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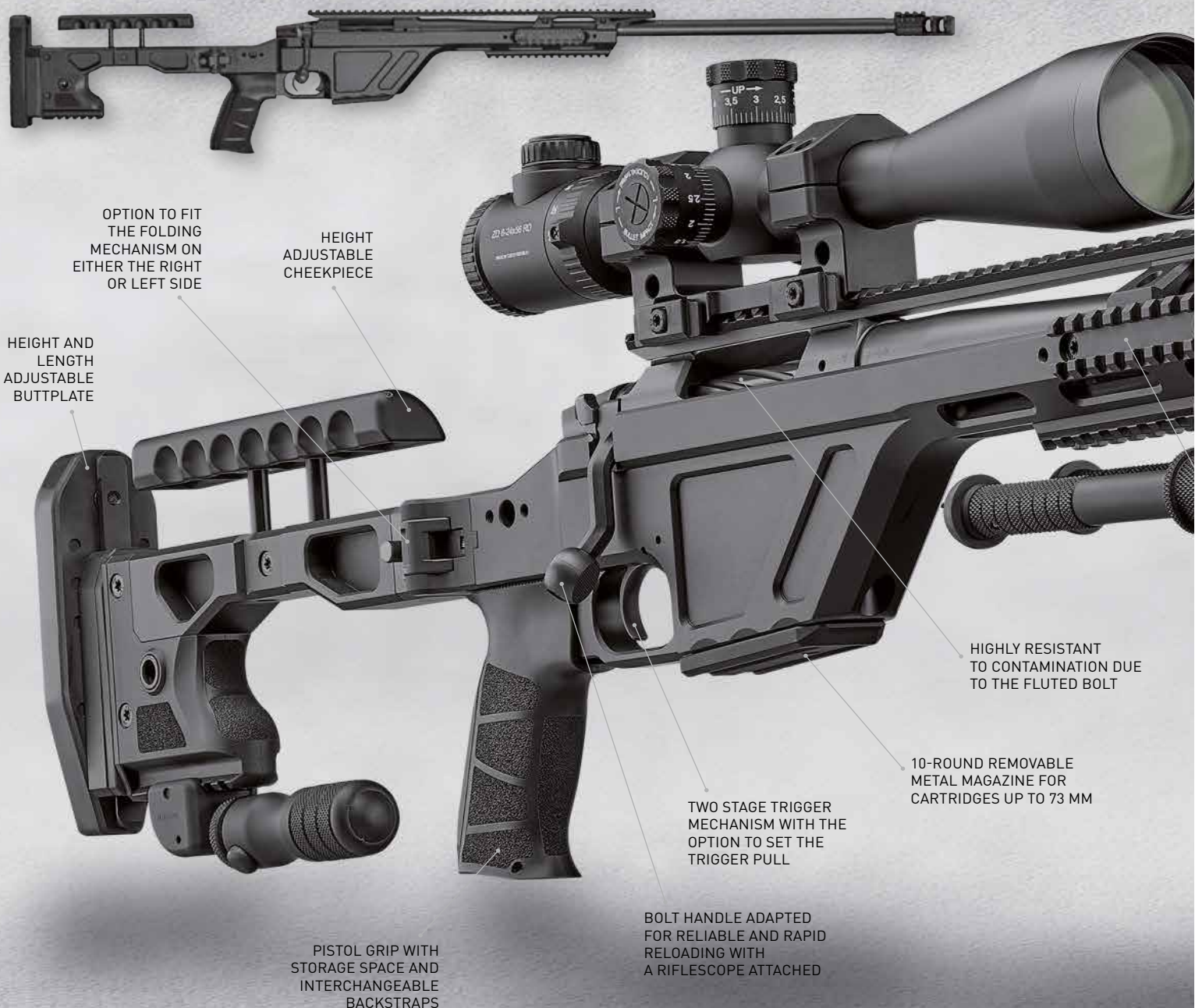
SNIPER RIFLE

CZ TSR



.308 WIN.

WE KNOW THE SECRET OF ACCURATE
LONG DISTANCE SHOOTING.



CALIBRE

.308 Win.

MAGAZINE CAPACITY

10

FRAME

ALUMINIUM

MAXIMUM
OVERALL LENGTH (MM)*

1237 ± 5mm

MINIMUM
OVERALL LENGTH (MM)**

920 ± 5mm

BARREL LENGTH
WITHOUT
COMPENSATOR (MM)

660 ± 1



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SUB MOA

VISIT US AT
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HALL 5A K 627
PARIS, FRANCE, 11 - 15 JUNE 2018



WIDTH OF WEAPON (MM)		HEIGHT OF WEAPON WITH CHEEKPIECE RETRACTED	WEIGHT WITH EMPTY MAGAZINE (G)	OPERATING TEMPERATURE RANGE	RATE OF TWIST	ACCURACY
WITH STOCK FOLDED	WITH STOCK UNFOLDED					
95 ± 2	70 ± 2	192 ± 2 mm	max. 6 300	from -50°C to + 50°	1:11"	Sub MOA

* unfolded stock with all buttplates and with compensator

** folded stock without buttplates and compensator

Stated dimensions may be different in particular design and configuration.

Dear customers and CZ brand enthusiasts,



ČESKÁ ZBROJOVKA A.S. HAS A LONG TRADITION, STRETCHING BACK MORE THAN 80 YEARS. DURING THESE EIGHT DECADES WE HAVE LAUNCHED MILLIONS OF WEAPONS FROM OUR FACTORIES IN THE CZECH REPUBLIC AND THE USA TO THE MARKET. SOME OF THEM HAVE BECOME GLOBAL LEGENDS – LET US MENTION AT LEAST THE PISTOLS OF THE CZ 75 AND DAN WESSON SERIES, OR THE 58 AND 61 SCORPION SUBMACHINE GUN MODELS.

However, the current generation of CZ brand products is not a result of nostalgic looking back on an illustrious history. It is the result of commitment, erudition and honest work every day of a large team of superior professionals, for whom weapons are literally a passion and the customer is king.

Thanks to an intensive modernisation of its production and development capacities, CZ currently offers top models in all segments, with which it is hard to compete. A significant breakthrough was the return of our company to the exclusive community of accredited suppliers to official armed forces. We have produced weapons for the forces that have managed to gain worldwide renown: CZ SCORPION EVO 3 A1 submachine guns, CZ BREN

2 assault rifles, and CZ P-07/09 and CZ P-10 pistols. It seems that our hot news – the CZ TSR sniper rifle – has started in the same direction.

A proof of the quality of the new CZ weapons is the expansion of our sales network to more than 100 countries around the world and a growing reference list of satisfied customers. Many of them select for logistics as well as economics as a more favourable way of purchasing an entire product series, which consists, in addition to weapons themselves, of numerous accessories, services, or precisely targeted training. I am pleased to state that the sales of licences and technological transfers for the production of CZ weapons to other countries in the world continue to increase.

An important benefit for our partners in the armed forces is that the ever-growing family of CZ also includes CZ 4M tactical equipment, which includes high-quality ballistic protection, as well as weapon accessories, uniforms and backpacks.

However, these achievements are not won by the CZ team in isolation. We also need to thank you, our customers and fans. The purchase of every weapon is a deeply responsible, individual choice and an expression of the highest trust, which we profoundly appreciate. It is, always, our commitment and a challenge to ourselves for us to deliver the best results possible, for you.

Ing. Ladislav Britaňák, MBA

CEO and Vice-Chairman of the Board of Directors of Česká zbrojovka a.s.



Comprehensive High Quality Solutions for the Armed Forces

IN 2018 THE CENTENARY OF THE FOUNDING OF CZECHOSLOVAKIA WILL BE CELEBRATED, BUT FOR MORE THAN 80 OF THOSE YEARS, ČESKÁ ZBROJOVKA A.S. HAS BEEN BUILDING ITS POSITION AND REPUTATION AS ONE OF THE MOST PROGRESSIVE AND SIGNIFICANT FIREARMS MANUFACTURERS IN THE WORLD. MANY OF ITS MODELS HAVE BECOME GLOBAL LEGENDS AND THE LATEST GENERATION SEEMS TO BE DESTINED FOR GREATNESS AS WELL.



Modern, technologically advanced firearms, developed and manufactured mostly at the primary CZ factory in Uherský Brod, are the company's main focus, as they form the foundation and backbone of the company's activities. This small town in the southeast of the Czech Republic is also the birthplace of some famous models, such as the Vz. 58 submachine gun (SMG), Vz. 61 ŠKORPION and the timeless CZ 75/85 pistols.

In terms of weapon categories it is useful to generally divide product lines according to their effective shooting distances...

Sniper Special

To cover the range of shooting at distances between 1,000 and 500 metres, CZ has prepared a completely new and extremely accurate sniper rifle, the CZ TSR in .308 Win (7.62×51 NATO) calibre. This weapon has been developed in cooperation with elite police and military snipers. Its key features include a cold hammer forged barrel with an exceptionally long lifetime and the barrel bore optimised for maximum accuracy; several MIL-STD-1913 Picatinny rails for the attachment of accessories; and a proprietary design of folding stock. The CZ TSR guarantees SUB-MOA accuracy even after 10,000 shots, and offers an impressive firing capacity due to its 10-round magazine.

Cutting-Edge Weapons With a Famous Name

With regard to the assault rifles sector, that is, weapons for combat at 500 down to 150 metres – which can of course be used at much shorter distances – CZ's fundamental product line is the second generation of the CZ BREN assault rifle. This famous name has become a synonym for an exceptionally reliable yet user-friendly and accurate automatic weapon, and all of these attributes apply to the CZ BREN 2. These are highly advanced multi-calibre weapons in 5.56×45 NATO and 7.62×39 calibres, with an option to be configured to meet the requirements of any mission and any customer, anywhere in the world. For all CZ BREN weapons, there is also the optional CZ 805 G1 grenade launcher in 40×46 mm NATO calibre on offer.



Tried and Tested SCORPION

For shooting at distances from 150 down to 50 metres, CZ produces a very popular SMG, the CZ SCORPION EVO 3 A1. In terms of the design and production, this is an exceptionally easy and reliable weapon that uses the powerful 9×19 calibre round. Its characteristic features include extensive use of plastics, numerous mounting rails, ambidextrous controls with an option to adjust the ergonomics, and easy handling in burst fire mode. The qualities of this model are given testament by the ever-growing reference list of satisfied customers from all over the world.

There is also a semi-automatic variant, the CZ SCORPION EVO 3 S1 using 9×19 and 9×21 cartridges, appreciated by fans of modern dynamic sport shooting disciplines as well as members of those security forces that are by law prohibited from using weapons with a burst fire mode.

Short Range Specialists

CZ weapons that are primarily intended for the fulfilment of combat assignments and law enforcement at ranges up to 50 metres are semi-automatic pistols. This is a field where CZ regularly excels, as confirmed in many international shooting competitions. Its status as one of the most significant pistol manufacturers in the world is enforced by the latest models bearing the famous CZ brand, above all, the CZ P-10 C model in 9×19 calibre. In this weapon the seemingly ordinary striker-fired pistol with a polymer frame has acquired a number of original innovations that have resulted in the creation of a model with significantly improved key user parameters, especially with regard to accuracy, durability and speed. Officially, it is a compact model, though in reality it is a full-blown large capacity service and defence weapon, suitable for open as well as concealed carry. The exceptional qualities of this model were confirmed by the American professional





shooting magazine Guns & Ammo, awarding it the title "Pistol of the Year 2017". The latest variation is the CZ P-10 C Optics Ready with a mounting rail for simple, easy and secure attachment of a collimator sight. However, CZ does not forget fans of single action and double action (SA/DA) pistols with an external hammer! Apart from the traditional CZ 75 family, these shooters can also appreciate the innovative, modern CZ P-07 and CZ P-09 models with polymer frames in 9x19, 9x21 and .40 S&W calibres, as well as .380 Auto for the first compact version. In addition, there are also conversions for the FX Simunition/CQT marking cartridges and adapters for shooting with .22 LR cartridges.

Abundant Accessories and Training

For all the above-mentioned models CZ supplies a wide range of essential accessories, specially chosen and tested by the company's product managers, who have a lot of experience from real deployments. An integral part of this process is intensive communication with actual end users: the aim is to offer anyone who is interested in a CZ product absolutely everything that they will need to meet their requirements to the ultimate degree. Some accessories are custom-made for CZ according to users' specifications. Thanks to this approach the company is able to meet all customer requirements, no matter if they just need ordinary spare parts sets or if they need a more comprehensive solution, from holsters and magazines

to sophisticated sights and transport cases. There is also an impressive selection of optical and electro-optic scopes, from compact collimator sights to powerful sniper scopes. CZ offers a complete service for all their weapons, including training for armourers as well as a special programme for user training. The company works closely with many experienced professionals who can provide all levels of modern training for security / first responders and armed forces. Besides their cutting-edge weapons and high-quality accessories, police and military units can also commission professional training programmes and courses from CZ, tailor-made to the requirements of any given unit, regardless whether it needs to learn "just" perfectly to handle their CZ weapons or to improve their tactical and operational readiness.

Tactical Equipment from CZ 4M

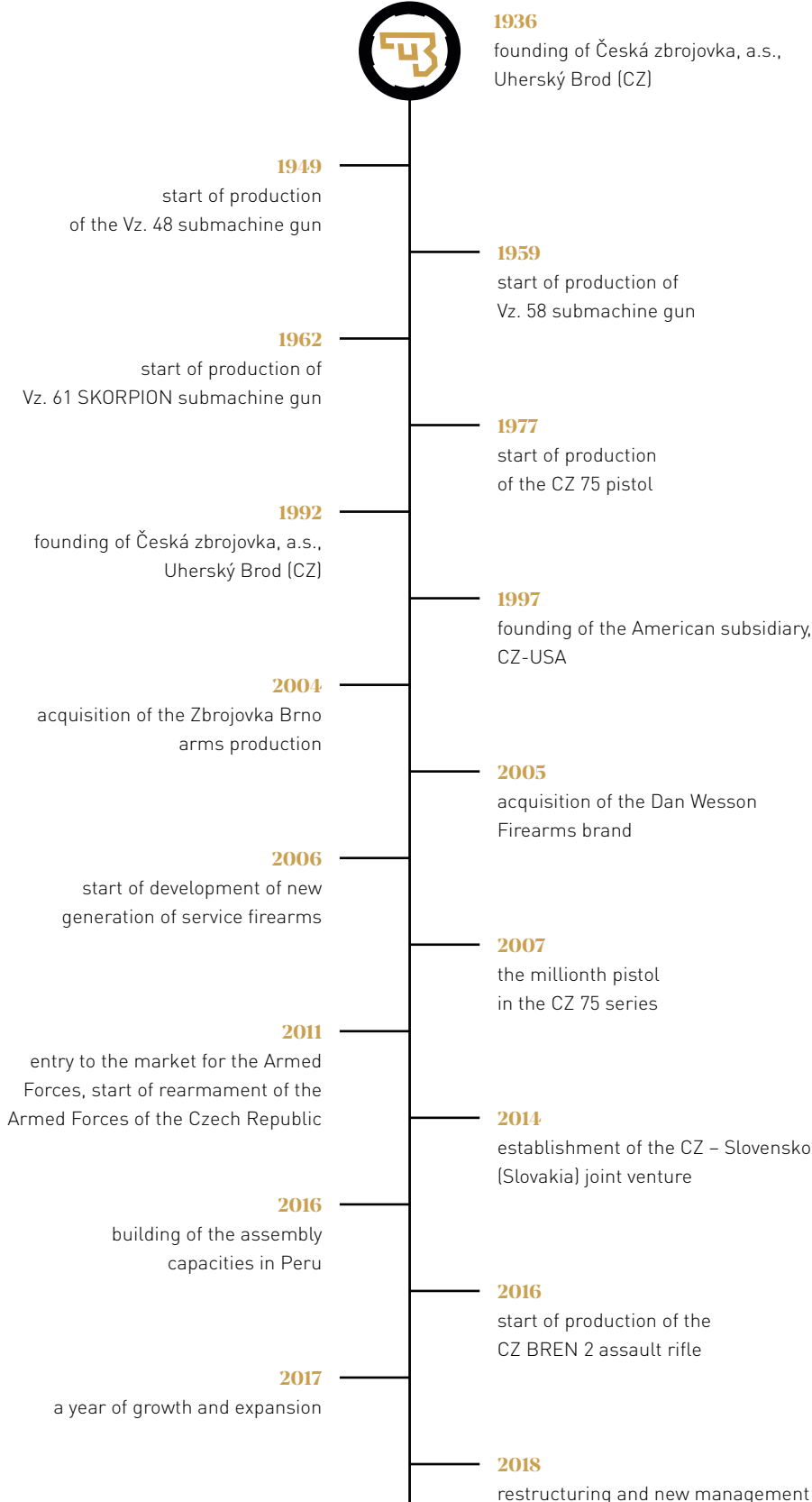
Unlike most of its rivals, CZ's comprehensive portfolio includes an extensive range of tactical equipment for the Armed Forces, as well as other customers. These include uniforms, backpacks and ballistic protection items, supplied under the CZ 4M brand, which have become very popular and are creating more and more satisfied customers and fans of the brand. The latest products from CZ 4M include two tactical backpacks, the FOP 35 and EXPEDITION 65, featuring a unique system of interchangeable and mutually compatible carrier segments, including an additional set for use with a ballistic vest. Backpack accessories now also include storage compartments for laptops, hydration packs and a special medical pouch for the FOP 35 model. Where combat uniforms are concerned, there is a new product line for 2018, the CZ 4M RECON, which has been developed

especially for reconnaissance units and which has undergone extensive testing by special units from the Czech Army. The CZ 4M OMEGA state-of-the-art line of Special Operations Forces' tactical uniforms now includes flame retardant coveralls in a unique design, allowing maximum freedom of movement in any situation.

Turning to the ballistic vest range, CZ's latest product is the SPIDER tactical protection vest. This is a versatile item with various different modes of use, from a tactical carry vest to a light ballistic vest with IIIA protection level, to a ballistic vest with level VI protection. All have a front zip fastening and light structure made from high strength 2D mesh. There is also an option to add a special SunFibre reflective protection element, exclusively offered by CZ for the Armed Forces.



Milestones in the History of CZ

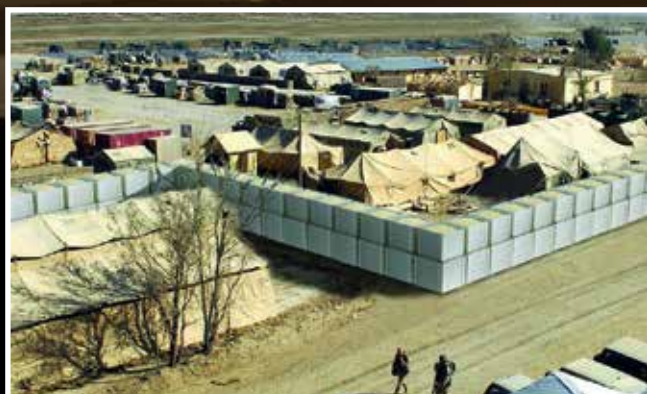




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Country Focus: France



New Technologies for Field Camps

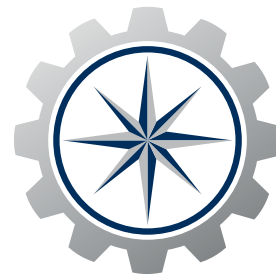


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Washington Has Made Its Decision



Those who believed that the military victory over the Islamic State (IS) would mean the beginnings of peace in the Middle East have been proven wrong. All sides have waged war on the would-be caliphate – even those who did not consider themselves allies, or only as partial allies: the Assad regime, Russia and Iran, Americans and Europeans, Kurds, Qataris and Saudis. Each had similar motives for preventing a terrorist organisation with state-like structures from establishing itself with territory. Now that their objective has been largely achieved, a fundamental clash of interests between the powers active in the region, both domestic and foreign, has once again come to the fore.

Complex as the situation as a whole may be, a major line of conflict can easily be identified. Iran has steadily expanded its influence in the region, despite the fact that it was put into quarantine for years. In Syria it supports the Assad regime. Its allies in Lebanon and Syria make up a significant part of their countries' domestic policy. It can afford to let the Palestinian Hamas play with fire on the Gaza Strip. It is even trying to gain a foothold in the Arabian Peninsula by ensnaring potential partners and attempting to curry favour by acting as a protective partner of Shiite minorities. Under the same pretext, it supports the Houthi insurgency in Yemen.

Saudi Arabia and Israel have decided to contain this influence – and to force it back. Now they have the USA on their side. Washington no longer wants to stoop to the level of the Europeans, who like to bask in their role of supposedly impartial mediator, but whose services don't seem to be of any use to anyone. The USA has made a decision as to who is its friend, and who is its foe. By moving its embassy from Tel Aviv to Jerusalem, it has adopted the Israeli position. Though this was nothing more than delivering on an ancient promise and a symbolic policy, it inevitably caused hysterical reactions and led to riots that claimed a number of victims. The US decision to unilaterally terminate the nuclear agreement with Iran, signed in 2015 after years of negotiations, carries far more significance.

There are good reasons for this decision. Inspections of Iran's compliance with the agreement are limited to facilities that were known at the time, and therefore subject

to the negotiations. But it is not possible to carry out random checks on whether nuclear programmes are being pursued elsewhere in Iran, for example in the Revolutionary Guard. Reintegration into the global economy following the lifting of sanctions strengthened the economic potential of the Mullah regime and enabled it to advance its rearmament policy. Progress in the development of high-capacity medium-range missiles, which could become carrier systems for nuclear warheads, raises doubts about the country's true intentions. This puts Europe in danger as well as Israel, as the latter continues to face ugly threats of complete destruction from Iran.

The USA do not want to continue to give Iran the possibility of economic growth that would allow it to continue its nuclear programme with even greater financial resources. What they are now demanding from the regime in Tehran, however, is no more and no less than unconditional surrender, which usually happens at the end of a lost war and involves a change of regime. Of course, Washington's maximalist demands may be dismissed as rhetoric, marking only the starting point for renegotiation. In this case the military attacks against Iranian forces in Syria would be seen as nothing more than a way for the USA and its allies to demonstrate their resolve. In any case, the risk of escalation cannot be ruled out, and the markets are already preparing. The war against the Islamic State has hardly had any effect on the oil market. The way in which the USA, Israel and Saudi Arabia have positioned themselves against Iran has driven the price of oil to levels that have not been seen in a long time. This benefits those countries whose prosperity depends significantly on the export of oil, such as Saudi Arabia and even Russia. This is likely to result in minimal interest in defusing tensions on their part. Europeans have a vested interest, but they are the weaker negotiating partners at the table. No European company will do business with Iranian partners if this would have serious consequences for the US market. If EU foreign policy leaders are adamant they want to remain in the nuclear deal, they will not be able to escape the pull of US sanctions.

Peter Bossdorf

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■ Cooling Systems for the Royal Navy

(ck) AERIUS Marine has received an order to support Babcock International within the framework of the Marine Systems Support Partnership (MSSP) with its air conditioning and refrigeration expertise. Babcock offers services to the British Ministry of Defence for both the new Queen Elizabeth class aircraft carriers and Type 45 destroyers.

The MSSP programme is divided into four lots. As the System Technical Authority (STA), Babcock offers technical and design support, configuration control, inventory management and operational consulting across all lots. For lot 2 (Environmental, Domestic and Habitability) AERIUS Marine will take over technical responsibility for air conditioning and refrigeration technology for both ship classes. AERIUS Marine has contributed its expertise in the development, manufacture and operation of these systems to the design of the Queen Elizabeth class aircraft carriers. With the new Babcock order, AERIUS Marine will provide technical expertise for the configuration of the air conditioning and refrigeration systems and will be responsible for the design and implementation of the new systems to ensure consistency throughout the life cycle of the ship, and to work with component manufacturers in the development and implementation of upgrades.

AERIUS Marine is a developer of marine air conditioning solutions including NBC protection and is also active in refrigeration. Its focus is on the construction of new passenger and naval vessels and the maintenance of air conditioning systems over the entire life cycle of a ship. AERIUS Marine, headquartered in Hamburg, is currently represented in Germany, the United Kingdom, France, India and Australia and employs around 400 people.

