an image of reliability on its own military capabilities. For example, in February 2013, the Iranian government announced the development of a fifth generation fighter with a low radar cross section dubbed the Iran Aviation Industries Organisation Qaher-313. At the time, the Iranian government characterised the jet as: "one of the most sophisticated fighter jets in the world." Nevertheless, the claims Iran makes about its indigenous systems are often hyperbolic, and "these claims nearly always outpace reality," Mr. Darling observed.

With this in mind, it is likely that Iran would: "seek as much localised workshare and technology transfer as it may finagle under any (defence) equipment deal related to high-end capabilities," Mr. Darling said: "Though Iran has worked at developing and manufacturing unmanned aerial vehicles, artillery systems and combat boats, it remains dependent upon legacy US, Chinese and Russian-sourced hardware ranging from combat aircraft to submarines, to air-defence systems." Among the technology imported from the PRC was the T-59 Main Battle Tank (MBT) which formed the basis for the Defence Industries Corporation of Iran's T-72Z Safir-74 MBT and of particular interest to Iran would be fixed- and rotary-wing aircraft, including fighters, transports, and a whole range of rotorcraft, as well as "force multipliers" such as airborne early warning aircraft, armed High-Altitude, Long-Endurance (HALE) or Medium-Altitude, Long-Endurance (MALE) Unmanned Aerial Vehicles (UAVs), and warships, Mr. Darling added.

Under the terms of the JCPOA and the US' lifting of its sanctions, if a UAV contains more than ten percent of American technology, it cannot be sold to Iran. A high proportion of MALE and HALE UAVs are US-manufactured, such as the General Atomics MQ-9 Reaper and Northrop Grumman RQ-4B Global Hawk respectively, with the next big supplier of these categories of systems being Israel which, among other aircraft, produces the Israel Aerospace Industries Eitan/Heron-TP MALE UAV, will not trade with Iran, although covert weapons supplies are thought to have occurred from Israel to Iran during the 1980s. Therefore, the PRC is one of the most promising vendors for this type of technology for Tehran. Current Chinese offerings in this regard include the Chengdu Wing Loong/Pterodactyl-1 MALE UAV.

## The Road Ahead

While progressive for Iran's international


*China previously provided its T-59 MBT to Iran, which in turn was a derivative of the Soviet-era T-54A. This MBT formed the basis for the T-72Z Safir-74.*

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*Iran could turn to Chinese-built MALE UAVs like the CASC CH-4 that entered service with Iraq in 2015. While the US is a world leader in the manufacture of MALE UAVs, it is unlikely to authorise a sale of this technology to Tehran.*

relations, the sanctions relief is facing a number of challenges. Firstly, it only offers relief on some of the restrictions that were in place, the rest of which will be lifted in 2020 if Iran continues to adhere to the JPCOA terms. Until that point, all deals that will be made over coming years will be scrutinised by the UN Security Council on a case-by-case basis, so the volumes of trade expected between Iran and the rest of the world will vary in terms of scale, size and technological sophistication, Mr. Darling argued: "Beyond 2020, there is also the question over whether Iran may initially be able to afford more expensive hardware (such as advanced missile systems and combat aircraft) without being advanced a line of credit by the provider," he added: "Russia, for instance, often extends a line of credit to interested buyers … Furthermore, the question of how much pressure a willing seller receives from the US, Europe, and Middle Eastern nations like Israel and Saudi Arabia over a potential deal and whether that effectively alters the variables in an agreement or final transfer also comes into play."

Another challenge to trading with Iran comes from any inclusion of an individual or company that is categorised on the US government's Specially Designated Nationals (SDN) list. The SDN contains names of people, organisations and vessels with whom US citizens and permanent residents are prohibited from doing business. Additionally, the terms of the JCPOA state that the EU and US can reverse sanctions relief at any time if it seems that Iran is not adhering to the measures that it ensured it would follow when the process to lift the sanctions began.

Despite a number of challenges, and a less than clear path in which Iran will trade with the US, Europe and the Asia-Pacific, the lifting of sanctions on a nation that has previously demonstrated hostility towards these regions, particularly the US which has been referred to as "The Great Satan" in some official Iranian government statements since 1979, is progressive to say the least. A way to further the success of the Iran nuclear deal would be use it as a template to conclude agreements with other 'countries of concern' such as the Democratic People's Republic of Korea (DPRK) which is pursuing a clandestine nuclear weapons programme.

It would appear that the new freedoms beheld to Iran have not been wasted, as indicated by the trade deals that the nation has concluded, and the previously hostile nation has taken advantage of the olive branch it has been offered by the international community via the JCPOA to increase its reengagement on the international stage. Where this will go remains to be seen, and Iran has to stay on track with its JCPOA commitments in order to retain the privileges it was granted some twelve months ago. The situation in 2020 will be a key indicator of how successful the cessation of decade-long sanctions can be, and many players are hopeful that it can be applied to states that are equally, if not more, antagonistic than Iran, such as the DPRK in the future. More discussion of Iran's emerging relationship with actors in the Asia-Pacific can be found in Dr. Aniseh Bassiri Tabrizi's article *Chabahar Project Haltingly Moves Forward* at *www.asianmilitaryreview.com*. AMR

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