■ Manned-Unmanned Teaming

(ck) Manned-Unmanned Teaming (MUM-T) can multiply the capabilities of both systems. Smaller UAS with vertical take-off and landing capabilities can, for example, fly closer to obstacles such as trees or buildings than a helicopter can: they are able to explore unknown territory and deliver information to the helicopter crew which is operating from a safe position and which can then step in with the helicopter's superior effects, having received a clear picture from the UAS. For demonstration purposes, Airbus Helicopters and Schiebel have tested MUM-T capabilities between an H145 platform and a CAMCOPTER S-100



Photo: Airbus Helicopters

Unmanned Air System (UAS), thus becoming the first European helicopter manufacturer to demonstrate this technology with the highest level of interoperability (LOI⁵). The two companies carried out test flights with the support of the Austrian Armaments and Defence Technology Agency, and the two aircraft together flew different scenarios including the detection of objects hidden in places inaccessible to helicopters. The S-100 was controlled and piloted by an operator in the helicopter. During the flights control was temporarily handed over by the pilot to a ground-based control station, in order to simulate the return of the manned helicopter for refuelling. The trials went up to MUM-T LOI 5, which allows the manned platform to exercise full control of the UAS including take-off and landing. LOI 1, the lowest level, is the indirect receipt and /or transmission of sensor data obtained by the UAS to the manned aircraft. The MUM-T capability can be implemented in the NH90, NFH, and the TIGER helicopters, and can interact with all types of unmanned systems, including Airbus Helicopters' new VSR 700 UAS.

■ Japan to Buy H225

(ck) Airbus Helicopters has received another order from the Japanese Coast Guard (JCG) for an H225 helicopter, increasing the JCG's H225 fleet to ten units. The JCG currently operates three AS332s and five H225s, both from the SUPER PUMA family. With this new order, the JCG SUPER PUMA fleet



Photo: Airbus

will grow to 13 units by March 2021 and it will become the largest SUPER PUMA operator in Japan. The new H225 will support the fleet in enforcing safety regulations, in territorial coastal activities and in disaster operations in Japan. The 11-tonne H225 twin turbine helicopter is the latest member of the SUPER PUMA family from Airbus Helicopters. It can carry up to 19 passen-

gers. Equipped with modern electronics and the 4-axis autopilot system, the H225 offers excellent endurance and high cruising speed and can be equipped with different role-specific features. 21 helicopters of the SUPER PUMA family are currently used by civilian operators and the Japanese Ministry of Defence for various search and rescue missions, offshore operations, VIP transport, fire fighting, and passenger and freight transport.

■ New Rocket Launcher System Introduced

(ck) Arnold Defense, a US-based manufacturer of 2.75-inch rocket launchers, introduced its FLETCHER 2.75-inch/70mm weapon system at SOFEX 2018. The system will be available in late 2018. Arnold Defense has manufactured more than 1.1 million 2.75-inch rocket launchers since



Photo: Arnold Defense

1961 for the US armed forces and many NATO customers. They claim to be the world's largest supplier of rocket launchers for military aircraft, vessels and vehicles. Core products include the 7-round M260 and 19-round M261, commonly used on helicopters; the thermal-coated 7-round LAU-68 variant and LAU-61 Digital Rocket Launcher used by the US Navy and Marines; and the 7-round LAU-131 and SUU-25 flare dispenser used by the US Air Force, and worldwide.

Current rocket launchers from Arnold Defense include the ultra-light LWL-12 that weighs just 27 kg. empty and the new FLETCHER 4-round launcher. Arnold Defense designs and manufactures various rocket launchers that can be customised for any capacity or form factor for platforms in the air, on the ground or at sea.

Arnold Defense applies extensive testing, calibration and inspection processes, and earned the prestigious ISO-9001-2015 certification from the International Organization for Standardization in Quality Management, achieving annual recertification since 2003. Located just south of St. Louis, Missouri, the company manufactures thousands of rocket launchers annually and earned the "Small Business of the Year" award from Lockheed Martin in 2013.

Traditionally, 2.75-inch rocket systems have been used as an area suppression weapon, ordinarily deployed by both fixed- and rotary-wing aviation assets, but by using laser guided rocket technology FLETCHER can meet the demands of land-based, vehicle-mounted and dismounted asymmetric warfare.

■ Solid Fuel Blocks

(ck) Warm food raises a soldier's morale, energy and concentration levels. Unfortunately, for far too long soldiers were also unknowingly inhaling toxic fumes each time they used hexamine fuel tablets to



Photo: BCB International

cook their food in the field. The UK-based survival equipment manufacturer BCB International has developed a safer and cleaner alternative: a solid bio-ethanol fuel

called FIREDRAGON. It is made from sustainable natural ingredients, is non-toxic, burns cleanly and can be ignited even when wet. The UK MoD has contracted BCB International to replace traditional hexamine fuel tablets with FIREDRAGON and to supply Operational Ration Heaters (ORH) consisting of stoves and associated fuel to the UK Armed Forces. ORH is used to boil water for preparing hot drinks and heating pouched meals within the Operational Ration Packs (ORP). The fuel is supplied with a small lightweight cooker which can be packaged with 3 FIREDRAGON fuel blocks.

■ Enhanced Network Capability for UAVs

(ck) Curtiss-Wright's Defence Solutions division has introduced a SWaP-optimised solution for adding dual Gigabit Ethernet (GbE) interfaces to its PARVUS DuraCOR and DuraWORX mission computers, in order to support in-platform LAN connectivity. The PARVUS mNIC-210 Mini-PCI Express (mPCIe) GbE Network Interface Card (NIC) is the first compliant mPCIe module designed to support dual GbE interfaces. The small form factor (SFF) module delivers the

network capabilities of two mini-PCIe NIC modules in a single slot, and the card conforms to the miniature mPCIe physical form factor while featuring Intel I210 network interfaces and on-board Ethernet magnetics. The very small PARVUS mNIC-210 is designed for use as a network control module in systems deployed on-board unmanned vehicles, helicopters and ground vehicles. It is designed for optimal performance in harsh environments and across a wide temperature range of -40 to +85°C. It is shock and vibration rated to MIL-STD-810G. For airborne applications the module supports operation at altitudes up to 18,288 metres.

■ Centigon Armour for Dutch Trucks

(ck) Following an international tender won by the Swedish manufacturer Scania, more than 2,000 trucks will be built and delivered to the Defence Materiel Organisation (DMO) of the Netherlands' Ministry of Defence. Centigon, a subsidiary of Centigon Security Group, a provider of civil and military armoured vehicles, was contracted by Scania to manufacture 185 armoured cabins with an option for 400 additional units

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for The Netherlands' Ministry of Defence. Centigon produces all types of protected vehicles: cash-in-transit, civil and military. Centigon vehicles offer protection against multiple threats (handgun, assault rifle, piercing weapons and blast): their armoured cabins are designed to withstand the various threats during missions. Armoured cabin deliveries to Scania will begin in 2020, and the ten-year framework contract also includes a suite of support services: integrated logistics (ILS); maintenance and repair (MCO); spare parts provisioning; and training.

■ New Drone and Land Target Detection Radars

(ck) FLIR Systems has developed three products for use by armed forces and government agencies including border patrol agents: two FLIR RANGER mid-range panel radars, one with airborne drone and ground target detection, and the RECON V ULTRALITE thermal monocular. The products are part of FLIR's SOLDIER SOLUTIONS family. The FLIR RANGER R8SS-3D and R8SS radars offer mid-range detection capability for both fixed-based installation and forward-deployed operations personnel. The R8SS-3D detects both land and air objects, such as micro-drones, and differentiates birds from drones. The RANGER R8SS-3D reports the altitude and location of small drones at ranges up to 2 miles and can also detect vehicles and people. Both the R8SS-3D and the R8SS can detect over 500 threats and their exact locations simultaneously, and work within an existing data network. The R8SS series mount to either a vehicle, surveillance tower, or tripod, and allow for full 360-degree surveillance, ensuring that threats within range are detected. The FLIR RECON V ULTRALITE is a thermal monocular. Weighing 1.4 kg, it can be used as a handheld device or mounted to a tripod or other fixed location. The system also has Android Tactical Assault Kit (ATAK) network capabilities to provide warfighters with real-time understanding of what is going on around them. The RECON V ULTRALITE uses commercial AA batteries and provides up to 4 hours of continuous use.

■ New Marksmanship Training System

(ck) Belgium-based FN Herstal, a leading firearms manufacturer, has just presented its new product, the marksmanship training system FN EXPERT. Designed and developed by Noptel, an FN Herstal subsidiary that specialises in electro-optic systems, FN EXPERT is a marksmanship trainer that



Photo: FN Herstal

can be attached to rifles and carbines to provide dry, blank and live fire training. Frequently, target practice is made difficult by a lack of shooting ranges, weapons and ammunition, and a limited number of instructors. By using a representative (airsoft) weapon or the shooter's own duty weapon, the FN EXPERT gives instant feedback on performance and improves fundamental marksmanship skills (breathing, holding, aiming, and triggering), and develops muscle memory. It also improves instructors' coaching skills by providing objective tools to measure shooter performance. The FN EXPERT measures rifle movement just before and during triggering, shows the location of both the hit and miss, and shows and analyses the shooter's performance in a simple graphical way. The FN EXPERT can be used everywhere, indoors or outdoors, in static or dynamic scenarios.

■ New Flight Record for AVENGER

(ck) General Atomics Aeronautical Systems Inc. (GAASI) has set a new endurance record with its AVENGER Extended Range (ER) Remotely Piloted Aircraft (RPA). On 24-25 January 2018, the AVENGER ER flew a simulated reconnaissance mission lasting 23.4 hours in a Intelligence, Surveillance and Reconnaissance (ISR) configuration. This exceeded the 20 hour flight test goal and reflects a 10 hour improvement over the baseline PREDATOR C AVENGER aircraft. The AVENGER and the AVENGER ER have accumulated over 20,000 flight hours. With an increased wingspan of 76 feet, AVENGER ER extends the legacy AVENGER's endurance, and RPA provides an optimal balance of long-loiter ISR and precision-strike capability, supporting a wide array of sensors and weapons payloads to perform ISR and ground support missions. Other improvements on the AVENGER ER include increasing the maximum gross takeoff weight (MGTOGW) to 19,500 pounds, using a co-cured composite centre wing and heavyweight landing gear, as well as integrating a dual redundant, lightweight brake control capability using

a GA-ASI-developed lightweight Hybrid Linear anti-lock brake system. AVENGER ER features avionics based upon the combat-proven PREDATOR B/MQ-9 REAPER, has a 3,000-pound payload bay, and is capable of flying at over 400 knots.

■ GA-ASI to Develop MQ-9B PROTECTOR

(ck) General Atomics Aeronautical Systems Inc., (GA-ASI) has been contracted by the US Air Force Life Cycle Management Center to participate in the UK's MQ-9B PROTECTOR unmanned aircraft system programme. The Foreign Military Sales contract has a total value of US\$81M and provides for integration and component level testing for UK-specific enhancements to support the programme. GA-ASI undertook the first flight of the MQ-9B configuration two years ago, and the PROTECTOR Remotely Piloted Aircraft (RPA) has continued to meet a series of key qualification milestones. MQ-9B is the UK version of GA-ASI's MQ-9 PREDATOR B product line.



Photo: GA-ASI

Its development is the result of a five-year, company-funded effort to deliver an RPA that can meet the airworthiness certification requirements of various military and civil authorities, including the UK Military Airworthiness Authority (MAA) and the US FAA. MQ-9B is the latest version of the multi-mission PREDATOR B fleet. GA-ASI named its baseline MQ-9B SKYGUARDIAN, and the maritime surveillance variant is SEAGUARDIAN. A weaponised variant of the system is being acquired by the Royal Air Force (RAF) under the UK's MQ-9B PROTECTOR programme. The MQ-9B PROTECTOR will fly in excess of 40 hours at airspeeds up to 210 knots, will reach altitudes of more than 40,000 feet, and can carry 2159 kg of external payload.

■ Invisible Passive Radar

(ck) At the International Aerospace Exhibition (ILA) in Berlin HENSOLDT, a German sensor manufacturer, presented its passive radar system TwInvis. The product name "TwInvis" is made up from "twin" + "invisible", as neither TwInvis itself nor the targets to be detected emit any signals on their own, which means that they are "invisible".

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TwlInvis can be integrated into an all-terrain vehicle or a van. It does not emit its own signals to monitor air traffic, but passively analyses the echoes of signals from radio or TV stations. In doing so, the highly sensitive digital receivers of a single TwlInvis system can monitor up to 200 aircraft in 3D within a radius of 250 kilometres. Working as mere receivers, passive radar systems detect aircraft by analysing the signals that they reflect from existing third-party emissions. TwlInvis delivers a precise picture of the airspace covered by simultaneously analysing a large number of frequency bands.



Photo: HENSOLDT

In civil applications, passive radar systems make cost-effective air traffic control possible without any additional emissions and without using transmission frequencies, which are in short supply. In military applications the system enables wide-area surveillance using networked receivers, while offering the advantage that passive radar systems cannot be located by the enemy. Two TwlInvis demonstrators have been delivered to potential customers in Europe.

■ Tac4G Communication System for UAVs

(ck) Israel Aerospace Industries (IAI) recently won several new contracts for Tac4G, a tactical communication system, to which IAI has added several new capabilities, including Tac4G's integration in tactical UAVs and additional platforms. The communication system has been developed by ELTA, IAI's Intelligence and Reconnaissance Division. Tac4G is an LTE (Long term



Photo: IAI

Evolution), broadband tactical communication system designed for armies, law enforcement, border control and paramilitary applications. It provides robust and secure communication independ-

ent of local operators. In addition, it is capable of transmitting high-volume video broadcasts to and from tactical forces in order to provide them with the necessary intelligence and achieve high situational awareness. Tac4G connects end-users, sensors and weapon systems in a unified manner into an independent, versatile network and allows the connection of tactical UAVs to the communication network and its embedding in UAVs, drones and other platforms. Integration became possible through reduced weight and power consumption.

■ New Submarine Rescue System

(ck) JFD is an underwater capability provider offering diving, submarine and hyperbaric rescue, submarine escape training, defence diving equipment and saturation diving systems, technical solutions and services. The company has delivered a new AUS\$19.7M submarine rescue system to the Royal Australian Navy (RAN), comprising a hyperbaric equipment suite and a transfer-under-pressure chamber. The equipment delivered means up to 86 people can receive life-saving medical treatment in the hyperbaric equipment suite and pressurised transfer chamber at any one time. "Given that a Collins-class submarine usually has a crew of 48, the increase in capability represents a significant evolution of submarine rescue services in Australia, to the point where the new system is the safest ever seen in



Photo: JFD

Australia," said Toff Idrus, General Manager of JFD Australia. The new hyperbaric equipment suite helps submariners rescued from a disabled submarine to overcome the life-threatening effects of being rescued in deep water. It is also the final step during a submarine rescue, which begins with rescuing the crew from the disabled submarine into a free-swimming rescue vehicle, carrying them to the surface and safely on to the deck of a rescue ship. From here, the submariners are moved through the transfer-under-pressure chamber, with doctors on hand to monitor their wellbeing as they

move into the hyperbaric equipment suite for further recovery.

■ Kent Periscopes for Malaysian Army

(ck) Kent Periscopes is a UK based supplier of unity vision periscopes, vehicle sights and related equipment for military armoured fighting vehicles, tanks and armoured personnel carriers. The company's unity vision periscope is a family of Embedded Image



Photo: Kent Periscopes

Periscopes (EIPs) designed to give AFV drivers enhanced capability whilst driving during the day or night. Current Driver Night Vision Systems (DNVS) will use a unity vision periscope for day driving when the hatch is down and will then revert to a separate screen to show images from vehicle-mounted sensors. This separate screen is sometimes clipped on to the unity vision periscope or mounted somewhere near, but not always in a location that is easy for the driver to use. The Kent Periscopes EIP system is a self-contained unit that permits a view of the outside world through a standard unity vision 'hard glass' periscope, or through a sensor suite where the images are relayed onto an embedded LCD that is hidden behind the unity vision mirror, which folds out of the way with one simple operation of a lever. There is therefore no requirement for a separate screen and associated electrical harness. The system has now entered service with the Malaysian Army.

■ FAST ROPES for Special Forces

(ck) Marlow Ropes, a UK-based producer of fibre ropes, includes the FAST ROPES range in its defence portfolio: the FAST ROPES range is used by special forces around the world. Fast Roping is a technique used for deploying troops from a helicopter in places where the helicopter cannot touch down. Fast Roping can be a hazardous operation, particularly if the person is carrying a heavy load.

Historically, wire ropes have been used for many applications requiring strength, but replacing ropes made from steel with those made from fibres holds many advan-



Photo: Marlow Ropes

tages. At 60% of its breaking load, steel wire reaches its yield point; beyond this point steel wire becomes permanently deformed. Unlike steel wire, synthetic fibre does not have a yield point. Winch lines will not be

damaged and there will be no change in the strength of the rope; in many applications this has been a critical factor when calculating working loads. Synthetic fibre ropes are eight times lighter than steel wire for a given strength and 35% stronger than wire for a given diameter. There are no hazardous wire splinters in synthetic fibre ropes and no yield point with synthetic fibre rope. Moreover, synthetic fibres float, and there is no strength loss when synthetic fibre ropes overlap on winch drums.

The construction of the Marlow FAST ROPE allows comfortable control throughout the descent and makes it easier to slow down and brake. The suppleness of the material means that the rope is not hard on the hands, as less force is required than with other ropes. Oil and general spillage do not affect the speed of descent as Marlow FAST ROPES absorb liquids.

The FAST ROPE range includes insertion and extraction systems for rapid deployment and retrieval, reducing risk to helicopters and personnel. Also available is a range of accessories, including the FAST ROPE QRM (quick release mechanism) which is designed for the release of fast ropes in case of emergency.

■ CAMM Completes Qualification Trials

(ck) MBDA and Lockheed Martin have jointly completed qualification of MBDA's Common Anti-air Modular Missile (CAMM) from Lockheed Martin's Extensible Launching System (ExLS) 3-Cell Stand Alone Launcher, following a series of trials. The latest trials from 3-cell

ExLS were successfully completed in the United Kingdom at the end of 2017.

CAMM is a compact missile that enables multiple warheads to be fitted in limited spaces. A modern air defence missile, it has recently completed a successful series of firings by the Royal Navy. ExLS is a low-cost alternative for integrating new missiles and munitions into naval surface combatants, leveraging Lockheed Martin's proven Mk 41 Vertical Launching System (VLS) design and electronics. The compact vertical launch 3-cell ExLS system is designed for smaller naval platforms that are unable to accommodate the larger 8-cell MK 41 Vertical Launching System (VLS). ExLS has also been designed to fit inside the MK 41 launcher, offering flexible installation solutions for larger ships to achieve high combat mass within a small on-board footprint.

When operated from either the ExLS or the MK 41 VLS, CAMM comes in a quad-pack arrangement which allows storage and launch of 4 missiles from a single cell.



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■ F21 Torpedo Launched From Nuclear Submarine

(ck) Naval Group has successfully launched an F21 torpedo as part of the Artémis programme led by the French Defence Procurement Agency (Direction Générale de



Photo: Naval Group

l'Armement, DGA). The DGA aims to equip all French submarines with this heavy torpedo. The launch was performed in early May 2018 from a nuclear-powered attack submarine (SSN) as part of the F21 qualification process. The F21 used for the test was identical to the combat torpedo currently under production, of which several tens of units will be delivered to the French Navy as of 2019. The launch was performed according to plan, and communication with the launcher was operational throughout the exercise. The objective of the Artemis F21 Torpedo programme is to replace the F17 with a new, more agile and faster torpedo. The F21 heavy torpedo is designed to neutralise enemy ships and submarines. With exceptional range and speed, the F21 torpedo is planned to operate in both blue water and littoral environments. Its high computing power gives the F21 exceptional real-time processing capabilities and the torpedo benefits from an advanced mission system and increased autonomy. The contract includes the development and delivery of one hundred F21 torpedoes as well as their integration into French submarines. The Brazilian Navy has also selected the F21 to equip its submarines.

■ Russian Unmanned Helicopter Tested

(ck) VR Technologies Design Bureau, a subsidiary of Russian Helicopters, has started testing the main systems of the VRT300 unmanned helicopter: flight testing is scheduled for late 2018. Russian companies and authorities have specified the functional and technical requirements of the civilian unmanned helicopter. These requirements are the basis for the prototype with an MTOW of 300 kg which is a flying testbed for all UAV systems and for testing the interaction with payload ele-

ments and ground-based monitoring and control devices. VRT300's technical solutions ensure the trouble-free operation and security required in the international market for civil UAVs. The VRT300 system has been developed in two versions: ARTIC SUPERVISION with a side-looking radar for reconnaissance and operation under arctic conditions, and OPTIC VISION with increased flight range for surveillance and remote sensing missions. The main tasks of VRT300 ARTIC SUPERVISION are to expand the transport infrastructure of the North Sea route and to support the exploration of the Arctic region. For this purpose, the UAV has been equipped with a high-resolution on-board radar, which enables a quick assessment of icefield dynamics. A heavy oil engine and shipboard capabilities make the Arctic version of the VRT300 irreplaceable for icebreakers and drilling platforms. Due to its payload of 70 kg, the aircraft can transport cargoes such as food and medical supplies. It can also participate in SAR



Photo: Russian Helicopters

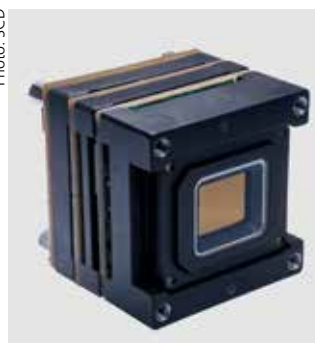
operations. The OPTIC VISION configuration was developed to prevent and assist in emergency situations; other tasks include overhead line diagnostics, mapping, freight transport, exploration and environmental and road infrastructure monitoring.

■ Replacement for Gen2 Image Intensifiers

(ck) Semi Conductor Devices (SCD), a manufacturer of infrared detectors and high-power laser diodes, will present its SWIR Imager (SWIRi) Video Core at EUROSA-TORY 2018. SCD offers a range of off-the-shelf and custom-designed detectors and laser diodes which are typically applied in IR seekers, thermal imagers, smart munitions, night vision systems, machine vision systems, laser rangefinders and laser designators. SCD's detectors are designed for the entire IR spectrum – NIR, SWIR, MWIR, and LWIR. The SWIRi is a low SWaP, 15µm, high sensitivity InGaAs SWIR (Short Wave InfraRed) Video Core Imager that has been designed to be a Low Light Level Sensor in man-portable and handheld devices for Driver's Vision Enhancement (DVE) systems, night vision goggles and handheld bin-

oculars. It comes with SCD's low SWaP-C detector package and an SCD SNIR ROIC. "The technology of previous-generation image intensifiers is mostly outdated, analogue, with limited performance, and cannot be integrated with advanced Command & Control and image fusion technology," says Dan Slasky, SCD CEO. "Our new SWIR Imager meets this need. We have developed dedicated algorithms to meet the requirements of low light night vision, leveraging "Night Glow" phenomena to provide high performance, even in conditions of moonless nights and adverse weather.

Photo: SCD



■ New Sensor for CAMCOPTER

(ck) Schiebel and Overwatch Imaging have successfully integrated PT-8 OCEANWATCH, a small target detection payload, on the CAMCOPTER S-100 UAS. The PT-8 OCEANWATCH delivers an image-based, wide area, maritime search capability that extends the coverage area and makes the CAMCOPTER S-100 a more powerful naval patrol solution. OCEANWATCH autonomously detects small targets on the ocean surface, solving the challenge of searching for small objects over vast areas and outperforming conventional cameras that face insurmountably large areas when zoomed in and invisible tar-



Photo: Schiebel

gets when zoomed out. OCEANWATCH is well-suited for intelligence, surveillance and reconnaissance (ISR) missions, SAR and anti-piracy. "OCEANWATCH is optimised for higher operating altitudes and longer ranges than other system and provides positive identification at market leading ranges when combined with a Wescam MX-10. And the camera never blinks, takes a break or gets distracted," says Greg Davis, founder of Overwatch Imaging.

■ Secure Smartphone for RESTRICTED Information

(ck) Smartphones operate in an environment where data security is put to the test. Under the guidance of the Dutch National Communications Security Agency (NL-NC-SA), IT and cyber security company Sectra has developed the SPECTRA TIGER/R encrypted smartphone, which has been approved by the European Union (EU) for communicating information at the RESTRICTED (RESTREINT UE/EU RESTRICTED) security level. The device provides EU agencies' officials with a modern mobile platform that gives them easy and secure access to highly confidential information when needed. The EU is the latest organisation, after NATO and NL-NC-SA, to approve the SPECTRA TIGER/R. RESTRICTED approvals from these agencies and other national safety authorities allow a large group of users to use mobile technology. SPECTRA TIGER/R

Photo: Sectra



is based on the Samsung Knox platform and can be installed on the latest Samsung smartphones or tablets without device customisation. In addition to encrypted voice and messages at the RESTRICTED level, e-mails, calendars and other internal applications can be used securely for unclassified or sensitive information because data traffic is protected by Sectra's mobile VPN. SPECTRA TIGER/R gives users the flexibility to adjust their device usage policies to strike the right balance between ease of use and security. In addition, SPECTRA TIGER/R can be used for calls to Sectra's TIGER solutions, which are approved at the much higher security level of SECRET.

■ Sikorsky Begins Deliveries to US Marine Corps

(ck) Sikorsky recently delivered the first CH-53 KING STALLION helicopter to the US Marine Corps (USMC), the first of an expected 200 helicopters for the USMC fleet, which will be stationed at Marine Corps Air Station New River in Jacksonville, North Carolina. The CH-53K is a new build replacement for the USMC's ageing CH-53E SUPER STALLION fleet which entered service in 1981. The CH-53K can lift three times the external load of its predecessor. At New River the helicopter enters the Supportability Test Plan: the USMC will conduct



Photo: Sikorsky

a logistics assessment on the maintenance, sustainment and overall aviation logistics support of the KING STALLION, which will also validate maintenance procedures, with USMC maintainers conducting hands-on care/upkeep of the aircraft. The Supportability Test Plan will ensure support on the flightline when CH-53K helicopters enter into service with the USMC. Sikorsky will deliver its second CH-53K helicopter to the USMC in early 2019. The CH-53K test programme recently completed the following milestones: maximum weight single-point cargo hook sling load of 16,329 kg; forward flight speed of over 200 knots; 60 degrees angle of bank turns; altitude of 18,500 feet mean sea level (MSL); 12-degree slope landings and takeoffs; external load auto-jettison; and gunfire testing.

■ 25 Years of TACTICOS

(Hans Karr) To mark the 25th anniversary of the TACTICOS combat management system (CMS) Thales Nederland invited media representatives to the company's headquarters in Hengelo, The Netherlands, on 5 April 2018. Developed in the early 1990s as an integrated and automated CMS for surface combatants, TACTICOS is able to handle all mission requirements of modern naval

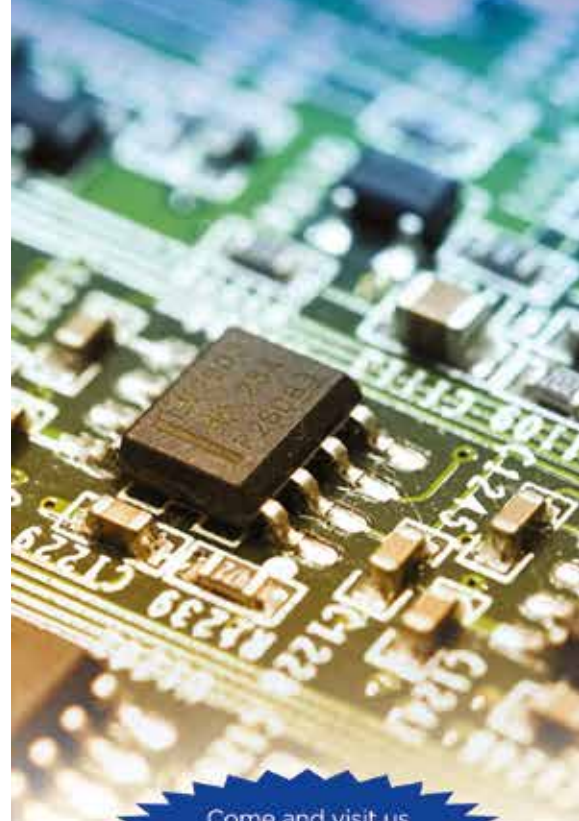


Photo: Thales Nederland

warfare, from engagement against pirates, asymmetric threats and conventional naval warfare scenarios through to ballistic missile defence. Various interfaces enable the integration of sensors, weapons and communication tools. Thales also offers dedicated mission packages, such as anti-air warfare clusters, fire control clusters and tactical data links. TACTICOS features include the processing of large information packages, a high level of automation, multi-sensor data fusion, threat assessment, sensor and



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weapon assignment, command support and on-board training and simulation. TACTICOS can track more than 1,000 targets simultaneously: for internal data traffic the system's data bus allows the processing of 4,000 signals per second; TACTICOS has 2,200 applications running on 150 processors. During its 25 years of existence TACTICOS has been subject to continued development, including evolutionary updates based on COTS standards. At present, TACTICOS is in service on some 180 ships with 24 navies. Recent sales include the Egyptian Navy's F 911 class frigate ALEXANDRIA (ex-MUBARAK, ex-COPELAND, OLIVER HAZARD PERRY class) as well as deliveries to an undisclosed customer. Among others, TACTICOS BL2 has been offered for the German Navy's new MKS 180 surface combatants. TACTICOS is an open-architecture, scalable and modular combat management system capable of handling mission profiles for various surface vessels, ranging from patrol boats to frigates and destroyers.

■ Datron Launches New Handheld Radio

(ck) Datron World Communications has introduced its new ruggedised tactical handheld radio, the multi-band SPECTRE M HH3100. With the addition of the HH3100 Series to the SPECTRE family of tactical radios, secure and flexible network communications operating over the 30-512 MHz bands are now extended to dismounted soldiers across the theatre of operations. The HH3100 features embedded ECCM,



Photo: Datron

COMSEC (AES-256), and GPS capabilities and meets MIL-STD-810G for operation in harsh environments. Position and time-of-day capability are afforded by the embedded GPS receiver, while frequency hopping and digital encryption waveforms offer a high level of jamming resistance and security. Extended frequency range and AM ground-to-air enables the user to effectively communicate with different

support groups for efficient battleground coordination. "The HH3100 provides our customers with increased frequency bands in a simple to use and rugged form factor that is designed for use in the harshest of environments," said Art Barter, CEO of Datron. "It addresses today's most pressing battlefield needs with a full range of embedded features, and is fully compatible with all encryption and hopping modes in our SPECTRE V family of products." The radios are backwards-compatible with legacy models from Datron's range. The HH3100 has been ergonomically designed, with dual push-to-talk (PTT) operation and with the antenna positioned in the centre of the radio for improved balance.

■ Airport Surveillance Radars for Canada

(ck) With the Site Acceptance Test (SAT) for the last unit in Greenwood, Nova Scotia, HENSOLDT has equipped a total of six military airfields in Canada with modern Airport Surveillance Radars (ASR). A training system has also been installed in Canada, completing the installation phase for the



Photo: Hensoldt

€50M contract awarded to HENSOLDT in 2013. The programme included the delivery of seven radar systems and two spare parts packages. The ASR radars each consist of an integrated primary and secondary radar system. The primary radar helps to detect non-cooperative objects such as small aircraft without transponders or enemy aircraft. It is based on a semiconductor transmitter and includes special signal processing techniques for wide area surveillance and wind farm mitigation. The secondary radar, MSSR 2000 I, enables the automatic identification of cooperative aircraft. It complies with the new Mode S/Mode 5 standard of air traffic control, which significantly improves aircraft identification queries and is currently being introduced in all NATO and allied armed forces. HENSOLDT supplies air traffic control and identification systems for military and civil applications to customers all over the world. Among other things, the company has equipped the German Armed Forces' airfields with the ASR-S (Airport Surveillance Radar, S-

Band) and supplies a complete approach control system for military airfields in Switzerland. Different versions of the new ASR-NG radar are under contract with Australia and the United Kingdom. The MSSR 2000 I secondary radar is used by the naval forces of Germany, France, Norway and Finland for military friend / enemy detection.

■ T-84 Tanks on Exercise JOINT RESOLVE X

(ck) In the practical phase of the Combined Resolve X exercises on Hohenfels training ground, T-84 tanks have proven their combat effectiveness. The Ukrainian airborne unit 79 AABr and the armoured unit 14 SMBr conducted a march, clashing several times with a hypothetical attacker and being ambushed. "During the clashes, several enemy ABRAMS tanks were taken out. Without significant losses, the subunit of Ukraine's armed forces managed to reach its destination," the Ukrainian Ministry of Defence reported on the exercises. During the exercise, the MILES modern integrated laser system was used to simulate the battle. The T-84 tanks were modernised this year by UKROBORONPROM's Malyshev plant and the Kharkiv engineering bureau, where specialists tested many components and replaced the electronic systems, installed secure digital radios and modernised the tanks' sights. The Ukraine's armed forces are armed with T-84 tanks with a 125mm autoloader-equipped gun capable of firing controlled precision anti-tank missiles out to a range of approximately 5 km. The 1200 hp engine enables a T-84 tank weighing almost 50 tonnes to reach a top speed of 70 km/h. The tank is protected by modern Ukrainian active armour and complex electro-optical countermeasures.

■ Thales Rocket Launchers for MD Helicopters

(ck) Thales' FZ220 missile launcher for guided and unguided ammunition (70mm) was qualified for the latest MD light helicopter (MD530G). Qualification followed tests were conducted in March 2018 at Yuma Proving Ground (YPG), Arizona, a US Army facility. This qualification takes place while MD Helicopters are modernising the light helicopter fleets of several countries around the world, including the Malaysian Army. Low mass is of utmost importance in helicopter applications, and Thales' lightweight composite rocket launchers are 50% lighter than comparable metal rocket launchers, and have no corrosion problem. They have been specifically developed for rotary wing aircraft due to payload limitation.



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■ Deployable Counter-UAV System

(ck) Sensor solutions provider HENSOLDT has developed a compact and deployable version of its XPELLER counter-UAV system, called XPELLER RAPID. The new configuration combines a radar system,



Photo: Hensoldt

camera, radio frequency detectors, direction finders and jammers. The system can either be integrated into a vehicle or used in a transport container for rapid deployment. Thanks to sensor fusion via a software application, all UAV-relevant signals are detected and extremely short reaction times are ensured. The sensor suite can detect and identify a drone and assess its threat potential at ranges from a few hundred metres up to several kilometres. Based on real-time analysis of the control signals, a jammer then interrupts the link between drone and pilot or interferes with the drone's navigation. The modular XPELLER system allows customised solutions by combining individual devices from the product family, and a customer can select from a set of components and countermeasures.

■ VIPER Geofencing EW Manpack System

(sb) Chemring Technology Solutions has launched VIPER, a whole-mission support and information system, delivering actionable intelligence and the world's first Electronic Warfare (EW) manpack geofencing capability, at the EW Europe 2018 event in Lausanne, Switzerland. Integrated into Chemring Technology Solutions' RESOLVE EW system, VIPER's geofencing technology provides operators with pinpoint accuracy for superior target precision. Traditionally, EW operators would expect to analyse all signals, significant or not: VIPER allows them to focus on a specific area of interest, such as a valley or building, significantly reducing the time and effort required and the communications and reporting load. VIPER's path profile tools support highly targeted pre-mission planning and

real-time mission adaptation, by processing terrain height against relative radio frequency (RF) to pinpoint the optimum locations for EW data collection nodes. Automated database analysis quickly delivers relevant target insight via a user-friendly interface, enabling commanders and operators to respond faster to the evolving battlefield situation.

VIPER simplifies operations and minimises the training burden by automating many previously operator-intensive processes. Non-expert users can easily access the database storage, providing them the information they need, formatted for ease of understanding and requiring minimal interpretation. VIPER has been developed to remove the issues of complex RF-data presentation and laborious information access. For example, VIPER visualises information by overlaying a map so that the operator can quickly identify a precise target location.

Eric Herron, Regional Manager, at Chemring Technology Solutions, said: "VIPER is another market-first for us as it delivers a level of EW capability usually associated with larger systems. Developed by EW operators for EW operators, we believe that we have created the most capable and user-friendly EW manpack system, offering the next step to counter current and evolving threats. VIPER delivers a highly automated and intuitive system that requires minimal operator input, so that they do not have to wade through large amounts of data general noise on the RF spectrum, but can instead focus on genuine signals of interest to find that needle in a haystack much faster. VIPER is deployed at this year's CyberQuest exercise in the USA to show exactly this capability." CESMO and JICD compatible, VIPER can contribute to, and receive data from, coalition partners operating in the land, sea and air domains - critical for combined missions.

■ Milrem to Maintain Estonian CV90s

(ck) Milrem LCM and BAE Systems have signed a contract to support Estonia's fleet of CV9035 Infantry Fighting Vehicles (IFVs). Milrem, an Estonian provider of defence vehicle lifecycle management, will provide maintenance and repair services for CV9035 vehicles from its facilities in Estonia, which is one of seven user nations operating the

CV90 IFV. There are more than 1,280 vehicles in 15 variants in service with Denmark, Estonia, Finland, Norway, Sweden, Switzerland and The Netherlands. The first batch of IFVs arrived in Estonia in October 2016, followed by a second shipment in December 2017. This agreement is part of BAE Systems' wider contract with the Estonian government to maintain and sustain 44 CV9035 vehicles acquired from the Netherlands in 2014.

■ Protecting Military Installations from Adversarial Drones

(ck) The US Department of Defense (DoD) operates over 800 military bases worldwide which are in need of anti-drone protection. In 2017 analysts estimated market value for counter-UAS equipment to be between US\$500M to US\$1Bn annually, and poised for double digit growth. To tap that market, Dedrone, a US-based technology company for airspace security will cooperate with the Defense Innovation Unit Experimental (DIUx), a US DoD organisation focussed on accelerating commercial technologies to the US military. DIUx and DoD are experimenting with Dedrone's technology in responding to UAS threats for flight operations and airbase security. Dedrone



Photo: Dedrone

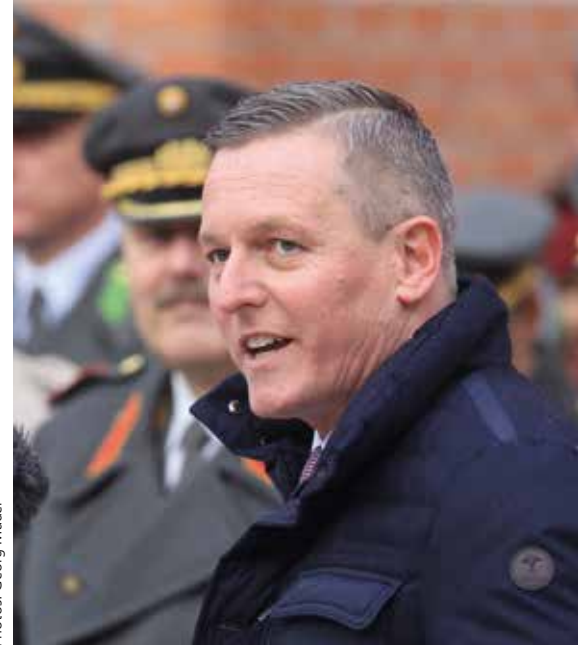
provides a commercial, off-the-shelf UAS detection system designed for integration into passive sensors, including their RF-100 and RF-300 radio frequency sensors as well as third party sensors including radar, cameras, and microphones. Dedrone's software platform, DRONETRACKER, gathers intelligence from these sensors to detect drone activity and collect forensic evidence, including the communications protocol of the drone, its flight path and the location of the pilot. Once a drone is detected, a defeat countermeasure can be automatically deployed.

“Many challenges and problems to address”

Shortly before Christmas 2017, a new centre-right government was sworn in in Vienna, supported by a clear majority of voters. This meant a clear break with the former "endless" grand coalitions with the always leading Social Democrats (SPOE), which many Austrians perceived as unwilling and boring to reform. This turnaround – to a large extent also a result of the migration crisis in 2015 – also brought a former staff NCO of the right-wing populist "blue" Freedom Party (FPÖ) into the Ministry of Defence (BMLV), who is calling for a stronger and better financed Austrian military.

Now it is up to Mario Kunasek to lead the army to new shores - and to reform once again. This must of course be done in coordination with the conservative People's Party (ÖVP) of the young Austrian Chancellor Sebastian Kurz, which, while placing national and European security policy in the foreground, is rather "apathetic" to real military issues.

One thing is already clear: Although a slightly larger annual budget is available due to the positive trend reversal under the former administration, an additional 10 billion euros would be necessary to overcome the investment backlog that has developed over the past 20 years. This can only be done with additional federal funds. This can happen after 2019,



Photos: Georg Mader

The new Austrian Minister of Defence Mario Kunasek visiting the Austrian Air Force



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Picture: GDELS

34 new PANDUR APCs from General Dynamics European Land Systems-Steyr are subject to an ongoing procurement effort by the Austrian Army. The contract includes the option for an extension of the programme.

at least according to what was agreed with the OEVP-led Ministry of Finance. Nevertheless, we are far from the 1% of GDP that was repeatedly mentioned in the 2017 election campaign.

ESD: Minister Mario Kunasek, you have had a first impression of the Austrian military in recent months. In which areas have you identified the greatest need for action?

Kunasek (briefly laughs): Oh, there are some - after many cuts and neglect in the past. For example, we have a lot of catching up to do in the area of mobility, with the equipment needed or restored to fulfill the task currently taking first place. Massive savings were also made on the infrastruc-

ture, which is why there is a great need for action. There are many challenges and problems we want to tackle, apart from a few major procurements.

ESD: For example?

Kunasek: When I visited the troops in Kosovo and Bosnia, it became clear to me that it is sometimes difficult to recruit personnel for special missions abroad. We are partly understaffed. So it will be our task to re-adjust many adjusting screws in order to increase motivation to serve abroad.

ESD: The introduction of the new PANDUR APCs and the HÄGGLUND off-road vehicles begins this summer. The replacement of the light helicopter and investments in air traffic control are also overdue. And slowly we will have to think about a successor of the LEOPARD MBT, plus investments in the infrastructure you have already mentioned. What's your first concern? Not everything can be tackled at the same time.

Kunasek: Some issues have now reached a point that cannot be postponed any longer. For the ALOUETTE III, for example, the life cycle will definitely be over by 2023, so we need to find a solution. And the introduction of this solution will soon be necessary, with an average procurement period of around three years. In consultation with the General Staff, we will also find solutions in other areas in order to be able to initiate the procurement of necessary equipment in good time.

ESD: There are parallel priorities, right? The ALOUETTE III example shows that procurement is often linked to infrastructure measures. Aigen Airbase in the Styrian Ennstal stands and falls with the helicopters stationed there.

Kunasek: As a Styrian politician, I am well aware of the critical location of

Aigen Airbase. In general, we need to analyse calmly what it needs, what has top priority and what can be realised in the years ahead. Of course we have to be careful not to lose sight of these long-time procurements. Unfortunately, many of my predecessors have done just that, which is why we are now in the situation that a lot has to happen almost at the same time.

ESD: A controversial topic will be the financing of the planned acquisitions.

Kunasek: These procurements certainly require special investment. We have great support among the population, where the importance of security was recognised earlier than at political level. Our task is to raise political awareness for these investments.

ESD: Your party and the general staff had long demanded an army budget of 1% of GDP, but at the moment you have only a little more than half of that. Are you satisfied with your budget?

Kunasek: Yes, in the sense that with this budget we can continue on our positive course. But for major investments we need special financing packages.

ESD: But most observers and budget specialists know relatively well what major investments are urgently needed, from the EUROFIGHTER Tranche-1 modernisation or the successor to the SAAB-105 to new helicopters. Wouldn't it be easier to finance this from the current budget?

Kunasek: When purchasing helicopters, for example, we cannot do without special financial packages. For a successor to the ALOUETTE III and the upgrade of the S-70 BLACK HAWK fleet alone, we will quickly reach over €300M. And we must also put together an appropriate package for modern airspace surveillance. These multi-year investments do not make sense in the daily budget. The more money we get, the better. Above all, it is important to continue on the course we have chosen in order to enable us to move forward rather than idling or reversing as in previous years. That is now guaranteed.

ESD: Your so-called lighthouse projects, which were presented at the beginning of January, should also contribute to improve the army. So how is your proposed recruit school going to look like?

Kunasek: We will start planning this year, and we want to introduce these recruit schools in 2019. The situation is similar with the other lighthouse projects presented, such as the preservation of the military



The Austrian EUROFIGHTER programme has been a contentious issue.

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high school in Vienna Neustadt, which is also included in the current government programme. And this also requires infrastructural measures. If you have a school, it should be attractive as such.

ESD: With regard to this institution: In a recent interview you said that you see it as the last kind of "school of the nation" that teaches basic skills that regular schools no longer teach. To exaggerate, there will be no math classes?

Kunasek (laughs): This quotation does not refer specifically to the recruit school, but generally to the basic military service which, thank God, we have managed to preserve and which is absolutely necessary

soldiers, but the corresponding equipment is only available four times on site.

ESD: When do you expect results for those flagship projects?

Kunasek: We expect this to happen this year, next year at the latest. For example, there are the planned sanctuaries for which the project phase is already underway, and later this year we will decide, in consultation with the General Staff, where we will set up 12 of these sanctuaries. This is an important issue, especially for the population, as I have learned time and again in personal conversations with the voters. Misunderstandings often arise here. People believe that we have huge amounts of fuel and a

future that we not only retain the scope for foreign assignments in terms of quantity, but that we can also fill the positions with talented people. We are fortunate to have these well-trained employees in general - but in some positions we have a lack of specialists. It will be our task to realise our potential on site. There is currently a lot of catching up to do and in future we will have to do more to recruit and train personnel.

ESD: In this context, a new "service law" is often mentioned. How is this law supposed to help?

Kunasek: The crucial thing is that the right to serve is a big issue throughout the army. However, this is an area which I cannot tackle alone, which requires the cooperation of the whole government and in which I hope we can produce results. It would be desirable to have an attractively designed military service law that suits our times. In the past, 20 or 30 years ago, the motto was: "You don't earn much, but you have a stable life" but has now lost its appeal in our fast-moving and changing working world.

ESD: We have saved the perennial topic for every minister of defence in recent years until the end.

Kunasek: Let me guess, EUROFIGHTER?

ESD: That's right! By the end of June, your six-member commission will examine all possible options for the future air traffic control/police which you have described as "open". Do we really have to wait for everything until summer?

Kunasek: Yes, I would ask you to await the results, because that is why we have set up the new Commission. I will not discuss this entire acquisition history in detail here, just this much: a few months have passed since the Doskozil Commission gathered new information, and it is quite clear that it is my responsibility and duty to reassess this information. We will then have a result on the table at the end of June with which we can approach the Federal Government to make a good, more cost-efficient and reassuring decision for the public and for the pilots and technicians with the highest operational performance for the benefit of the sovereign Austrian air police.

ESD: Has the Commission been given a specific objective?

Kunasek: The only goal is to lead us into a more cost-efficient future than in the past and at the same time "fly better" than today. This is a major challenge which I am aware of but which I must accept in order to ensure efficient airspace surveillance. As far as the wording "open" is concerned,



Kunasek at a troop visit with Karl Gruber, Commander Austrian Air Force

in times like these - for military service on the one hand, but also - and this was meant by the quotation - to convey to young people certain values which perhaps do not exist anymore, such as punctuality, order and sense of duty. Last but not least, recruit schools should make training more efficient.

ESD: In what way?

Kunasek: For example, we are striving for infrastructural "mergers" and effects with the facilities in order to keep the currently often long arrival and departure times as short as possible. Valuable training time is lost, commuting is also stressful. It will be important that we have the appropriate equipment on site. From my own experience I know that the training value decreases when you have to equip about ten

sustainable supply for a longer period of time. But in reality, we do not have that anymore. That is why we are now in the process of repairing this malus - from our annual budget. In times of crisis or disaster, the safety islands should be sanctuaries for our personnel and the population. This means creating and maintaining an independent energy and water supply and storing necessary supplies and food over a long period of time.

ESD: Let us talk about missions abroad: Do you support the current Austrian focus on the Balkans?

Kunasek: That is right, I do. The Balkans will remain a security priority for us. In this way we contribute to stability on our doorstep, which means more security for Austria. However, it will be important in the

it will also take into account the results of the task force set up by my predecessor, but I do not feel bound by his decision to terminate the EUROFIGHTER programme prematurely. As I said, new information is now available which requires reassessment. What we report at the end of June is completely open. Minority reports - not accepted by all four subgroups - of the results are also possible.

ESD: And then? When will you make a final decision about the EUROFIGHTER?

Kunasek: The report with recommendations will be with me by the end of June. I then will inform the federal government of the findings and recommendations and propose a timetable. This far-reaching decision takes time. I assume the matter will be decided by the end of the year.

ESD: But you are under pressure; the EUROFIGHTER programme is also connected to the 50 year old Saab 105 which will reach the end of its service life in 2020. Any decision would have to be made in the second half of the year at the latest.

Kunasek (smiling): Therefore the swift establishment of the current commission...

ESD: Yet another try: Will supersonic jets only secure Austria's airspace as has been suggested by your predecessor, or could there still be a combination with slower or cheaper jets?

Kunasek: Again, I want to emphasise that all variants are at the table, the commission really is open-ended. It is important that we ensure the entire spectrum of airspace-surveillance 365 days per year.

ESD: Currently, the type is optical/infrared night-blind. Would you accept that in the future?

Kunasek: Interceptors must have a night vision capability. I really would have liked that to be secured earlier.

ESD: You have repeatedly said that you want future procurement without interference from so-called lobbyists. At the presentation of your commission, however, some of them were present again.

Kunasek: Well, it is clear that they are trying to dock here and there. That's why I gave the commission members clear compliance and documentation rules. Contacts to lobbyists are not helpful.

ESD: Your predecessor wanted to negotiate directly with foreign governments on new or other jets - and not with the manufacturers. What is your take on that?

Kunasek: It has been clearly stated in the past that the so-called Government to Government Business is a reasonable solution. I see it the same way as my predecessor. It would be a good solution.

ESD: Finally, a look into the future: Where do you see the army in three to four years?

Kunasek: I see many highly qualified people in the army, from the Joint Chiefs to the recruits. I see the army at a "high level" in its missionary work and I see an army in which we have invested much more in procurement and infrastructure. I also see that I have succeeded in making the public more aware of the fact that in times like these a strong and modern army is indispensable for the security of Austria, but also of the European Union.

Thank you.

**The interview was conducted by
Jürgen Zacharias**

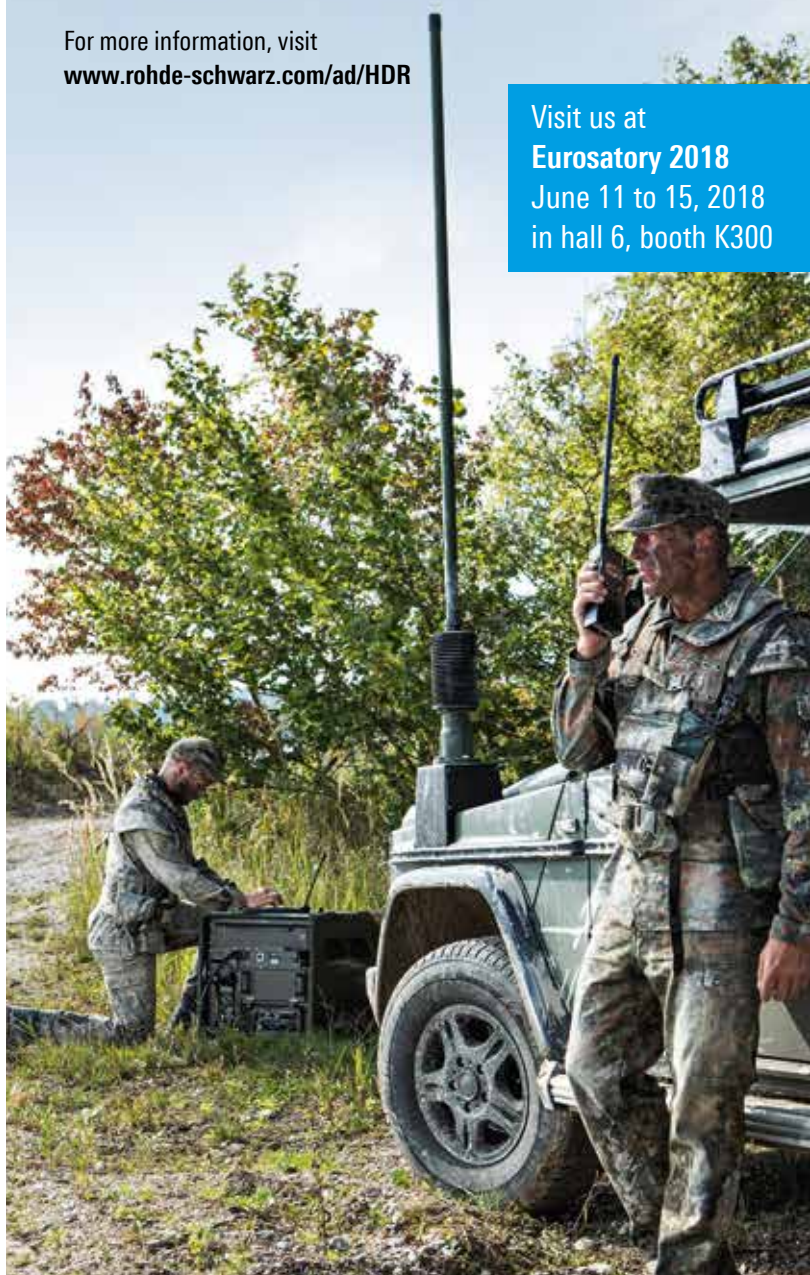
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Whither the Russian-Chinese Alliance?

Stephen Blank

The Russian-Chinese relationship has grown closer and more intimate, and Russian dependence on China has increased. Slowly but surely, the relationship is developing into an alliance.

An extensive literature already exists on Russian-Chinese relations. And most of the writers contend that, while this relationship has grown closer and more intimate and that Russian dependence on China has grown, it is not an alliance and will not become one. This article, however, argues that what we are seeing is, in fact, the development of an alliance that has accelerated after 2014 and the invasion of Ukraine. Indeed, Russian experts like Sergei Karaganov, Director of the Council on Foreign and Defence Policy, argue that

Photo: ESD archive



Photo: Kremlin



Russian President Vladimir Putin at a meeting in Astana with Chinese President Xi Jinping, 8 June 2017

Author

Dr. Stephen Blank is a Senior Fellow at the American Foreign Policy Council. He is the author of numerous foreign policy-related articles, white papers and monographs, specifically focussed on the geopolitics and geo-strategy of the former Soviet Union, Russia and Eurasia. He is a former MacArthur Fellow at the US Army War College.

this relationship is already a quasi-alliance. Furthermore, in this alliance China is the rider and Russia the horse as in Bismarck's telling metaphor. Chinese dominance has become more clearly visible as Russian dependence on China has grown since 2014 and can only become ever more visible as both sides unite against the West and conduct aggressive policies against it. This aggressiveness will probably grow, because Russia and China's policies go beyond the territorial aggrandisement of both countries that have either invaded their neighbours or forced "border rectifications" upon

them as China has done in Central Asia. Rather, their similar domestic systems drive their imperial urges. Indeed they have never stopped viewing themselves as empires that deserve "their place in the sun". Vladimir Putin has again stated his wish that he could undo the collapse of the Soviet Union and his policies clearly suggest that for him Russia was (and ideally should be) the Soviet Union. This writer has written extensively on the domestic drivers of Russia's imperially minded policies. But Xi Jinping's China presents a similar orientation. China's global ambitions, and its effort to play a major role in areas that no Chinese statesman ever dreamed about, such as the Arctic, where it intends to be "a great polar power", are clearly growing. As Abraham Denmark of the Woodrow Wilson Center has observed, "The rise of China is the defining characteristic of every commons. A 30-year modernisation effort has made China the region's largest potential threat to the stability of the global commons while, ironically, also making it more dependent on these commons." Equally crucial is the fact that what drives both sides' foreign policies is the intention to use their relationship as a resource for domestic consolidation of dictatorships that they have both now become. Thus we see a pattern of institutional and policy emulation where Xi emulates Putin and Russia emulates Chinese internet policies, and so on. It is this congruence in domestic self and external presentation that provides the real glue here. Despite China's growing predominance, it does not challenge Russia's governing system and willingly abets the corruption and anti-democratic proclivities of the regime. It is fundamental to their relationship that China does not stir up Russian sensitivities by publicly extolling its growing dominance over Russia. Therefore, largely due to this "elective affinity" between them, this alliance will probably grow as long as both the current rulers remain in charge. Lastly, Chinese President Xi Jinping's assumption of dictatorial power as president for life will have profound repercussions in intensifying China's already aggressive policies in Asia and beyond. He also is clearly emulating Putin in doing so and also chose to do so now because of the growing Russian-Chinese shared conviction that the West is weak, in decline, and that the Trump administration eschews the global promotion of democratic values.

United Against the West

But while both Moscow and Beijing are united in resisting Western power and values and in creating their own alternative structures to supplant it, paradoxically most if not all of China's enduring gains in world affairs have come at Moscow's expense. China, not Russia, is the pre-eminent economic power in Central Asia and already is beginning to spread its military influence there, not least to defend its huge investments in that region. Beijing has also eclipsed Moscow in the long-standing rivalry between them for influence in North Korea, as recognised even by Moscow who professes an identity of views with China regarding North Korea. Russian-Japanese relations are also stuck, even though Japan launched its initiative towards Moscow five years ago in the hope that it could somehow pry Russia loose from China. Today, not only will Russia not make any concessions to Japan, Japanese policymakers have been forced to scale back their previous dreams concerning Russia and China.

Turning south, Russia is increasingly aligning itself with China's interpretation of the South China Sea issue and the ensuing turn of states like Vietnam increasingly closer to Washington. Likewise in South Asia, we see the dismantling of the long-standing Indo-Russian partnership as Delhi turns to Washington and its Asian allies against intensifying Chinese pressure, most recently expressed in the dispatch of Chinese warships into the Indian Ocean and to the Maldives. Meanwhile, Russia and Pakistan are becoming ever closer, with Russia making arms sales and large energy deals with Pakistan, quite possibly at China's suggestion and also to avenge India's alliance with Washington.

Neither is this alliance confined to politics and economics; it also embraces military relations between the allies, though here the literature is of necessity rather more opaque given both sides' secretiveness on top of the natural reticence of these governments to discuss defence issues transparently. While this barrier to our understanding of Russian-Chinese relations impedes our ability to assess those relations and draw appropriate conclusions about how policymakers should respond to it, it is increasingly urgent that we grasp as much as possible about bilateral defence ties, especially as we see growing signs of co-operation between Moscow and Beijing, such as a new agreement on joint collaboration in space research that will undoubtedly go beyond civilian activities.

While we know a great deal concerning Russian arms and technology transfers to

China and about joint army and navy exercises in areas like Central Asia, Russia, China, the Mediterranean, the Baltic Sea, the South China Sea, the Sea of Japan, and the East China Sea, we know almost nothing about the bilateral military relationship and the extent to which there is actual joint military collaboration. We also have no true assessment as to the degree that there is shared learning and common approaches to the understanding of questions of contemporary and/or future war.

The Scale of Cooperation

Despite ancient strategic cultures, distinguished individual military traditions, and distinct vocabularies for discussing and

military as well as the civilian spheres since then. This increased intimacy is reflected in Russia's sale of advanced military systems to China, increasing numbers of joint exercises, and open calls by Russia's military for an alliance with China.

Thus in 2014 Russia's Minister of Defence, Sergei Shoigu, and his deputy, Anatoly Antonov, speaking in Beijing, openly advocated a military alliance with China. Shoigu argued that Russia and China confront not only US threats in the Asia-Pacific but also US-orchestrated "colour revolutions" and Islamic terrorism. Therefore, "The issue of stepping up this cooperation [between Russia and China] has never been as relevant as it is today." Specifically he advocated enhanced but unspecified bilat-

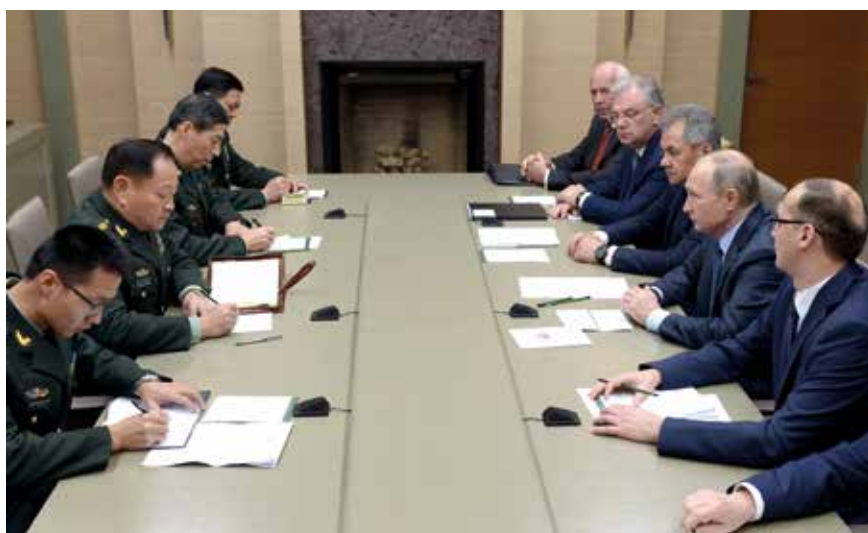


Photo: Kremlin

Meeting of the Russian-Chinese Intergovernmental Commission for Military-Technical Cooperation on 7 December 2017

analysing strategic issues, joint staff and defence talks have occurred for almost a decade if not more. Marcin Kaczmarek wrote in 2008 that, "The scale of cooperation between Russia and China is reflected in the extensive infrastructure of dialogue between the two states. Regular contacts are maintained at nearly all levels of central Authority. Political dialogue takes place within an extensive framework for bilateral consultations, including meetings of Heads of State held several times a year (at least once a year on a bilateral basis, and also during several multilateral meetings); meetings of prime ministers and foreign ministers; consultations on strategic stability (at the level of deputy foreign ministers); consultations on military cooperation (at the level of defence ministers); and consultations on security issues (between national security advisors since 2005)." If anything, given the growing intimacy between the two governments, this structure of inter-governmental dialogue has grown in the

eral Sino-Russian security cooperation and within the Shanghai Cooperation Organization. Shoigu and Antonov further included not only Central Asia but also East Asia. Shoigu further stated that, "In the context of an unstable international situation the strengthening of good-neighbourly relations between our countries acquires particular significance. This is not only a significant factor in the states' security but also a contribution to ensuring peace throughout the Eurasian continent and beyond."

This overtone fundamentally reversed past Russian policy to exclude the PLA from Central Asia and retain the option of military intervention there solely for Russia itself. This gambit signified Russia's growing dependence on China under mounting Western and economic pressure. Such an alliance would also reverse China's past policy shunning military involvement in Central Asia while characteristically abdicating those responsibilities to Russia. But there are some signs that Beijing is rethink-



Photo: USNWC

China's Silk Road

On the other hand, on 16 December 2014 after Shoigu's visit, Prime Minister Li Keqiang proposed that the SCO become the "guardian of Eurasia". Obviously this relates to Chinese concern for its showcase policy of a new silk road through Afghanistan and Central Asia to Europe, which would come under severe pressure if Afghanistan collapsed. And in August 2014, Russia and China held their largest SCO exercises to date, with China contributing J-10 and J-11 fighters, JH-7 early warning assets and control aircraft, and WZ-10 and WZ-19 attack helicopters. There also were signs then that China might actively contribute to the struggle against ISIS by supporting coalition air strikes even if does so independently and apart from the US coalition. That would have marked a revision of past Chinese policies and indicated an impending major policy change towards a genuine Sino-Russian military-political alliance in Central Asia against terrorism and Islamism in all its forms. Moreover, since 2016 there are some signs of China's rethinking of its capabilities to insert military forces beyond its borders into Central Asia. And in 2018 there are increasing reports of China opening a base in Afghanistan.

Today we see calls by Chinese scholars like Yan Xuetong and Chinese diplomats for an open alliance with Russia against the United States. Other signs indicate that there may be more and deeper collaboration between these two militaries than has hitherto been imagined. Russia's new defence doctrine proposes to "coordinate efforts to deal with military risks" in the SCO's common space. It also provides for creation of joint missile defence systems. While Moscow has previously pursued this outcome with the West, it indicates a new willingness to work with China in creating missile defences. In addition to Shoigu's statement in 2014 about fostering "good-neighbourly relations", he commented that, "During talks with Comrade Chang Wanquan, we discussed the state and prospects of Russian-Chinese relations in the military field, exchanged opinions on the military-political situation in general and the APR (Asia-Pacific Region) in particular... We also expressed concern over US attempts to strengthen its military and political clout in the APR," he said. His conclusion: "We believe that the main goal of pooling our effort is to shape a collective regional security system." It would be difficult not to see this objective as an invitation to an alliance.

Since then, Shoigu remarked that, "Russia's strategic partner is the People's Republic of China. Bilateral military cooperation is developing actively. Primarily it is focused

The Soviet-made "VARIAG", now named "LIAONING", was China's first aircraft carrier. Since then, the first domestically built Chinese carrier has been launched.

ing this position. On the one hand, China's Ministry of Defence spokesman went out of his way at an international press conference on 27 November 2014 to deny that an alliance with Russia existed: "I need to emphasise here, though, China and Russia adhere to the principle of no alliance,

no confrontation, and not targeting a third party in military cooperation, and therefore it will not constitute threats to any country. It is inappropriate to place normal military cooperation between China and Russia in the same category as the US-Japan military alliance."



Photo: MoD Russia

In the summer of 2017, 10 Russian and Chinese warships participated in the exercise "Maritime Cooperation 2017" in the Baltic Sea. The photo shows the ceremonial farewell by Russian and Chinese naval officers.

on the fight against international terrorism. Joint actions are regularly practised during the military exercises Naval Interaction and Peace Mission. The Russian Federation continues to prepare specialists for the People's Liberation Army of China. In total, more than 3,600 Chinese servicemen have been trained in the universities of the Ministry of Defence of the Russian Federation."

Increased Cooperation

Likewise, Michael Yahuda observes that Russian elites strongly favour enhanced collaboration: "Moscow believes that bolstering China's military position in East Asia is very much in Russian interests. As the official in charge of Russian arms exports stated in April 2015, "if we work in China's interests, it means we also work in our interests." In other words, the US-led economic sanctions on Russia have made Sino-Russian strategic interests more congruent. Admittedly, advocacy for an alliance openly contradicts Russian and Chinese stated policy at the highest levels, despite media and official statements urging further broadening of bilateral ties. Yet cooperation steadily deepens. Vice President Li Yuanhao told Sergei Ivanov, Putin's Chief of Staff, in 2014 that, "China is willing to work with Russia to fully implement the fruits of a meeting between the two nations' leaders in Shanghai and conduct cooperation on a larger scale and with greater depth." Ivanov clarified that while Moscow and Beijing complement each other both bilaterally and internationally, neither he nor China saw any point to a military alliance. Meanwhile, Russian-Chinese military relations were directed against nobody and were purely bilateral. He even argued that Russian-Chinese relations are based on human relations at the highest and lower levels, not on "politicking". Moreover, the crisis in Ukraine does not affect these relations. In July 2014, Putin reiterated that joining an alliance subordinates Russia to the other parties and undermines its sovereignty: "Any nation that is part of an alliance gives up part of its sovereignty. This does not always meet the national interests of a given country, but this is their sovereign decision. We expect our national legal interests to be respected, while any controversies that always exist, to be resolved [sic] only through diplomatic efforts, by means of negotiations. Nobody should interfere in our internal affairs."

A More Formalised Alliance

Even so, Russia has clearly called since then for a more formalised alliance. China has sidestepped the issue, but is clearly

prepared to upgrade cooperation with Russia, especially since Moscow's rising dependence upon its largesse and support can be turned to China's advantage, and Chinese President Xi Jinping has long advocated closer security cooperation with Russia. In their book about the Russian Far East (RFE), Artem Lukin and Rensselaar Lee insist that Putin has offered China an alliance, and Lukin has subsequently reiterated his position elsewhere.

If this assessment is accurate, then Russia is becoming not just a junior partner to China but also losing a place of primacy on the overall international agenda, given Asia's economic dynamism and the many arenas of geopolitical strife there. But it also means that there is a great deal more by way of shared military assessments, transfers, and learning than we have previously assumed. For example, Putin recently stated that, "Regularly during the last years we have conducted military drills, have participated in so-called military games and competitions. I will repeat – during many years both on land and on water. Cooperation between China and Russia, including the military component, is one of the key elements of world security."

Whatever the exact state of this relationship is at the moment, it is clearly evolving, and the trend lines point to greater Sino-Russian identity on issues of defence and international security in both Europe and Asia. On Syria and Ukraine, China has provided steady if not loud support to Russian positions in the UN and in general and has underwritten expanded loans and investments to and in Russia that take up some of the slack generated by Western

sanctions. And on Asian issues, Moscow increasingly follows Beijing, while Beijing is systematically overriding Russian economic initiatives that are part of its so-called pivot to Asia.

Given both states' revisionist appetites, dictatorial systems and imperially based political culture, their multi-dimensional challenge to the West is taking shape as the defining challenge of contemporary world politics and will likely remain such for some years to come. But we should also remember that change is the law of life, and that by their domestic and foreign policy actions both regimes have consigned their nations to what will likely be periods of economic stagnation even as their external militancy grows. That stagnation will impede their progress but also possibly fuel their frustration and aggressiveness. Neither is it inconceivable that, precisely because they are both dictatorships, they will turn on each other in the longer term. But as long as the imperatives of protecting their regimes drives their power and upholding the imperial vision is one of those crucial imperatives, then we can expect much trouble under heaven in the years to come. ■

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Viewpoint from Jerusalem



Israel's View of the Iranian Adversary

Tamir Eshel

On the 70th anniversary of its independence, Israel is appreciated as a strong nation determined to thrive despite the threats it faces in a hostile region. The first three decades were the most challenging for the young Jewish state, which faced combined and constant threats from neighbouring countries such as Egypt, Syria, and Iraq.

Over the years things have changed. Israel formalised peace agreements with Egypt and Jordan. The existential threat from hostile neighbours changed into a continuous pressure by non-state actors, backed by the new regional power – Iran.

Iran did not achieve this dominance by force, but by navigating opportunities created by others, particularly the elimination of the Afghan Taliban on their eastern border and Saddam Hussein's Ba'ath regime in Iraq, on the west, both by a US-led coalition. Iran was smart to exploit the chaos of the "Arab Spring" which toppled regimes in Yemen, Egypt, and Libya and opened Iraq and Syria to Iranian influence.

Iranian support to subversive forces throughout the world is part of the foundations of the Iranian Islamic revolution. For many years Iran exploited the Hezbollah, the Lebanese Shi'ite movement it created in the 1980s, for terror operations worldwide. More recently, their activity expanded to other trouble spots in the region, where the Iranians leverage their influence, in Yemen, Syria, and Iraq.

Iran established its Lebanese proxy organisation in 1983. The group was known for its bold and deadly attacks that caused many casualties to Israeli, US and French forces in Lebanon. But until the 2000s it did not have any strategic weight. It obtained this position by establishing its rocket and missile force. Back in the 1990s they had about 500 short-range rockets that could barely reach the Israeli border. Five years later Hezbollah had 1,500, among them medium-range rockets it received from Iran. By the year 2000, when Israel withdrew from the security zone it established in Lebanon, Hezbollah stocked 20,000 rockets which could hit Israeli population centres as far as Haifa, Tel-Aviv, and Jerusalem. Thousands of those rockets were fired at Israeli towns in the Second Lebanon War of 2006. The numbers kept growing and now exceed 100,000.

Realising the new threat, Israel quickly established an effective defensive capability to engage and minimise the rockets' effect by creating a multi-layered missile and rocket defence capability that received full US support. Hezbollah (Iran) and Israel maintained a kind of mutual deterrence since 2006, while Iran turned to support, arm and equip Israel's other opponents like the Palestinian Hamas in Gaza with the same rockets and weapons it provided to their Lebanese proxy. The rapid progress of Hamas in obtaining rockets and missiles, and locally

manufacturing medium-range rockets, as reflected in its confrontations with Israel in 2012 and 2014, only highlights this effort.

Iran learned a lot from its experience with Hezbollah and succeeded in repeating its success in Yemen. Within only three years the Iranian supported Shi'ite Houthis gained the capability to hit the Saudi Arabian capital, Riyadh, with ballistic missiles, despite facing Saudi-led coalition forces in Yemen and the determined missile defence capability of the Saudis and their allies.

Israel's perspective of these Iranian activities reflects its concerns. The lessons Israel learned from the Iranian establishment in Lebanon, the rise of Hamas in Gaza and Daesh in Sinai is to leave no territory close to its borders uncovered. When local authorities are incapable of doing the job, Israel takes the initiative. An example is the West Bank, where Israel maintains the security cooperation with the Palestinian Authority despite the political rift between the two governments. Israel reportedly conducted offensive actions against Iranian missile construction facilities in Sudan and in Syria, and Iranian attempts to establish operating bases in Syria, but never officially claimed credit. The recent intensified Iranian attempts to supply precision-guided missiles to Hezbollah, and establish bases in Syria and hostile actions conducted directly by Iranian forces at Israel led Jerusalem to respond in force, taking full credit for the attacks, overtly, and being determined to continue doing so in the future.

Despite its active role in destabilising actions throughout the region, Iran is vulnerable, since its military is quite limited in defending its huge territory. In fact, despite Chinese and Russian arms sales, most of Iran's weapons are obsolete, and its military capabilities are questionable. To compensate for its weakness, Iran has developed a powerful missile force as a lesson from its long war with Iraq. Armed with unconventional warheads, this missile force would position Iran as a regional superpower that would keep the region and the world hostages. Therefore, Tehran's appetite for missiles increased, with its weapons getting bigger and more far-reaching, in 2004 placing the Jewish state within reach of Iranian missiles for the first time.

Deep inside, the regimes in the region know that Tehran uses Israel as an excuse, while hiding its true intention to obtain the weapons and capabilities to dominate the entire region – a goal it currently tries to achieve by supporting proxy wars. That is why Israel stands hand in hand with other Middle Eastern countries, such as Saudi Arabia, Jordan, Egypt and the Gulf States, determined to block Iranian influence in the region. This cooperation has a clear goal – to contain Iran's aspiration to destabilise the region, obtain nuclear weapons and the means of delivery which pose a risk to the region and the entire world.

Israel-NATO Relations

Eugene Kogan

Between September 2011, when then Turkish Foreign Minister Ahmet Davutoglu vetoed Israel's attempt to open a diplomatic mission at NATO headquarters, and May 2016, when Turkey finally lifted its veto, Israel's cooperation with NATO was restricted, particularly in the field of diplomacy.

The limited relations between Israel and NATO member states were directly linked to the Mavi Marmara incident of May 2010, which led to the deaths of nine Turkish citizens killed by the IDF. However, Israel's cooperation with NATO has continued, particularly in the areas of counter-terrorism and air

maintained numerous direct and indirect channels to NATO, but none of them operated directly from Alliance headquarters in Brussels. The fact that we will now have permanent and daily access to NATO headquarters in May 2016 offers greater opportunities for cooperation. The lifting of the Turkish veto significant-

ambassador. The opening of a diplomatic mission within NATO may appear to be a purely technical matter, but it is very important and has led to other things, namely the Israeli presence during the NATO debates and not least the agreement on cooperation between the secret services.



Photos: NATO

Israeli President Reuven Rivlin and NATO Secretary General Jens Stoltenberg announcing the opening of an Israeli diplomatic mission at NATO headquarters on 4 May 2016

force exercises. In November 2013, for example, the first Israeli Air Force exercise "Blue Flag" brought together the USA, Greece and Italy at the Ovda AFB in southern Israel. The following "Blue Flag" air force exercise pitted the Greek, Israeli, Polish and US air forces against a fictitious enemy state. This exercise took place in late October/early November 2015 in southern Israel.

In addition, Oded Eran, a former Israeli ambassador to the EU, said: "Israel has

ly improves Israel's relations with NATO. Prime Minister Benjamin Netanyahu said in May 2016: "We have worked on this for many years. I think that is important for Israel's image in the world. The countries of the world want to work with us because of our determined fight against terrorism, our technological knowledge and our secret services."

On 4 May 2016, the North Atlantic Council decided to allow Bahrain, Israel, Jordan, Kuwait and Qatar to open diplomatic missions at its headquarters. The Israeli diplomatic mission to NATO was finally opened in January 2017 in the presence of IDF Deputy Chief of Staff, Major General Yair Golan.

Aharon Leshno-Yaar, Israel's ambassador to the EU, has also been appointed NATO

As the next milestone in the improved relations between Israel and NATO, an agreement on the protection of classified information was signed in November 2017. Wendy Bashnan, Director of the NATO Security Office (NOS), and Nir Ben Menashe, Director of the Israeli Ministry of Defence (IMOD), signed the agreement. The agreement is important for the expansion of information sharing between Israel and NATO, focusing on the growing power and influence of terrorist groups in North Africa and other countries in the region, as these groups pose a threat to Israel and NATO member states. Whether Israel will be prepared to provide real violence in the fight against terrorist groups remains to be seen.

Author

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In the same month of November, representatives of 12 NATO countries attended the first Israeli conference on urban warfare in Tel Aviv. Eitan Shamir, former head of the Department of National Security Doctrine at the Ministry of Strategic Affairs, said: "The IDF built one of the most modern facilities in the Tze'elim Ground Forces Training Centre, a Palestinian village used for Israeli military training. American units and (indeterminate) others have asked to train in it." The IDF shared key concepts with NATO guests on how military force can be activated in built-up areas and how these forces can be assembled and trained before their deployment.

also trained together in the centre of Israel. According to Colonel Amnon, Ramat-David AFB Commander, "The Greek deployment was of historical significance because Ramat-David AFB usually does not host foreign fighter division deployments. This was a trailblazing event." It remains to be seen whether or not the Ramat-David AFB will host further air force training.

Finally, in November 2017, a flight exercise was held in Israel for seven nations, including France, Germany, Greece, India, Italy, Poland and the United States. While Greece, Italy, Poland and the United States participated in previous "Blue Flag" exer-

nia, Great Britain and the USA as well as international observers held briefings and planning meetings on land. In the second week, they practised a series of scenarios they might encounter. These included sea-supported anti-terrorist operations, strikes, dealing with enemy swarmboats loaded with explosives, air threats and practising how to rescue stranded ships and provide medical assistance to the injured. Lieutenant Colonel Yaniv Lavi, commander of the 32nd squadron of the Israeli Navy, said: "The learning process was mutual. We learned from others and passed on our knowledge. We're improving all the time."

Compared with other fleets that have spent most of their time at sea, carrying out international missions such as monitoring and rescuing refugees, combating international terrorism and smuggling, the Israeli Navy is on daily missions against the country's enemies off the coasts of Gaza and near Lebanon. It can be said that the Israeli Navy remains vigilant and ready for all eventualities. NATO countries can learn a lot from Israeli experience, because patience and perseverance are the main characteristics of the Israeli Navy.

Lavi added that, "Ultimately the Israeli Navy would like to become an active participant in NATO. Such cooperation builds confidence and links to other countries. And it is very important for regional stability and maintenance of the unity of the like-minded nations."

Lieutenant Colonel Assaf Boneh, Head of the Israeli Navy's International Cooperation Planning Branch, highlighted Israel's growing bilateral naval links with Cyprus, France, Greece and Italy in particular. He said that, "The French often come to Israel. They made Haifa their home port. They are looking for a safe, stable haven where they can rest and train with a modern fleet. Their visits are also an advantage for us. The intensity of their visits has risen sharply. Sometimes the French Navy is in Israel more often than the American Navy, which is our biggest partner."

As a result, increasingly complex and well-planned Israeli-French naval exercises have taken place. As recently as March 2018, the joint anti-submarine warfare (ASW) exercise saw the participation of two Israeli ASW vessels, a French frigate and ASW helicopter, and the SEAGULL multi-mission unmanned surface vessel (USV) in the Mediterranean. The joint force has simultaneously operated manned and unmanned surface and airborne vessels, practising advanced means and tactics for submarine detection and deterrence.



Photo: ESD archive

On 31 May 2010, Israel conducted a military operation against the MS Mavi Marmara in international waters in the Mediterranean Sea. The ships were carrying humanitarian aid for Gaza. Israeli soldiers killed nine Turkish citizens on the MS Mavi Marmara during the raid.

An unnamed IDF official who was involved in organising the conference with NATO countries said: "We did not bring people here to preach, but to discuss the complex challenges that each of us must face. Israel is a laboratory, but it is definitely not the only country to meet these challenges." Eitan Shamir added: "The IDF has much to offer, but it is important to emphasise that this is a dialogue. NATO military have also gained experience in Afghanistan and Iraq as well as in Africa and other countries. That's why the IDF learns from its experience." We can expect this dialogue to continue and be developed because it enriches both sides, strengthens confidence between Israel and NATO, increases enthusiasm for the exchange of experiences from the conflict and draws conclusions for future development.

In November 2016, Israel and France held their first joint air exercise on the Island of Corsica. The "White Stripes" exercise saw Israeli F-15s fly alongside French RAFALE combat aircraft. In December 2016, the Israeli Air Force and Hellenic Air Force

cises, France, Germany and India participated for the first time. In addition, officers and attachés from around 40 countries participated as observers. In the words of Lieutenant Colonel Richard Hecht, Head of International Affairs of the Israeli Air Force, "Things are very tense in our tiny airspace and the environment around us. So we are providing a kind of combat laboratory where the armed forces can improve the capabilities needed to combat growing threats." It should be recalled that for the representatives of the Israeli and NATO countries the post-air exercise evaluation is of the utmost importance. They highlight shortcomings that need to be addressed and ask for interoperability, as NATO countries fly different jets, while India as a non-NATO member flies Russian aircraft and everyone is interested in learning more about Russian technologies.

In another initial experience, the Israeli Navy was invited by the Greek Navy to participate in a NATO exercise. In the first week (from mid-November 2017), crews from Bulgaria, Greece, Israel, Italy, Roma-

Boneh added that: "Due to its relatively small size and high workload, the Israeli Navy has less time than the NATO fleets to participate in exercises, but at the same time is also conducting more and more international exercises. Therefore, more and more foreign fleets are expressing the desire to participate in Israeli naval exercises – more than the navy can support."

In addition, as Boneh continued, "Israel has reaped many benefits from this growing maritime partnership. For instance, a friendly partner like Greece owns similar vessels to Israel's – such as German-built propulsion submarines, which can travel great distances without needing to resurface. Maintaining such submarines is a complex matter and requires a lot of knowledge. The Greeks have technical knowledge on maintenance and we are happy to learn from them. We expect our cooperation with others to increase" to the benefit of both sides.

As far as Lieutenant Colonel Lavi's wish is concerned that "the Israeli Navy ultimately wants to become an active participant in NATO" this wish is shared by the NATO member states.

As another sign of expanding Israel-NATO relations Ambassador Leshno-Yaar signed a logistic agreement with the NATO Support and Procurement Agency (NSPA) in February 2018. The agreement is a breakthrough for Israeli companies in the cyber, optics, defence and software sectors. What is more, it enables Israeli companies to compete in NATO tenders and be part of companies choosing to operate in this channel.

IMOD International Defence Co-operation Authority (known by its Israeli acronym SIBAT) representative Merav Dar went to Brussels to finalise the details of the agreement. Registration in NATO's authorised database of suppliers will take place through SIBAT according to a database of 700 registered Israeli companies. NSPA's corresponding database will be managed from Brussels.

Ambassador Leshno-Yaar said that "NSPA coordinates work with NATO countries' armies, and this is the ideal way for Israeli industries to get a foothold in various projects. NATO greatly values the IDF's military capabilities and the Israeli defence industries, and wants this connection."

Israel estimates the value of the transactions that the agreement might open for Israeli companies at US\$4.5Bn. It is expected that most tenders for Israeli companies will come from (unidentified but small) NATO member states and not from the US. Peter Dohmen, NSPA General Manager, said that: "This cooperation agreement will enable the further discussions between our Agency's logistics experts, and will not only benefit Israel, but can also offer potential economies of scale to other NATO Support and Procurement Agency (NSPA) nations."

Finally, the sad chapter of relations between Israel and Turkey is behind us, and a new chapter in relations between Is-

rael and NATO has begun. The opening of an Israeli diplomatic mission at NATO headquarters in Brussels, the signing of an intelligence cooperation agreement, the first urban warfare conference, the first joint air force and naval exercises and the recent agreement with NSPA point the way for relations between Israel and NATO, which have a real positive impact on both sides. As a non-NATO member, Israel can maintain intensive and diverse cooperation with NATO. Moreover, the development and expansion of relations has been so rapid that it appears that Israel and NATO have been waiting for the right opportunity to move forward and not waste their time on trifles. ■

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Sweden and Russia – A Complicated Relationship

Jörgen Elfving

Sweden and Russia have a common history that goes back centuries. Unfortunately, it is a story that is primarily marked by war.

This has a strong influence on the Swedish perception of Russia and could explain why an international survey showed that only 18% of Swedes have a positive image of Russia, compared with 64% of Greeks.

Since the 16th century, Sweden has been at war with Russia 10 times for a total of 95 years. These wars were the result of border disputes in eastern Finland and a Rus-

to reach the east coast of the Baltic Sea. The Russian claim can easily be explained by looking at the map and the fact that Russia was in a situation that was disadvantageous from a maritime point of view. The Black Sea was blocked by the Tartars and the Ottoman Turks, and the White Sea was difficult to reach both by sea for potential trading partners and by land from central Russia.

the annexation of Finland in 1809. This led to Sweden and Russia having a common border in the north and Russian troops being stationed on the strategically important island of Åland, the latter a dagger pointing to the central part of Sweden and the capital. This meant that a Russian invasion in times of crisis was more likely, which had an impact on Swedish war planning. At the beginning of the 20th century, for example, this led to the construction of a line of defence north of Stockholm to parry an attack against the capital and serve as an anvil for attacks from the west to throw an intruder back into the sea.

A Mare Sovieticum

As a consequence of the 1917 revolution, Russia and the Soviet Union lost their position in the Baltic States when the Baltic States and Finland became sovereign nations, which lasted until 1939, when Russian troops occupied the Baltic States in 1940. The Second World War and the establishment of Communist regimes in Eastern Europe and the creation of the Warsaw Pact led to the Baltic Sea essentially becoming a Mare Sovieticum, as the Soviet Union ruled the Baltic coast from Vyborg to Lübeck.

The emergence of the Soviet Union as the dominant power in the Baltic Sea region explains to a large extent why Sweden became one of the most militarised countries in the world during the Cold War. This small country had a local defence industry of world fame that produced almost everything the armed forces needed, from aircraft to anti-tank missiles. In the early 1950s, Sweden had the fourth largest air force in the world and was able to mobilise 850,000 men and women in just a few days. Each sector of society was involved in one way or another in the concept of "total defence". The role of the armed forces was "to contribute to stability in Northern Europe". A military attack on Sweden should require so much by way of resources and time that the potential advantage of the attack did not correspond to the efforts involved.

Photos: NATO



In 2016 the Swedish government decided to re-establish a permanent military base on Gotland island.

sian "push to the west" when Russia collided with Swedish interests in its attempt

Author

Jörgen Elfving is a former lieutenant colonel in the Swedish Army. Between 2012-2016 he participated in research at the Swedish Defence University focussing on the development of Russian military capabilities. He is a frequent contributor to magazines covering military issues, such as the Swedish Royal Academy of War Sciences Proceedings.

The numerous wars with Russia had their victories (Narva, 1700) as well as defeats (Poltava, 1709). These examples were Russian intrusions into the Swedish archipelago in the early 18th century, which devastated many cities and settlements and led to a real invasion in 1809. The Swedish defeats in the wars with Russia are also something Russia often reminds Swedes of, for example in a recent article in "Nezavisimaja Gazeta".

After Sweden's defeat in the Great Northern War of 1700-1721, Russia became the dominant power in the Baltic States, which was reinforced by the division of Poland at the end of the 18th century and later by



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After the collapse of the Soviet Union in 1991, Sweden's situation was reminiscent of that in the 1920s. The Baltic States had once again emerged as sovereign nations, with Russia trying to find its role in a new domestic and international political setting. The threat was gone as the former Soviet and now Russian armed forces were in turmoil due to the withdrawal from Eastern Europe and the political and economic upheaval in Russia. Between 1992 and 2015 Sweden issued six defence resolutions which, with

different orientations depending on the perception of Russia, reflected the changes in the security situation in Europe in general and in the Baltic Sea region in particular. The defence resolution of 1992 was a result of uncertainty regarding what direction the political developments in Russia and Europe would take; it resulted in a limited reduction of the brigades in the army, but kept the previous defence against an invasion more or less intact. However, the 1996 resolution initiated a process which heralded change

and abandoned the long-standing focus on defence against an invasion. During this process, a vast number of units in the armed forces were disbanded, the civil defence dismantled, garrisons abandoned and equipment scrapped, sold for a trifle or donated to the Baltic States. In the end, the total defence concept was thrown out with the bathwater, all based on the assessment in the government bill issued prior to the resolution in 2000 which stated that an armed aggression against Sweden was unlikely in the foreseeable future.

Total Defence

This statement heralded a time of so-called strategic time out, in which historical heritage was completely ignored and Russia was forgotten. As a result, parts of Sweden became free of military units, such as the island of Gotland, an island of strategic importance since antiquity and often occupied, most recently by Russia in 1809. Restructuring and downsizing was completed in 2009, when conscription was suspended and professional soldiers were introduced. Unfortunately, this also led to a reduction in interest in Russia in general, from which the intelligence and security services also suffered.



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The role of Sweden's armed forces is to contribute to stability in Northern Europe.

The war between Russia and Georgia and the subsequent radical reform of the Russian armed forces remained largely unnoticed in Sweden. In 2013, however, Sweden experienced a rude awakening when Russian military aircraft simulated a large-scale bombing attack on Sweden on Good Friday. An embarrassing fact was that no Swedish fighter was on alert that day. In addition, from 2011 onwards, for the first time since the 1980s, there were also suspected sightings of Russian submarines in Swedish waters. One of the possible intrusions in October 2014 received extensive Russian attention, mocking Swedish concerns, vehemently denying the presence of Russian submarines in Swedish waters both now and in the past, pointing out that inflating non-existent Russian threats served the purpose of supporting Swedish defence efforts. The headline of a Russian article is typical: "The submarine story: The Russian threat" is maintained as an incentive for Sweden's security policy, a message that is repeated whenever official and unofficial Russian sources comment on Sweden's defence efforts.

The Russian Bear

That something had changed in Russia and that the Russian bear had risen again became clear in connection with the annexation of Crimea and the subsequent events in eastern Ukraine. This led to a reassessment of the capabilities of the Russian armed forces and possible Russian intentions in the Baltic Sea region. The Russian threat was back on the Swedish agenda, leading to a series of studies on the subject, including a study published by the Royal Swedish Academy

of War Sciences describing a possible future Russian military attack on Sweden. More importantly, however, the changed security situation was addressed by politicians, where defence resolution 2015 signalled a return to the defence of Swedish territory and less effort for expeditionary warfare. Something obvious was stated on the first page of the resolution: "The main priority in the Defence Act for the period 2016 to 2020 is to increase the operational capability of the armed forces and ensure the collective power of Sweden's total defence", that is to say, a return to the overall defence concept, but in a new form, taking into account the changes in society since the Cold War. As the Defence Minister described it: "We have a Russian annexation of Crimea, we have the aggression in Ukraine, and we have more activity in our neighbourhood. That is why we have decided to build a stronger national defence." This has also led to more money being made available for defence purposes, but obviously not enough, according to a recent study by the Swedish armed forces. The study states that Russia does not hesitate to use military power to achieve its political goals and is considered to be the player with the greatest impact on the security situation in the Baltic Sea region until 2035.

As a result of Sweden's more down-to-earth policy due to the more aggressive attitude of Russia's and the changed security situation in the Baltic Sea region, the Swedish government also decided in 2016 to establish a permanent military presence on Gotland. A measure originally planned for 2018 but now brought forward was the reintroduction of compulsory military service in 2017. But not only the military

has changed; civil protection is also to be rebuilt, and by 2025 around SEK25Bn will have been made available for this purpose.

Sweden in NATO?

An interesting result of the revival of the Russian military is Sweden's 2009 declaration of solidarity, which states: "Sweden will not remain passive if another EU Member State or a Nordic country suffers a disaster or attack. We expect these countries to take similar measures when Sweden is affected. Sweden should therefore be able to provide and receive military assistance." This declaration, which initially found little understanding among Sweden's neighbours, was quickly forgotten until 2014, when Russia annexed the Crimea. Since then, Sweden has been able to assure its neighbours and other actors of its commitment to joint action in the event of a crisis in the Baltic Sea region.

The Russian threat is not only of a purely military nature, but also has allegedly Russian "active measures", such as forged letters talking about the sale of artillery to Ukraine, allegedly signed by the Swedish Defence Minister and appearing in the social media to influence public opinion in order to prevent the signing of the host nation support agreement with NATO. With regard to NATO, Sweden has often been warned by Russia against joining the Alliance, most recently by the Russian President in June 2017, when he said: "We will regard this as an additional threat to Russia and look for ways to eliminate it."

The same message was delivered by the Russian Foreign Minister, the Russian Ambassador to Sweden and the Russian Foreign Minister Maria Zakharova. When it comes to relations with the North Atlantic Alliance, such as participation in NATO exercises, the development of interoperability with NATO and the host nation support agreement, and so on, these are often commented on by official and unofficial Russian sources, comments that give the impression that Russia considers Sweden a covert member of NATO.

Sweden and Russia have had a complicated relationship throughout history in which an actual or perceived Russian threat has shaped Swedish foreign policy and defence planning. From 1996 to 2009, when the territorial defence of expeditionary warfare made way, Russia was more or less absent. This is a striking example of the fact that the history or geostrategic characteristics of the Baltic Sea region cannot be ignored and that it will take both time and money to remedy the situation. ■

“We envisage an agreement with the European Commission on defence”



Photo: Esteban Villarejo

Interview with The Rt Hon. the Earl Howe, Minister of State for Defence and Deputy Leader of the House of Lords, United Kingdom

ESD: How might the UK remain a key part of EU defence after Brexit?

Howe: It has to be discussed. But it was encouraging, in our view, that the agreement reached at the European Council in March recognised defence and security as a separate issue. How can we join in the Common Security and Defence Policy (CSDP) without being a EU member? How can we ensure that European security is not degraded by Brexit? I perceive a general willingness to look creatively at that.

ESD: Can you give an example for the type of cooperation you want to establish with the EU on defence and security matters?

Howe: There are some parallels, actually, for example, Sweden in the context of NATO. Maybe that is the kind of relationship we should be looking for with regard to the EU. Our view is that we want something stronger than Norway's relationship with the EU, something more intimate, more joined-up. And I hope that it is achievable, not simply in terms of operations, missions and training but also on the industrial side. The industrial question is, of course, very important to us: Britain has a very strong defence sector, and we believe that we have a lot to contribute to European industrial cooperative projects – as we have in the past.

ESD: Would you like to be part of PESCO, the Permanent Structured Cooperation on Security and Defence?

Howe: By definition we cannot be part of PESCO as a whole, as we are leaving the

EU, but we would like to be able to join it at the project level. We are enthusiastic about PESCO as an initiative, it has a tremendous scope to enhance the European pillar of NATO. And of course one must regard this as an opportunity to ensure that we look at the EU and NATO together, as complementary capabilities. Where can the UK most usefully play a part in that? We are very enthusiastic about the proposed PESCO project on military mobility, which is a classic example of how the EU can contribute to NATO capabilities.

ESD: Do you see PESCO as a reaction by France and Germany to take advantage of Brexit from the industrial point of view?

Howe: I hope that those countries recognise the opportunities for their own industry, but also appreciate contributions the UK can make – and other third countries, not just the UK. I say that mainly for three reasons: Firstly, the European Union needs the best capabilities, and if you exclude countries that can provide some of those best capabilities it can be counterproductive; Secondly, we want interoperability within NATO but also in an EU context; Thirdly, value for money: every country should wish to see its money being spent in the best, most cost-effective way, if the major European Union nations act as a protectionist faction I don't think we will achieve that.

ESD: How can this “soft Brexit” regarding the defence industry be achieved?

Howe: We want to see the least possible friction in the movement of goods and people. Multinational projects and companies, such as Airbus, are important to us. We want to see the UK contribution continuing. This is a major focus for our Brexit negotiation, there is no doubt about that. But I am the first to acknowledge the complexity of it.

ESD: Do you see any chance to stop Brexit?

Howe: It would be strange behaviour for a Government to ignore the result of the referendum. Of course, there are people who are very sad about this. But we have an opportunity to create an agreement with the European Commission that does the mini-

mum damage to defence and security, and the minimum damage to commercial and economic relationships as well.

ESD: Do you expect to sign a treaty with the EU on defence?

Howe: That is possible, yes. It would be helpful. We envisage an agreement with the European Commission, hopefully underscored and approved by member states.

ESD: Spain expects to host the operational headquarters of the EU Atalanta Operation which is located in Northwood (UK) now. What do you think about it?

Howe: It is right for me to remain neutral in this question, but if Spain were chosen as the HQ I am sure it will do a very good job.

ESD: What are the main threats the EU and the UK will face in the next years?

Howe: We face common threats, that is the reason why it makes sense for the states to stay close together. And we know what those threats are: the threat of Islamic terrorism that is born of the upheaval we have seen in the Middle East and Sub-Saharan Africa; the challenge of mass migration which is a potential destabilising factor; and, of course, the threat from Russia that, from the UK point of view, is very large at the moment. It was very gratifying to us to see the strong international support that we had after the Salisbury incident, a collective response to what I think member states saw as a collective threat from Russia. You do not have to simply isolate the incident in Salisbury; this is part of a pattern of activities that we have seen from Russia. It is a threat to the rules-based order that we have enjoyed as free countries for so many years. We are very aware of it. The ability of NATO to adapt to these new realities will be a major focus of the next NATO Summit. But so will the ability of the EU to play a part in ensuring security more widely and in a complementary way with NATO. And these threats are intensifying.

**The interview was conducted by
Esteban Villarejo during the
Minister's visit to Spain in April 2018**

Crimea: Sink or Swim in Russia's Waters

Gayane Novikova

The transfer of Crimea out of the Russian SSR and into Ukrainian SSR jurisdiction in February 1954 became the cornerstone of an international conflict between two sovereign states immediately after the dissolution of the Soviet Union.

Introduction

A long-term high-intensity hybrid war prepared the ground for the legal, political, diplomatic, and geopolitical confrontations which transformed into a low-intensity conventional war in mid-February of 2014. Tensions reached their peak on 16 March 2014, when the majority of the population of the Autonomous Republic of Crimea voted for independence from Ukraine. On 18 March

citizens in these unrecognised de facto states. Using the Kosovo precedent, Russia quickly recognised their independence, therefore casting them into a free-floating situation. The world reacted to this violation of international law in a very mild way.

However, Crimea's cause was very differ-

internationally recognised borders between two neighbouring states and, in a broader sense, a new configuration of the European security system. In contrast to its posture vis-à-vis the Russian–Georgian war, the international community acted unanimously: Russia should be restrained and punished. The most intriguing part of the Crimea conundrum is the Russia–Crimea interaction. This is the core issue of this analysis.

"The test of policy is how it ends, not how it begins."

Henry Kissinger



Photo: Bogomolov PL

The "March of Peace" on 3 March 2014 in Moscow. The banner reads: "The occupation of Crimea is a disgrace to Russia."

2014, President Putin announced a reunification of Crimea with the Russian Federation. For the rest of the world this action was viewed as an annexation of part of the territory of neighbouring Ukraine by Russia, and its incorporation into the Russian Federation. At first glance, these developments can be viewed as analogous to the gradual escalation of the Russia–Georgia confrontation that culminated in the five-day August war in 2008: Georgia lost Abkhazia and South Ossetia. Russia justified its actions, among other reasons, by reference to its obligation to guarantee the security of Russian

ent. Four factors played a critical role: 1) Russia's historical, political, military, cultural, and identity sensitivity regarding Crimea; 2) Ukraine's underestimation of all these aspects; 3) the referendum of independence passed by the Crimean Parliament in May, 1991, and the concessions made by Ukraine to preserve Crimea as a Ukrainian territory and to avoid possible tensions with Russia; and 4) the ethnic composition of Crimea. Furthermore, Crimea became both a test for Russians' unity, and a confirmation that Russia can act in violation of international law to defend its national interests even if a threat of serious punishment exists. It also revealed the weakness of the Ukrainian government and its ineffective governance of the peninsula. Finally, Crimea also became a testing ground for external actors: proponents of the rule of international law must decide to what degree they can – or cannot – accept an unprecedented change of

Challenging Ukraine's Territorial Integrity

In accordance with Article 2 of the bilateral "Treaty of Friendship, Cooperation, and Partnership between Ukraine and the Russian Federation" signed in 1997, the two states agreed to "respect each other's territorial integrity, and confirm the inviolability of the borders existing between them."

However, the Russian–Ukrainian tension reached a point of no return by the autumn of 2013. The loudly articulated desire of the Ukrainian leadership to establish close relationships with NATO and the EU, a new wave of unrest in Ukraine, and its economic decline – all this was endangering Russia's strategic interests. Crimea and Sevastopol, in Russia's strategic calculation, could not be lost to Ukraine, which was ready once and for all to leave Russia's orbit. In the meantime, two factors have significantly limited Ukraine's manoeuvring space: a continuing hybrid war in Eastern Ukraine and a large and strong pro-Russian segment of the Crimean population. Putin's decision to use political and military leverage to retain Crimea was well-calculated and realistic. Russia has not viewed the incorporation of Crimea into the RF as a violation of any bilateral agreements with Ukraine, or as a violation of Ukraine's territorial integrity. The partial revision of the 1997 Treaty started almost immediately after the annexation of Crimea. In his interview with TV Channel France 24 on 16 December 2014, Russia's Minister of Foreign Affairs Sergey Lavrov

Author

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stated: "The Ukraine as we recognise it now is territorially integral from the Russian point of view and should be supported in this form." Four years later, on 14 January 2018, Konstantin Zatulin, First Deputy Chairman of the State Duma (Parliament) Committee for CIS Affairs, Eurasian Integration and Relations with Compatriots, proposed to denounce Article 2 of the 1997 Treaty. Minister Lavrov confirmed the Russian of-

the Crimean economy, including heavy subsidies for pensions, salaries, medical insurances, and so on, as necessary. In May 2014, 48% of respondents indicated they understood that the West could impose sanctions and that they were ready to tolerate any negative influence of these sanctions.

Two years later, in March 2016, the number of supporters was slightly reduced: 80% still were supportive. This survey indicated

et for 2018–2020 indicates that the federal government covers about 75% of Crimea's expenses. They include first of all infrastructure development, welfare, healthcare, and education. Separately, roughly 60–65% of Sevastopol's budget is also covered by Moscow. Finally, all security and defence-related expenses of Crimea, including those related to the Black Sea Fleet, will be covered by the federal government.

It should be noted that different sources indicate different figures regarding the growth or decline of the Crimean economy after March 2014. It depends upon whether these sources are Russian- or Ukrainian-friendly.

In general, taking into account the cumulative effects of sanctions and fluctuating oil and gas prices, it is not clear how the Russian Federation can implement even a conservative scenario. Besides, the gradually worsening economic situation will definitely affect the lives of ordinary citizens. It will probably reduce their enthusiasm regarding Crimea's reunification with Russia.

Some Aspects of Being a Crimean in Russia

Article 12 of the Russian–Ukrainian "Treaty of Friendship, Cooperation, and Partnership" ensured "the protection of the ethnic, cultural, linguistic, and religious originality of national minorities on their territory" and the creation of "conditions for the encouragement of that originality". When the treaty was signed in 1997, this article referred to the large Russian minority in Ukraine and to Ukrainian communities in Russia.

In 2001, the ethnic composition of Crimea when still a part of Ukraine was the following: 58.3% Russians, 24.3% Ukrainians, 12% Tatars, and 8% other nationalities. This demographic situation significantly influenced the results of the referendum on independence held in Crimea in March 2014, followed by the incorporation of the peninsula into the Russian Federation owing to the tremendous support of ethnic Russians. Ukrainian and Tatar minorities, which constitute 36% of Crimea's population, were mainly against the reunification with Russia. The Crimean Tatars (more than 225,000 in 1930) were among several other ethnic groups which were deported in 1944 from their lands, as a consequence of being blamed for collaboration with Nazi Germany. Partially rehabilitated in the Brezhnev era, they began to return to Crimea after the independence of Ukraine; in 2001, their population in the Crimean peninsula reached 248,000. The hostile attitude of Tatars (as well as Ukrainians) toward Russia was understandable;



Photo: Amitchell 125

ficial view on the next day: "Politically... we continue to respect the territorial integrity of Ukraine within the boundaries redrawn after the referendum in Crimea, the reunification of Crimea with the Russian Federation." Factually, Russia has moved the Crimea issue beyond the framework of negotiations with Ukraine about the latter's territorial integrity. According to Russian officials, further discussions are relevant only in regard to Eastern Ukraine. Interestingly, Ukraine's Western partners silently agreed with such an approach.

The Power of Western Sanctions, or "Крым наш!"

Immediately after the acute stage of the Crimea crisis, in March and May 2014, the Levada Centre – a Moscow-based non-governmental research organisation (which was forcibly included in the registry of non-commercial organisations acting as foreign agents) – conducted two surveys in Russia. One thousand and six hundred respondents were asked whether they were "for" or "against" the reunification of Crimea with Russia: 88% in March and 90% in May were in favour of reunification. The people were ready – to some degree – to sacrifice their well-being for a reincorporation of a very symbolic land into the Russian Federation. They also viewed the federal investments in

that the people were very much concerned about a worsening economic situation in Russia; however, they did not connect the changes in their living conditions with the Western sanctions imposed on Russia after the annexation of Crimea. In the public discourse only 12% of Russians considered a return of Crimea to Ukrainian jurisdiction.

In October 2015, the Russian government introduced a very ambitious "Strategy of the Socio-economic Development of the Republic of Crimea for 2017–2030". Defining three possible scenarios – conservative, modernist, and innovative – the Russian government announced, "Owing to the priority of the development of the Republic of Crimea in the Russian Federation, high expectations of the population of the region and a readiness of the leadership of the Republic of Crimea to implement an active social-economic policy, the basic scenario will constitute a combination of the modernist scenario (for 2017–2020) and the innovative scenario (for 2021–2030)."

The Kremlin and the Crimean authorities claim that Crimea can be self-sufficient in the foreseeable future, counting upon a flow of benefits after the completion of the construction of a 19-kilometre Crimean Bridge, as well as upon a developed tourism industry. However, it is obvious that the unification/annexation of Crimea has come at a high financial cost. An approved budg-

not surprisingly in March 2014, the Mejlis of the Crimean Tatar People called for a boycott of the referendum.

President Putin addressed the issue of the Crimean national minorities in a speech on 18 March 2014: "Crimean Tatars returned to their homeland. I believe we should make all the necessary political and legislative decisions to finalise the rehabilitation of Crimean Tatars, restore them in their rights and clear their good name. We have great respect for people of all the ethnic groups living in Crimea. This is their common home, their motherland, and it would be right – I know the local population supports this – for Crimea to have three equal national languages: Russian, Ukrainian and Tatar."

Crimean Tatars – never applied for the Russian citizenship and now face difficulties in preserving their Ukrainian citizenship. They live in limbo: In April 2018, Ukrainian President Petro Poroshenko proposed a contradictory Bill No. 8297, "On Ensuring the Rights and Freedoms of Citizens and the Rule of Law in Temporarily Occupied Territories", as an amendment to the Law on Citizenship. If passed, according to the Kharkiv Human Rights Protection Group, this Bill "would deprive Crimeans of their Ukrainian citizenship for actions forced on them by Russia as an occupying state." The civil rights groups which have access to Crimea, or are stationed there, report on growing violations of the rights of ethnic and religious minorities. In April 2016, the

pendent organisation, has provided information regarding access to education in the native language in Crimea. According to its research, classes in Crimea were divided as to the language of instruction: 875 Ukrainian classes, 384 Crimean Tatar classes, and 8,965 Russian classes. By 2016 the situation had changed dramatically for the Ukrainian classes: their total number was reduced to 163. Classes in the Tatar language as a language of instruction were reduced to 348. The range of Russia's actions in Crimea indicates that the Russian government is not interested in the preservation of the multi-ethnic and multi-confessional character of Crimea. Through suppression of human rights it forces ethnic Ukrainians, above all, to leave Crimea, thereby turning this region into a loyal Russian province.



Photo: Kremlin

Western politicians condemn the annexation of Crimea, with the exception of Italy's former Prime Minister Silvio Berlusconi. Berlusconi met with Vladimir Putin in Yalta in Crimea on 11 September 2015, officially referred to as a private visit.

This reference by President Putin to the minorities problem was important: it aimed to win over their hearts and minds and to avoid their transformation into a "fifth column." The next step in this direction was the Presidential decree on 21 April 2014, "to rehabilitate the Crimean Tatar population, the Armenian population, Germans, Greeks – all those who suffered (in Crimea) during Stalin's repressions," and "to restore historical justice and remove the consequences of the illegal deportation (of the groups) and the violations of their rights."

However, further developments have made manifest serious complications in regard to the implementation of a transition from Ukrainian to Russian citizenship and in regard to guarantees of equal rights for everyone in Crimea. In its 2017 report Human Rights Watch indicated several areas of human rights violations in Crimea. The most critical issue relates to obtaining Russian citizenship, which is a prerequisite for employment and medical treatment. However, a segment of the Crimean population – mainly ethnic Ukrainians and

Crimean Supreme Court banned the Mejlis of the Crimean Tatar People. According to the New York Times, one of the deputy heads of the Mejlis commented that "the formal ban would not change much, as the Russian government has already done everything to obstruct the operations of the body." By September 2017, several Crimean Tatar leaders were the targets of criminal prosecutions. The Moscow-based human rights group Memorial viewed the case against one of them, Ilmi Umerov, as "illegal and politically motivated." Another Moscow-based NGO, the Centre for Information and Analysis SOVA, which conducts research on nationalism and racism, relations between the churches and secular society, and on political radicalism, provides many examples of the violation of the rights of Crimean Tatars as an ethnic and religious minority group. Some cases are related to the misuse of counter-extremism measures by the Russian government. Broad violations of human rights were also reported by the office of the UN Commissioner for Human Rights. The Crimean Human Rights Group, an inde-

Conclusion

The very fact that there are no discussions – to say nothing of negotiations – on the Crimea issue between Russia and Ukraine (as well as in the international discourse) allows us to assume that a long-term status quo has been established. Its main characteristics are the following:

- Crimea has shifted completely into Russia's domain.
- Russia has secured the city of Sevastopol as a base for its Black Sea Fleet.
- There is a general understanding in Russia that a reunification of Crimea with Russia is an indication of the country's return to its role as a great power on the international stage. The Crimea factor per se contributed to the reelection of Vladimir Putin in March, 2018.
- In the mid-term perspective, Ukraine can undertake only symbolic actions regarding Crimea.
- The Western sanctions imposed upon Russia further fuelled nationalist sentiments among the Russian political and military elites. In the mid-term, these sanctions will continue to unify the Russian population at large: they now, in the mass consciousness, serve to preserve an image of the West as an enemy.
- An ethno-political conflict is simmering in Crimea. A deterioration of the human rights of Ukrainians and Tatars can lead to the low-intensity conflict that definitely will be used by Ukraine to apply legal, political, and diplomatic pressure to reclaim Crimea. In this regard, Ukraine will acquire strong political and diplomatic support from external actors.
- The militarisation of the Black Sea basin is ongoing, which challenges and further endangers the fragile European security system.



The French Strategic Vision: National, European & Global

David Saw

The current French government finds itself dealing with an extremely complex strategic environment that contains real threats to national safety and security. Added to this, there are significant threats to the European order to which France is wedded.

The international order that France is a part of is also under threat. France is experiencing what many other Western countries have also discovered, in that the comfortable certainties of the Cold War and the immediate post-Cold War world have been replaced by a set of uncomfortable strategic challenges that nobody expected or planned for.

There had been an assumption that there was a strategic shift in progress, that the successful economic globalisation would eventually bring in its wake political globalisation, where transnational entities such as the EU would play an increasingly more important role, and where shared economic, political and social values would hold sway. This was to be the era of the so-called 'Davos Man', a predominantly liberal caste inhabiting the intersection of business, politics and culture.

The problem was that outside the 'Davos Man' ecosystem reality had not stood still, and the world was changing in unanticipated ways. The 'Great Recession' of 2008/09 and its aftershocks that reverberated as late as 2012/2013 would tarnish the inevitability of economic globalisation. While European governments were keen to say that the recession was over, there was very little evidence of economic recovery, and the spending power of ordinary people seemed unable to catch up with the rising costs of goods and services.

Elsewhere at the end of 2010 and into 2011, the 'Arab Spring' saw the Arab World convulse and governments fall. At the time, there seemed to be a belief, which was unsupported by any real evidence, that these momentous events would mark the dawn of a new liberal and progressive era in the Arab world. Instead, the fallout from the 'Arab Spring' was the Syrian Civil War, the rise of the so-called Islamic State in Iraq and Syria, Libya becoming a failed state, the Civil War in the Yemen and the spreading of Islamist insurgencies into West Africa amongst other negative developments.

Illegal Migration

As a result of all of this, Europe found itself in the midst of a migration crisis, which gained vastly increased momentum from 2015 onwards, where refugees from zones of conflict in Africa and the Middle East sought sanctuary in Europe. The other aspect of the migration crisis were the economic migrants who arrived in tandem with the conflict refugees and further added to the impact of the crisis.

entrance. Initially, this was for 600 refugees, but numbers quickly grew to 2,000. The Sangatte camp became an embarrassment to both the French and British governments, and this led to its closure in 2002. As part of this process, the British agreed to take 1,250 migrants and the French offered residence permits to the remaining inhabitants of the camp, some 250 people. The end of Sangatte did nothing to halt the tide of migrants heading towards Calais, and subsequently other



Photo: Kristie Boyd, US House of Representatives

French President Emmanuel Macron addresses a Joint Meeting of Congress in Washington DC on 25 April 2018 during his state visit to the United States. France sees itself as having a central and influential role to play internationally, thanks to its UN Security Council seat and its effective and deployable military capabilities.

France was already dealing with a significant illegal migration problem prior to this point. There were two aspects to this: those that wished to enter France and remain and those who used France as a stepping stone to a third country in the shape of Britain. By the end of the 1990s the number of migrants in Calais led to the French Red Cross opening a refugee centre at Sangatte, near the Channel Tunnel

French channel ports, for onwards travel towards Britain. It therefore became a domestic political issue in France and also caused continual problems between Britain and France on measures to resolve the issue. In France, as with most everywhere else in Europe, illegal migration continues to be a hot-button political issue; in addition, it also represents a potential security threat.



Imported Terror

Terrorism continues to be a critical threat to French security, but this is a threat that has both domestic and foreign components. Prior to 2012, the threat of terrorism had faded from public consciousness in France; between January 1997 and December 2011 there had only been six terrorist attacks, with casualties coming to five killed and 26 wounded. The perpetrators of the majority of these incidents were Basque, Breton or Corsican nationalists.

Modern Islamist terrorism came to France in March 2012 with Mohammed Merah. Merah was born in France, but he became radicalised in prison and, even though he was on the 'Fiche S' terrorist watchlist, he was able to acquire weapons. Between March 11 and 19, 2012, Merah was able to commit a number of terrorist acts, murdering three soldiers and severely wounding another. He then attacked the Ozar Hatorah Jewish school in Toulouse, killing a Rabbi and three children (ages three, six and eight) and seriously wounding a 17-year-old boy. On 22 March 2012, French security forces tracked Merah down and attempted an arrest; eventually Merah's apartment was stormed, and he was killed in the process. The incidents in Toulouse confronted the French government and security services

Photo: French Ministry of Defence



French Air Force RAFALE combat aircraft flying from bases in Jordan and the UAE as part of Opération CHAMMAL have undertaken numerous missions to combat Islamic State elements in Iraq and Syria. More recently, they participated in the attack on Syrian chemical warfare capabilities on 13/14 April 2018.

calised were vast. In September 2016, then French Prime Minister Manuel Valls commented that the French security services were monitoring some 15,000 people who were being radicalised.

It was only in 2015 that the level of the Islamist terrorist threat was truly realised. In January 2015, there were the attacks in Paris against the satirical magazine Charlie Hebdo and the Hypercache Jewish supermarket; 17 were killed and 22 wounded. All of the terrorists were French nationals and had been radicalised in prison, and all had no problem accessing military-grade

ducted more effectively and the suicide bombers been able to detonate amongst the crowd entering or leaving the stadium. After this, there was no ignoring the fact that France was facing a committed terrorist threat based on jihadist ideology. Even worse was the fact that these attacks had been conducted at the behest of the Islamic State, with active support from French nationals, indeed most of the perpetrators of the Paris attacks were French or Belgian citizens. Thus the terrorist threat was two-faceted, both from within and without.

Into 2016, the level of terrorist incidents was reduced to stabbing attempts and a single car ramming attack; obviously these were not highly sophisticated attacks. That did not mean that they could not be deadly: In July 2016, a truck ramming attack into crowds celebrating Bastille Day in Nice killed 86 and wounded 434. Since that time, terrorist incidents have continued, but no successful mass-casualty attacks have taken place. Thus far in 2018, the only terrorist incident was a shooting and hostage taking attack in southern France in the towns of Carcassonne and Trèbes, with four killed and 15 wounded. The perpetrator, who had pledged allegiance to the Islamic State, was killed.

The French security services have foiled numerous terrorist plots, but their task is complicated by the sheer number of people who have been radicalised. It does not take much planning to embark on a stabbing or a car ramming attack. On the other hand larger, more sophisticated terrorist efforts appear to have been blocked. The return to France of those who fought in Iraq and Syria for the Islamic State continues to be a major concern. These people could not only promote radicalisation, but their operational and leadership skills could increase the tempo and effectiveness of terrorism. The connected nature of many terrorist and criminal networks across Europe, North Africa and

Photo: French Air Force



A French Air Force General Dynamics MQ-9 REAPER UAV operating out of Niamey in Niger, providing support to French and allied forces in an anti-terrorist mission in March 2018 as a part of Opération BARKHANE. BARKHANE sees French troops operating across the Sahel, assisting local states in the struggle against armed islamist groups.

with a disturbing threat matrix that posed some uncomfortable questions about French society and the prevalence of Islamist radicalism in communities across the country. Merah was radicalised in prison, but the avenues of radicalisation spread much further than that, even including self-radicalisation via the internet. It became clear that the numbers of potentially radi-

weaponry. Further small-scale terrorist attacks followed in February, April, June and August, killing two and wounding nine. Much worse was to follow.

In November 2015, Paris experienced a wave of mass-casualty attacks leading to 130 killed and 368 wounded. These numbers could have been even worse had the attack on the Stade de France been con-



the Middle East also present a significant threat, in that these criminal networks are perfectly capable of supplying weaponry to jihadists. Illegal migration continues to present a means to bring committed and trained terrorists into France.

Leadership

In the end, national strategy depends on those who decide the strategic direction and provide the leadership to actually carry out the strategy. This means that it is necessary to take a look at the current political leadership of France and the direction in which it hopes to lead the country forward. The French Fifth Republic came into being with the constitution of October 1958; initially, the president of the republic served a seven-year term, but this was reduced to a five-year term in 2000. Jacques Chirac was the seventh president of the Fifth Republic (two were interim unelected presidents and so Chirac was the fifth to be elected) and was in office from 17 May 1995 until 16 May 2007. By the end of his term in office, it was quite clear that France needed to change direction: put simply, the system was not working.

The 2007 presidential elections were won by Nicolas Sarkozy on a centre-right political platform that embraced change; at the time there were real possibilities to alter the trajectory of the French political and social model and much popular support to do so. However, by the end of 2007 the US was in the midst of a financial crisis, and that spread to Europe kicking off the 'Great Recession'. Instead of grand plans to change the system, the Sarkozy administration had to deal with the recession and embrace austerity rather than change. In consequence, public support for Sarkozy bled away, and this was not helped by the 'dynamic' – not to say confrontational – character of the president. Perhaps this explains how Sarkozy lost the 2012 presidential election to François Hollande of the Socialist Party (PS). Hollande ran a left-of-centre campaign that energised the PS base, but also presented himself as a safe pair of hands and less dramatic than Sarkozy to appeal to the political centre. Hollande would go on to win 51.7% of the vote, relative to Sarkozy's 48.3%, in the presidential election and become president on 15 May 2012.

François Hollande was a creature of the French political system. He attended the École Nationale d'Administration (ENA), the finishing school for those destined for high-level government careers. Those who emerge successfully from ENA are known as 'énarques', and Hollande was the third to be elected president of France. Apart

from producing senior civil servants and politicians, ENA has also produced a large number of industry leaders in France. After ENA, Hollande entered the civil service, but was then given leave of absence to become an advisor to the socialist president François Mitterrand, after he became a full-time politician.

While the Hollande administration might have wanted to move forward on a left-of-centre political programme, the state of France at the time meant that they were unable to do so and they instead tried to occupy the political centre, while still keeping to the prevailing European political trend of austerity. The problem was that the world had changed and France needed to change with it, something that was easier said than done. Whatever Hollande tried to do never seemed to work and his unpopularity rose, leading to concerns in the PS that if he stood for a second presidential term in the 2017 election he would lose. In the end Hollande decided not to run again, not that it did the PS any good as they are now a marginal political force.

vote on 23 April 2017. Of these, only five could be considered as serious contenders: the SP candidate Benoît Hamon got 6.3% of the vote, Jean-Luc Mélenchon of the far-left La France Insoumise got 19.58% of the vote, Fillion got 20.01% of the vote, leaving two candidates to contest the second and final round of the presidential vote: Marine Le Pen of the far-right Front National (FN) with 21.3% of the vote and Emmanuel Macron of En Marche! (EM) with 24.01% of the vote. Although 77% of registered voters bothered to vote, 22% of these abstained on their ballot paper.

Macron Emerges

In the second round of the presidential election on 7 May 2017, Emmanuel Macron would go on to obtain 66.1% of the vote. Turnout was 74.56% of registered voters, and 25.44% of those who voted abstained. What was significant in all of this was that a man who had never been elected to political office, who had served as Minister of the Economy, Industry and Digital Affairs



French troops on patrol in the Gare Montparnasse, a main railway station in Paris. As a part of Opération SENTINELLE, some 7,000 troops are deployed in France (around 3,500 in the greater Paris area) in support of French security operations against terrorist threats. This is a major on-going commitment for French ground forces.

It had been assumed that François Fillon, who had emerged as the presidential candidate of the right-of-centre Les Républicains (LR) at the end of November 2016, was most likely to win the May 2017 presidential election, but by the end of January 2017 he was linked to a corruption scandal which compromised his presidential hopes. There were 11 candidates who were up for election in the first round of the presidential

for only two years, and representing a political party that had only been officially established in April 2016 had become president of France. Then in the June 2017 legislative elections, Macron's political party – now named La République En Marche! (REM) – would win 43.06% of the vote and 308 seats in the National Assembly. The Mouvement Démocrate (MoDem), a centre-right party, who had allied themselves with REM,

obtained 6.06% of the vote and 42 seats. With 350 seats, this pro-Macron bloc has an absolute majority in the 577-seat National Assembly.

In the wake of the “Leave the EU!” vote in the June 2016 Brexit referendum and the Trump victory in the US presidential election of November 2016, Macron’s victory also had international significance, in that it was portrayed as the tide turning against populism and nationalism. Macron was seen as the embodiment of resurgent liberal values; “Davos Man” was suddenly back in the ascendency! The international profile of Macron was further boosted when the German federal election of September 2017 failed to produce a clear winner and it took until March 2018 for a new governing coalition to take office. The previously unassailable Angela Merkel had lost the air of invincibility that had surrounded her, opening up

All of this translates into strikes, and it is here that Macron will be tested. Plans to reform SNCF, the French railway company, will be bitterly resisted by the unions. Should the unions fail here, they are perfectly well aware that they will become irrelevant. According to the European Trade Union Institute, only 8% of French workers are in unions, in comparison 18% of German workers. The bulk of French union membership is concentrated in the state sector and in those companies/institutions that were formerly state-owned, for example Air France. Even though French unions have become a labour aristocracy and are not really that popular, there is always a danger that public sympathy could swing in their favour. What Macron wants is a France that is competitive, innovative and business friendly, not in the sense of the US capitalist model, but like the Northern European EU members

erate a European military structure. More broadly, France remains a key player into international coalitions. For example, France joined the US and Britain’s strikes against Syria’s chemical warfare capabilities in April, using French Air Force RAFALE and MIRAGE 2000 combat aircraft, as well as AWACS and other support aircraft, plus French Navy frigates. Other ongoing international commitments include Operation Barkhane in the Sahel, plus other deployments in Africa and in the Middle East.

Effective military capabilities and effective diplomacy are seen as key tools by the French political elite. However, the military can often be taken for granted, and this led to one of the few missteps of the early months of the Macron presidency. Général d’Armée Pierre de Villiers, Chef d’État-Major des Armées (Chief of the Defence Staff) resigned in July 2017. This came after de Villiers criticised defence spending cuts in a meeting with the National Assembly Defence Committee and his comments were leaked to the press. Macron saw this as disloyalty, and this made the position of de Villiers untenable. It is French government policy to raise defence spending to the NATO standard of 2% of Gross Domestic Product (GDP) by 2025, but this is a rather empty promise, as there will be another presidential election in 2022 and commitments made prior to that point are essentially worthless.

In the final analysis, the France of Emmanuel Macron represents both change and continuity, change in that his administration is prepared to embark on necessary reforms in France. The key question is can he deliver these reforms in the face of opposition from the unions and the political left? On the international front, Macron remains wedded to a technocratic liberal world view, globalisation, more Europe and the importance of the environment will remain key drivers. President Macron addressed a Joint Meeting of Congress in Washington DC on 25 April, during his state visit to the United States. Amidst the diplomatic platitudes, there was an impression given that Macron sought to anoint himself as the anti-Trump, the liberal alternative to populism and nationalism.

Certainly, there is a feeling in France that there are immense foreign policy opportunities emerging in Europe and more broadly internationally, which offer potentially great strategic benefits to France. Exploiting these opportunities for maximum advantage will depend on domestic politics and reform programmes being successful. Domestic turbulence will inevitably sidetrack any international ambitions that a Macron presidency might have. ■

Photo: French Ministry of Defence



France continues to support the defence of the Baltic States. French infantry participated in Exercise HUNTER, a multinational NATO exercise in Lithuania, held from 9-20 April 2018, featuring forces from Canada, Croatia, France, Germany, Lithuania, The Netherlands, Spain and the US.

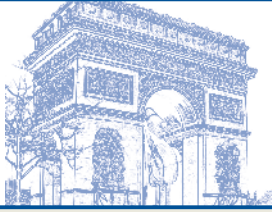
new possibilities for France and its dynamic new leader. Both in terms of the domestic and the European context, Macron has, for now at least, the momentum to achieve his goals. Of course, that begs the question, will he be able to achieve these goals?

Emmanuel Macron is a technocrat, to a great extent he is a product of the French system. He is another *énarque* and then became a civil servant or *fonctionnaire*, before leaving government to become an investment banker at Rothschild & Cie Banque. This gives him a unique skill set for a politician, in that he has a real understanding of economics and business. He is also a reformer, at least to a certain extent, and is well aware of the need to confront vested interests in terms of the state sector, unions, lawyers and students amongst others.

with social welfare protections intact. Macron is also extremely pro-EU and supports further EU enlargement and an increase in EU powers and areas of competence, which makes him somewhat unique amongst the leaders of the EU member nations.

Future Prospects

With its seat on the UN Security Council France remains on the top table of international diplomacy, a position that is enhanced by the fact that in reality only two European countries, France and Britain, have seriously deployable military capabilities. Furthermore, with a post-Brexit Britain moving away from Europe, France will be *primus inter pares* in terms of a European military capability as the EU moves to gen-



Viewpoint from Paris



French Defence One Year After Macron's Election

Giulia Tilenni

During the 2017 electoral campaign, Emmanuel Macron declared that he would have fully assumed its role of French armed forces' chief. The defence programme of candidate Macron was focussed on the need to provide the French armed forces with sufficient means for self-protection against external security threats and to tackle current international instability in an effective way. Meeting the NATO 2% objective by 2025 and working to relaunch French and EU strategic autonomy were indicated as crucial steps to take for feeding French ambitions.

As French President, Macron has been extensively working to achieve these objectives, actively playing his role as commander-in-chief. This included, in July 2017, open conflict with the then Chief of Staff, General De Villiers, about the 2018 defence budget. Although the French defence budget was planned to rise in 2018 (+€1.8Bn compared to 2017), Macron proposed a €850M cut to the defence budget as a measure to reduce public spending. All French ministries were requested to take similar measures but in the case of the defence ministry this would have directly affected operations abroad which were already in distress due to a decade of limited defence spending. As 6,000 servicemen are deployed abroad and another 6,000 are involved in the domestic operation Sentinelle, matériel and human resources have been rapidly deteriorating, thus increasing inefficiency. Furthermore, a number of indispensable programmes (for example frigates, tankers, tanks) continue to be delayed due to budget constraints. The French defence minister, Florence Parly, has finally found a solution to partially compensate for cuts. However, General De Villiers' resignation to protest against French armed forces' overstretch resulted in tensions between President Macron and the military.

Future French defence spending is at the core of discussions on the forthcoming Loi de Programmation Militaire (LPM), the legal framework defining French military planning, in this case from

2019 to 2025. To be consistent with French ambitions by 2030, the draft proposes investments up to €198Bn, which means defence budget would reach €39.6Bn per year between 2019 and 2023, compared with the current €32.2Bn per year. Should these indications be respected, France would invest 2% of GDP on defence by 2025, and the French armed forces could improve their level of efficiency.

French strategic documents such as the LPM and the Revue Stratégique reaffirm that EU cooperation (one of Macron's mantra) is crucial to gain strategic independence from Washington. After Brexit, France will remain the most powerful military and the sole nuclear power on the European continent. The more effective EU defence cooperation will be, the more EU countries will be capable of self-protecting and enhancing their strategic autonomy. According to Macron, this cooperation should have included, for example, highly impacting joint capability programmes within the PESCO framework. Nevertheless, member states opted for the German idea of inclusive projects with lower military impact.

In effect, Germany's defence policies are likely to be a brake for some French ambitions, both within and outside the EU framework. For instance, the two countries agreed on working together to address some capability gaps (such as the future maritime patrol aircraft and the next fighter aircraft). However, as the new German government is more timid than the previous one on defence issues, including joint programmes, and Chancellor Merkel continues to promote inclusiveness, the Franco-German engine could prove ineffective in the defence domain. In his first year as French President, Macron has stressed the importance of defence as a tool to reaffirm the international role of France. However, differences in theory and practise are the main obstacles that must be overcome in order to turn excellent strategic planning into a viable modernisation path.



A Search for New Directions

The Changing Shape of the French Defence Industry

David Saw

The French military is without doubt one of the most significant military forces in Europe and one with operational commitments on a global scale.

This was proven once again as the international community sought to strike Syrian chemical warfare capabilities on the early morning of 14 April 2018. French Air Force Dassault RAFALE and MIRAGE 2000 combat aircraft, and frigates from the French Navy, played a key role alongside forces committed by the US and Britain. France sees itself as having a global role to play in strengthening the international system and acting as a stabilising force, while in parallel looking after its own interests. For many France is an enigma, especially in the context of how it views its military and its defence industry, and what part these two elements play in the overall national strategy. In reality the difference between

Photo: MoD France



Operation BARKHANE sees the French Army assisting local forces in anti-terrorist operations in the Sahel. Soldiers from France and Mali are seen in front of a Nexter VBCI armoured vehicle. The VBCI is on the verge of receiving a firm order for 490 systems from Qatar, marking the first export of this vehicle. French national programmes will continue alongside collaborative efforts.

Photo: MoD France



A French Air Force RAFALE fighter takes to the air in a mission under Opération CHAMMAL, the French participation in air operations over Iraq and Syria. France has ordered 180 RAFALE with all deliveries complete in 2024, with Egypt, India and Qatar ordering another 96 aircraft. The RAFALE replacement, the FUTURE COMBAT AIR SYSTEM (FCAS), might be a collaborative programme with Germany.

France and many of the other European countries is that France actually does have a strategy that encompasses the role of the military and the defence industry. Put simply France knows that it needs a military and it is persuaded that it needs a defence industry to provide for the needs of its military. Another bonus is that the ability of France to supply state-of-the-art defence equipment gives it real political influence around the world.

It must be remembered that France is a significant power in its own right. Although France has been a prime mover in European integration and its current president Emmanuel Macron is a supporter of increased integration, it is France that has the permanent UN Security Council seat. Furthermore it is France that has the strategic nuclear deterrent, based on four TRIOMPHANT Class nuclear submarines (SSBN), each carrying up to 16 M51 SLBM. These are MIRV weapons with the Tête nucléaire océanique (TNO) warhead and penetration aids. A British House of Commons Briefing Paper

on the "French Nuclear Deterrent" notes that France has a total of 48 M51 missiles; the M51.2 variant is the in-service version. France continues to invest in its SSBN capability. The development contract for the next generation M51.3 missile was awarded to ArianeGroup in 2014 and this system should be fielded in 2025. M51.3 will offer improved performance over M51.2, with a key area being the ability to defeat enhanced anti-missile defences. Studies on the eventual replacement for the TRIOMPHANT Class SSBN have also commenced; this will be required from 2030 onwards. The ability of France to develop an SLBM system from national resources has also provided a critical capability in related technology areas. France is at the centre of the European space ecosystem, being able to offer a range of launch vehicles and associated services, as well as satellites for military, government and commercial customers. France is in the process of upgrading its military satellite capabilities: the SYRACUSE 3A and SYRACUSE 3B com-



munications satellites will be replaced by the two SYRACUSE IV (COMSAT NG) communications satellites ordered in 2015, one being built by Thales Alenia Space and the other by Airbus, and due to be deployed in the early 2020s. These will be joined by the CERES signals intelligence satellite family of three satellites and the Composante Spatiale Optique (CSO) imaging intelligence family of three satellites (Germany and Sweden will have access to CSO product). The target is that by 2021 all eight French military satellites will have been replaced by more modern and capable systems.

French nuclear capabilities are not just limited to the SSBN fleet. The French Air Force and the French Navy have nuclear-tasked aircraft (both RAFALE and MIRAGE 2000) employing the MBDA Air-Sol Moyenne Portée-Améliorée (ASMP-A) stand-off weapon. Studies on a successor weapon system, known as the ASN4G, have already started, with the future system being a hypersonic missile that will be fielded in the 2030s. It is estimated that between 10% and 11% of the French budget is spent on their nuclear forces.

Possession of a strategic nuclear deterrent that is fully designed and developed by France, as well as the ability to design,

develop and launch communications and reconnaissance satellites, gives France capabilities that very few other nations can match. This is due to the French desire to be nationally self-reliant in key strategic areas, something that has been a fundamental part of French policy since 1945. There is more to it than that of course: France seeks to retain the freedom of action necessary to look after its own interests. This is tempered by realism though. There is a recognition that the world has changed and that national self-interest can also best be served by taking a leading role in international organisations such as the EU. Whatever the future holds, France intends to remain at the top table of the international system and it intends that its voice be heard.

Future Ground Systems

While France will continue to support its own defence industry through national programmes, the most important future acquisition programmes will be collaborative, with France probably working with Germany at the centre of these efforts. There are two key programmes that may define this new Franco-German collabora-

tive defence relationship. On the land systems side there is the design, development and production of a new tank, known as the Main Ground Combat System (MGCS), to replace the German LEOPARD 2 and the French LECLERC. On the aviation side comes the development of a new fighter aircraft initially to supplement and then to replace the RAFALE in service with France and the EUROFIGHTER in service with Germany.

KMW+Nexter Defense Systems (KNDS), formed from the integration of Krauss-Maffei Wegmann (KMW) of Germany and Nexter of France, should inevitably prime the new Franco-German tank programme. Frank Haun, the CEO of KMW and Co-President of KNDS, stated in a German media interview that over the next 20 to 30 years some 5,000 main battle tanks (MBT) could be required. Add in specialist variants of the tank for AVLB, ARV and AEV requirements, plus a self-propelled artillery version and the numbers are even greater. Although an official programme timetable has yet to be fixed, the projected in-service date would be late 2020s or early 2030s.

Efforts to build a collaborative European MBT are nothing new. For example in the 1950s France and Germany were moving



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Photo: Dico

The LECLERC tank is to be replaced by a new system that might be the result of a Franco-German collaborative programme known as the Main Ground Combat System (MGCS). The new tank might be the responsibility of KMW+Nexter Defense Systems (KNDS), formed by the integration of Krauss-Maffei Wegmann (KMW) of Germany and Nexter of France.

forward on a joint tank programme. This effort failed in the early 1960s due to differing operational requirements and political issues, principally the French attitude to NATO. The end result was that Germany met its tank needs with the LEOPARD 1 and France acquired the indigenous AMX-30. Today the political and industrial environments are totally different and realistically there is no alternative to a joint Franco-German tank programme.

What is important though is that both France and Germany are realistic in terms of tank numbers. The current French LECLERC fleet is heading for a total of 200 upgraded tanks in 2020, while Germany plans to have a force of 330 tanks by 2022. A direct one-for-one replacement of these tanks by the new MGCS could provide the basis for the new tank programme, but a little over 500 vehicles can only be a starting point. Being positive, it is expected that other European nations will join this programme, and, of course, there are a large number of LEOPARD 2 all over the world that will need replacing, not forgetting a future LECLERC replacement possibility in the United Arab Emirates (UAE). Without doubt this new tank programme represents the most significant future land systems programme on offer in Europe.

Future Air Systems

French participation in collaborative European combat aircraft programmes does not have a happy history. At the end of the 1970s with both the French Air Force and the French Navy needing a next generation combat aircraft, France joined Britain and

Germany in the European Combat Aircraft (ECA) programme, this collapsed in 1981 and was superseded in 1983 by the Future European Fighter Aircraft (FEFA), with Italy and Spain becoming partners in the programme. Differences over programme leadership and aircraft design could not be resolved and this led France to move forward with the Dassault RAFALE programme, while the others developed the Eurofighter TYPHOON.

The current status of the RAFALE programme is that by mid-2017, 149 of the 180 aircraft on order for France had been delivered, with three scheduled for delivery in 2018, and the remaining 28 to be delivered by 2024. It was originally envisaged that France would take 286 RAFALE and that export sales would account for 300 more. Thus far RAFALE exports include 24 for Egypt (who want to acquire 12 more), 36 for India and 36 for Qatar. RAFALE is competing in an Indian Navy competition for 57 aircraft, other stated export opportunities exist in Belgium, Finland, Malaysia (although the new Malaysian government seems unlikely to advance the fighter programme) and the UAE. It is quite likely that RAFALE will obtain more export orders, but despite this, the expectations at the start of the programme for export and domestic orders have not been met. It therefore becomes clear that any RAFALE successor would inevitably have to be based on international collaboration.

In July 2017 President Macron and Chancellor Merkel announced the new Franco-German fighter programme. More recently, in April 2018 at the Berlin Air Show, Airbus Defence and Space and Dassault announced that they would be teaming for programme as the lead contractors. According to Dassault this Future Combat Air System (FCAS) programme will be: "developed as a system of systems, including unmanned aerial vehicles, connectivity and



Photo: MBDA

The MBDA Missile Moyenne Portée (MMP) has been selected by the French Army as the successor to the MILAN. 400 firing posts and 1,750 MMP missiles have been ordered and first deliveries were in December 2017. MMP is also likely to be acquired by Qatar. The MMP is a rare case of a national programme superseding an international collaborative programme.



secure communications.” They also state that FCAS will include a “next generation fighter aircraft to complement and eventually replace current generation of EUROFIGHTER and RAFALE fighter aircraft by 2035-2040.”

Although not as visible as the FCAS programme, France and Germany have signalled their intention to proceed with the joint development of a new MPA aircraft to be known as the Maritime Airborne Warfare System (MAWS). This will replace the existing French ATLANTIQUE 2 and German P-3C ORION MPA systems from the mid-2030s onwards.

Naval Progress

Naval Group of France and Fincantieri of Italy have successfully worked together on the Frégate Européenne Multi-Mission (FREMM) frigate programme, Naval Group building eight frigates for the French Navy at Lorient, plus a frigate for Egypt and one for Morocco. Fincantieri was contracted to build 10 FREMM for the Italian Navy, of which seven are in commission. The FREMM frigate design is also one of the five designs selected by the US Navy for further evaluation in connection with their FFG(X) future frigate programme. The FREMM is also being proposed for the Royal Australian Navy (RAN) frigate competition. Now the relationship between Fincantieri and Naval Group is on the verge of becoming much closer as France and Italy move to integrate the two companies to create a European naval industrial behemoth. France has long wanted to see the creation of what is often called a “Naval Airbus”, feeling that it was necessary to have a multinational European naval shipbuilder to be globally competitive and where Naval Group could play a leading role. It had been thought that France would seek to build this new European champion through an arrangement with Germany. This never became a reality, but the integration of Naval Group and Fincantieri is now on the verge of happening.

The path to this new company actually starts with Fincantieri making itself very unpopular in France, as it attempted to acquire control of the STX shipyard at St. Nazaire. Korean shipyard STX was in financial trouble and had looked to sell its foreign yards, attracting a joint bid from Fincantieri and another Italian investor for 55% of STX St. Nazaire. The French government blocked the acquisition in 2017. The reason behind this was that the yard had strategic value, the majority of the MISTRAL class LPDs were built there; and another factor was concerns



Photo: MoD France

A Dassault ATLANTIQUE 2 maritime patrol aircraft of the French Navy drops a GBU-12 laser guided bomb. The French Navy will need to replace its ATLANTIQUE 2 fleet from the mid-2030s, with Germany needing to replace its P-3C ORION fleet at the same time. Their replacement will be the new Franco-German Maritime Airborne Warfare System (MAWS).

over possible reductions in the labour force.

The St. Nazaire issue was finally resolved in February 2018 when Fincantieri was allowed to buy a 50% shareholding in the yard, with the other 50% divided between the French government (34.34%), Naval Group (10%), STX employees (up to 2.4%) and local suppliers to the yard (up to 3.26%). The French

All of this puts France at the centre of critical future European defence programmes in the ground systems and aerospace sectors. Other French companies such as Safran and Thales will also have key roles to play in these programmes, as will existing European forces such as MBDA. Once the integration of Fincantieri and Naval Group moves forward,



Photo: MoD France

LANGUEDOC (D653) was the third Frégate Européenne Multi-Mission (FREMM) built by Naval Group at Lorient and was commissioned in March 2016. FREMM was a joint programme between France and Italy, with Naval Group in France and Fincantieri in Italy as the industrial leads.

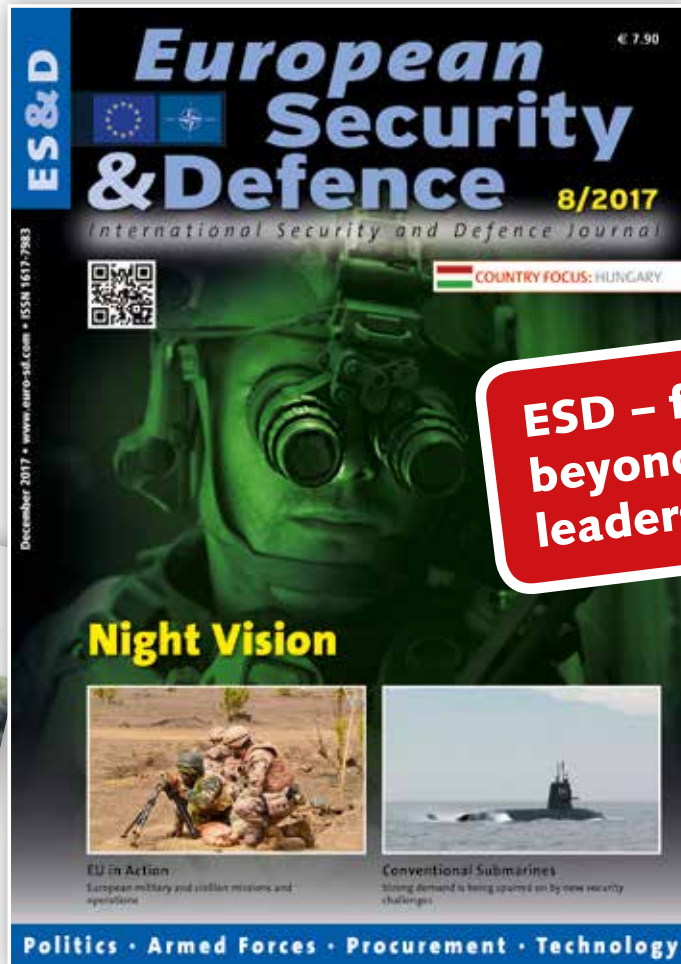
government will loan Fincantieri a one percent shareholding to give the Italian company operational control of the yard. With this issue resolved, the next step will see Fincantieri and Naval Group starting towards integrating their naval shipbuilding activities, with the eventual aim being a full merger of the two companies.

France will have secured the future of its defence industry in the air, ground and naval domains. Add this to France's effective and proven military capabilities, plus its sizeable defence budget and it becomes plain that France intends to make its voice heard and wishes known in matters of European defence. ■

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The Direction générale de l'armement – Seizing the PESCO Opportunity



**Interview with General (armament corps) Joël Barre,
Chief Executive of the Direction générale de l'armement (DGA),
the French Defence Procurement Agency**

ESD: In many western countries, the changed security-political situation in Europe has induced governments to allocate additional funds for defence and armament. To what extent and in what way has this trend influenced your country?

Barre: The world has entered an era of great turmoil, as shown by the findings of the French Strategic Review issued in October 2017. To respond to these threats and future challenges, the President of the French Republic has approved a 2030 Ambition programme for our armed forces. It rests on a balanced and full-spectrum force model capable, sustainably and over time, of guaranteeing the fundamental operational capabilities that are essential for our defence (deterrence, protection, knowledge and anticipation, prevention, and intervention). To realise Ambition 2030, he has decided to make unprecedented resources – €198Bn – available to the armed forces over the first five years of the Military Planning Law 2019-2025, covering the period until 2023. This exceptional increase in the budget earmarked for the armed forces reflects the President's pledge to increase defence spending to 2% of national GDP looking to 2025.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Barre: With the Military Planning Law 2019-2025, 50% of the Army's new medium size armoured vehicles will be delivered between now and 2025, in the framework of acceleration of the SCORPION programme. 32 CAESAR artillery guns will also be

delivered. The Navy will receive more modern nuclear attack submarines and frigates, with the delivery of new BARRACUDA, FREMM and FTI vessels (respectively 4, 8 and 2 to be delivered by 2025). The target number of patrol vessels is increased from 17 to 19, of which 11 new-generation patrol vessels will have been delivered by 2025. The Air Force will benefit from the arrival of new refuelling aircraft, drones, transport aircraft and new (28 RAFALES) or upgraded (55 M2000Ds) fighter planes. The number of refuelling and strategic transport aircraft will be increased from 12 to 15 looking to 2025, and delivery of the first 12 aircraft completed in 2023. This MPL will also usher in the renewal of the two components of the French nuclear deterrent.

ESD: Which of these are carried out in international partnerships and who are your partners?

Barre: Beyond the continuation of collaborative European programmes already launched (A400M, NH90, FREMM, FSAF, MUSIS, TIGER, etc.), the Military Planning Law for 2019-2025 intends to seek European cooperation more systematically than in the past. In the field of intelligence, the European MALE drone programme has been launched with Germany, Italy and Spain with a target of first deliveries in 2025. Also jointly carried out are: the future Anti Ship and Cruise missiles programme (with the UK), the preparatory studies on the future air combat system, on the next generation land systems (replacement of the LECLERC battle tank) and on the renewal of maritime patrol aircraft (with Germany), and the

MMCM project (with the UK) in the field of maritime mine warfare capability. Cooperation is also planned for our sea-refuelling tanker programme (with Italy). Finally, with Belgium, we have a significant perspective in the land field around the SCORPION programme.

ESD: In what way do you intend to consider the PESCO (Permanent Structured Cooperation) concept?

Barre: One of the major elements of the Military Planning Law 2019-2025 is to systematically seek European cooperation where possible, to benefit from the initiatives taken in Brussels, such as PESCO or the European Defence Fund and to move to strategic autonomy, which today is French but will have to be more and more European. Such a strategy involves industrial reconciliation, such as the "one MBDA" missile initiative. Such industrial linkages will have to continue to consolidate the technological base across Europe. It seems to me, there is a strategy for moving to the European level, which obviously has to be developed in a pragmatic way, while respecting our freedom of use, our sovereignty and industrial interests. From now on, the European Defence Fund gives us additional funding opportunities for both European military research and industrial development projects. We intend to seize the opportunity offered by these European credits and by the political impulse generated by PESCO.

**The interview was conducted
by Peter Bossdorf.**

The Royal Netherlands Navy

Jaime Karremann

The Royal Netherlands Navy is on the eve of a large-scale renewal. Almost half of the fleet will be replaced in the next fifteen years.

Although the number of ships will not increase, the plans are still the largest renewal plans in forty years. The main problems with the equipment seem to have been solved; the crew problems are clearly not solved. In November last year, Marineschepen.nl reported on the poor state of the Dutch fleet and especially of the frigates. The Air Defence and Command frigates were no longer able to fight. The ships have second-hand 127mm guns which are more than 50 years old; there are too few spare parts, and once weapon systems function they are transferred to other frigates.

The Defence Review 2018

When the Defence Review was published at the end of March 2018, it became clear that billions were being invested in the navy. The concise document listed plans for the coming years, which included the replacement of the M class frigates, replacement of the ALKMAAR class minehunters and replacement of the WALRUS class submarines.

These three replacement projects had already started at that time, but had become uncertain.

An important point in the Defence Review was the

excluded two options: "We are replacing the submarines with manned submarine capability. Research from TNO has shown that variants other than manned submarines cannot meet the need (and are very expensive) which is why these variants will no longer be pursued."

Future Programmes

The Defence Review also mentioned future programmes:

- Replacement of training vessel VAN KINSBERGEN (€25-100M) in 2025;
- Replacement of torpedo recovery ves-



Source: Koninklijke Marine

The new multirole M Class frigate

Although the new government that took office in autumn 2017 promised an extra €1.5Bn for the Dutch armed forces, the new Minister of Defence Ank Bijleveld quickly said that the additional amount would be insufficient for the planned replacements. Instead of continuing with the existing plans, she announced a Defence Review for Spring 2018. This marked a new low for the navy, despite recent successes: During exercise "Formidable Shield" in autumn 2017, the air defence and command frigate HNLMS DE RUYTER was quite successful when it tracked a ballistic missile in space. And when Hurricane Irma devastated the Caribbean islands the Marine Corps and the Navy's OPV HNLMS ZEELAND and Joint Support Ship HNLMS KAREL DOORMAN made an important contribution to emergency relief.

Author

Jaime Karremann is the Editor-in-Chief of the Dutch naval website marineschepen.nl.

choice of manned submarines. In 2016, the then Minister of Defence Jeanine Hennis had asked an external advisory committee led by former Shell CEO Jeroen van der Veer to investigate the replacement of submarines. The committee advised the MoD to consider four options: replacement by the same type of boats (ocean-going submarines), replacement by smaller homeland security submarines, replacement by unmanned systems or no replacement at all.

These four options received considerable criticism. For several years, the minister had explained in documents and debates why submarines were needed and why they should be ocean-going submarines. She had also explained that the tasks of the current submarines cannot yet be done by unmanned systems and that homeland security submarines are not of much use for The Netherlands because large parts of the North Sea are too shallow.

Despite the criticism, the Dutch defence organisation did investigate the four options and, surprisingly, the Defence Review

sel HNLMS MERCUUR and the two Hydrographic Survey Vessels (€25-100M) from 2026;

- Replacement of the diving vessels (€25-100M) from 2027;
- Replacement of the Air Warfare & Command Frigates (more than €2.5Bn) from 2029;
- Replacement of the Support Vessel HNLMS PELIKAAN in the Caribbean in 2030;
- Replacement of the Landing Platform HNLMS ROTTERDAM (€250M to €1Bn) from 2030;
- Replacement of the Landing Platform HNLMS JOHAN DE WITT (€500M to €1Bn) from 2032.

In addition to major replacement projects, many smaller projects were announced, such as the replacement of the GOAL-KEEPER Close-In Weapon System (CIWS) and the replacement of the HARPOON surface to surface missile. The decision to close fewer barracks was also made known. For the navy this means that the Joost Dourlein Barracks, home of the Surface Assault &

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The M-frigate MS VAN SPEIJK during the Joint Warrior exercise in Scottish waters in April 2014.

Training Group of the Royal Netherlands Marines Corps, will remain open. There is still a lot of uncertainty about the naval barracks in Amsterdam, which the armed forces wanted to close in 2018.

The Defence Review is not only about procurements. With the new investments,

the cutbacks on training and sailing days must be over and the backlogs in spare parts must be eliminated quickly.

With the Defence Review, the Royal Dutch Navy can make progress in the coming years. According to insiders, the new minister needed the note to convince op-

ponents (such as the Ministry of Finance) to invest in defence. It is the first serious investment in the Dutch Navy since the 1990s. Nevertheless, there is still no plan to expand the small Dutch Navy, which has only six frigates, four patrol ships, four submarines and three large auxiliary ships. In addition, the €1.5Bn earmarked in the review still do not mean that The Netherlands is approaching the NATO's defence spending benchmark of 2% of GDP. In fact, The Netherlands is moving further away from the NATO benchmark due to economic progress.

For extra investments on top of the €1.5Bn, the armed forces look forward to 2020, when the Dutch government will review the current plans. Whether additional investments mean that the navy can grow is uncertain, because for example the air force has put an eye on procuring more F-35 aircraft.

The A Letters

The Defence Review was not an empty promise. At the beginning of May, about a month after the presentation of the memorandum, Defence Minister Barbara Visser sent no fewer than ten "A" letters to the House of Representatives. Dutch defence projects are carried out through the De-

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fence Materiel Process (DMP), which consists of five phases: A–E. Letters with an A mark the end of the first phase during which the requirements are defined. This is followed by research phase B.

Most of the A letters had been sitting in the drawer in The Hague for some time. Because funds for some projects were scarce. For example, in 2013, Marineschepen.nl accidentally discovered a draft for replacing the M class frigate. The replacement of the minehunters had also been on the agenda for several years.

However, many projects really did start recently, and the following projects received an A letter:

- Replacement of the M class frigates
- Replacement of the minehunters
- A new supply vessel
- Midlife Update for the HNLMS JOHAN DE WITT
- Midlife Update for the Hydrographic Survey Vessels
- New Close-In Weapon System(s)
- ESSM Block 2
- A new 127mm gun
- A new anti-ship cruise missile
- A soft-kill torpedo defence system

Projects such as new ship builds are complex, but projects such as a new 127mm gun can be completed quickly and at low risk.

Combat Support Ship

The Combat Support Ship, or supply ship, is one of the latest naval projects. From 1975 to 2012 the Royal Dutch Navy had two tankers. When HNLMS ZUIDERKRUIS was decommissioned in 2012, it was replaced by HNLMS KAREL DOORMAN. HNLMS AMSTERDAM was sold to Peru in 2014, which is why then the Dutch Na-



Photo: Koninklijke Marine

HNLMS KAREL DOORMAN is a logistic support and supply vessel or Joint Logistic Support Ship (JSS). With a length of 205 meters, it is the largest ship in the Dutch Navy.

vy had only one supply ship. The HNLMS KAREL DOORMAN is not only a tanker, but also has strategic buoyancy and seabed tasks, which is why the navy does not have a full tanker, but only half a tanker.

Due to the sale of HNLMS AMSTERDAM, the navy wanted another supply ship. The arrival of a new tanker was announced in June 2017. This tanker will enter service in 2022.

This is an urgent issue not only because of the shortage, but also because the navy wants more commonality in the fleet. Therefore, the combat support vessel will, if possible, be similar to the Joint Support Ship HNLMS KAREL DOORMAN. The Logistics Support Vessel (LSV) designed by Damen for the

tender for the new Norwegian tanker is expected to serve as the basis for the planning process. The ship with a crew of 75 will be about 180 m long with a displacement of 20,000 tonnes. The new tanker must be able to support a task group of six ships for consecutive weeks and must be able to supply fuel via positions over starboard, port and aft. The ship will boast a large crane and space for 20 containers.

At the end of 2018, the contract may be signed. The Dutch government wants the ship to be built by the Dutch shipyard Damen. The tanker will probably be built on the Damen yard in Romania. The estimated costs range between €250M and €1Bn.

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M Class Frigate Replacement

Just like The Netherlands, Belgium has two M class frigates. All these four frigates will be replaced by new frigates from 2024 onwards. The Netherlands is in charge of this replacement programme.

The Class M frigates are developed in the same way as the Dutch Navy has been doing since the 1970s. The Defence Materiel Organisation is to design the frigate for the most part and will complete the design in collaboration with the chosen

the bridge. Sixteen cells are planned (for a maximum of 64 ESSM Block 2s). There is room in the nave for the new SSM, in the hangar for the new CIWS and in front of the VLS for the new gun. Which systems these will be, is not yet known.

The frigates will receive new radar sets to be developed by Thales in Hengelo. To detect submarines, the frigate will receive a Low Frequency Active and Passive Sonar (LFAPS). The frigates will also receive a UAV, which is a novelty for the Dutch Navy.

The new frigates must be able to remain

The new mine countermeasures vessels (MCMVs) will be able to deploy unmanned MCM systems. These can be Autonomous Underwater Vehicles (AUVs), Unmanned Surface Vehicles (USVs) and Unmanned Aerial Vehicles (UAVs).

The platforms are expected to be vessels of about 80 metres, almost 30 metres longer than the current minehunters. The ships themselves do not enter the mined area; they have an MCM toolbox on board to remove the mines remotely. Belgium is in a hurry with the project and wants to sign a contract for the twelve new vessels plus MCM toolboxes at the end of 2018.

Dutch advocates of commonality among naval vessels criticise the project, because the European tender gives Dutch project managers only a limited influence on the project when defining the requirements. The systems offered by the shipbuilder may differ from those currently in service with the Dutch and Belgian Navy which would mean more training and a higher logistical effort.

The first MCMV with toolboxes will be delivered to Belgium in 2023 and to The Netherlands in 2025. The estimated costs range between €250M and €1Bn.

New Submarines

The stack of A letters did not include the replacement of the WALRUS class, as this project is already in the B phase. At the end of this year, that phase will be concluded with a B letter.

Four companies are in the race to build the four new Dutch submarines. These are the Dutch-Swedish combination Damen-Saab, the German TKMS, the French Naval Group and the Spanish Navantia. Little by little, it is becoming clear what the companies want to offer. Damen-Saab will offer a submarine based on the Swedish submarine A26. TKMS will offer the Type 212 CD, which is currently being developed together with Norway. Naval Group wants to develop a diesel-electric version of the new BARRACUDA class SSN. Little is known about the plans of Navantia.

The first new submarine must enter service in 2027; estimated costs are more than €2.5Bn.

Other Projects

In the next decade, the Royal Netherlands Navy will not only obtain new ships but also new weapons. For the current Air Defence and Command frigate, The Netherlands wants to purchase new



The minehunter MS VLAARDINGEN in the Baltic Sea during the international exercise BALTOPS 2012

shipyard. In this case, the Dutch government has opted in advance for construction by Damen.

The four ships will be multirole ships, specialised in anti-submarine warfare. Part of this flexibility is provided by the multimission bay midships which can accommodate several containers with special mission equipment. These can be containers for staff, prison containers, freezer containers, containers for intelligence personnel, blood bank or storage containers. Automation will reduce the crew number down to 110 people. To make this possible, the navy establishes the Maritime Support Centre (MSC). The MSC will support all vessels on a logistical, operational and technical level on a 24/7 basis.

The ships will have ESSM Block 2, which will be launched from the VLS in front of

in service until the mid-2050s. These ships are also expected to be built in Romania and completed in Vlissingen. The estimated costs range between €250M and €1Bn.

Minehunter Replacement

The Dutch DMP will not be in charge for the replacement of the TRIPARTITE class minehunters, as Belgium is responsible for this project and has decided to launch a European tender. In 2016 and 2017, the Belgian Navy hosted its Industry and Technology Days, where companies were able to demonstrate their unmanned mine defence systems. A Request for Information (RfI) took place in 2017 and several companies expressed their interest in the project.

127mm guns. These guns must be able to fire precision guided ammunition and there are only two suppliers: BAE Systems' Mk 45 Mod 4 gun and Leonardo's 127/64 LW gun. It is also interesting that these guns are not only for the ADCFs, but possibly also for the replacement of the M class frigates, which currently have the 76mm Oto Melara gun.

The navy also wants to replace the old CIWS GOALKEEPER, which is currently being upgraded but will be decommissioned in the period from 2024 to 2030. Additionally, the frigates will receive a new anti-ship cruise missile which must have a land attack mode – a new requirement for The Netherlands. Whether the new submarines should also be able to launch these missiles is not yet known. The Dutch research institute TNO is currently researching laser weapons which are to be adapted for the new frigates. However, such a weapon system will only be installed on board after commissioning.

The Hague announced the modernisation of the JOHAN DE WITT in the coming years. The WALRUS class submarines, HNLMS ROTTERDAM and the ADCFs are currently being modernised.

Personnel Problems

The biggest problems with the equipment seem to be solved, but when it comes to personnel, the situation looks rather bad as the prospering economy confronts the Dutch armed forces with recruitment and retention problems.

In 2011, the human resources departments of the navy, army, air force and military police were merged into a single defence recruitment department. Even during the last recession, the new department had difficulties recruiting enough staff. Achieving the even-higher targets today is even more difficult due to the shortage of skilled labour. To make things worse, the commanders of the navy, army, air force and military police have only marginal influence on recruitment campaigns.

A report at the end of April shows that 15% of the jobs in the Navy are vacant, which increases the pressure on current personnel and increases the recruitment target for the recruitment department. A record high of around 4,500 vacancies is expected. As the problems persist, jobs outside the armed forces become more attractive for many employees,

making recruitment and retention even more difficult.

The Royal Netherlands Marines Corps has its own problems. In 2012, it was decided to close the barracks in Doorn (the Van Braam Houckgeest barracks) and to open new barracks in Vlissingen in 2022, but the move is controversial. The old barracks were too small and the local administration did not approve the enlargement of the Marines' compound. But the municipal administration of Vlissingen is pleased about the new barracks, since the area has to grapple with population decline.

However, many NCOs of the Marines fear problems for their families, they say that their partners cannot find work in Zeeland, and the area is remote while Doorn is in the middle of the country. According to the Dutch daily De Volkskrant, 10% of the marines resigned because of the planned move.

A little more money here and there will not solve the recruitment problems of the Dutch armed forces. Minister Bijlvelde has therefore announced further measures. We'll see if this works. What is certain is that the new ships and weapons are of little value without good personnel. ■

Source: Courtesy of the Public Relations Office of the SA Fleet, Simon's Town

State-of-the-art classification rules for submarines and naval surface vessels

Cost savings

Advisory services

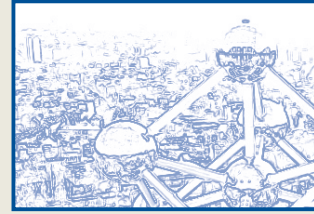
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NATO and the Black Sea Region

Joris Verbeurgt

The Black Sea is an almost completely landlocked mass of water separating Eastern Europe, the Caucasus and Western Asia. Although the origin of the name is surrounded by mystery, it is believed that it is derived from the anoxic nature of the Black Sea water that slows down the process of decomposition in the lower water layers, giving it a dark, blackish look. At 440,000 km², its surface is as big as the territories of Germany and Austria combined. The Black Sea is supplied by major rivers like the Danube, the Dnieper, the Dniester and the Don, while Istanbul, Odessa, Sevastopol, Trabzon and Yalta are just a few of the major cities along its coastline. To the west, the Black Sea is bordered by Bulgaria and Romania, to the north by Ukraine and Russia, to the east by Georgia and to the south by Turkey. To the north, it is linked by the 4 kilometre wide Strait of Kerch to the Sea of Azov, which stretches out between the Crimea and mainland Russia. In the south, Turkey's largest city Istanbul overlooks the narrow Bosphorus that connects the Black Sea with the Sea of Marmara. Via the narrow Strait of the Dardanelles, the Sea of Marmara offers access to the Aegean Sea, and thus to the Mediterranean. From an economic point of view, the Black Sea is an important year-round transportation artery, linking Eastern European countries with world markets. The historic Ukrainian city of Odessa is responsible for most of the sea's freight turnover. Several other ports in Russia, Georgia and Romania specialise in the transportation of petroleum, connecting oil-bearing regions with world markets. The Danube acts as a huge trade artery for the Balkan countries and links European capitals like Vienna, Bratislava, Budapest and Belgrade with the Black Sea region. Fish are the most widely utilised biological resource of the Black Sea. In recent years, the implementation of conservation and antipollution measures have succeeded in controlling pollution, sustaining fisheries and protecting marine life in what once was



Photo: NATOFRAN CPO C.Valverde.2018

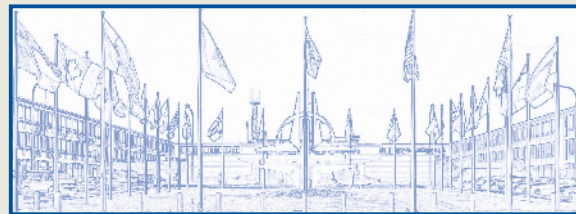
Standing NATO Maritime Group 2 (SNMG2) ship TCG GEMLIK launching its SH-70 B SEA HAWK helicopter as they participate in an Anti-Submarine Warfare drill during Romanian-led exercise SEA SHIELD. SNMG2 is currently deployed in the Black Sea, contributing to NATO's situational awareness and participating in international exercises with Allied nations in the region.

one of the most polluted sea areas in the world. Finally, tourism provides for a good share of income and employment around the Black Sea. The magnificent climate and mineral springs make it a major recreational and recuperative centre, with the contested Crimea region containing most of the important spa resorts.

Geo-strategic Importance of the Black Sea Region

Besides being important from an economic point of view, the Black Sea region is also significant from a geo-strategic standpoint, as it is a crossroads of east-west and north south corridors. The current geopolitical constellation is rooted in the conquest of the Crimea and parts of the Caucasus by the Russian Czarina Catherine the Great in the second half of the 18th century. In a series of wars against the Ottoman empire (precursor of modern-day Turkey), Russia gained access to the Black Sea, and, indirectly, to

the Mediterranean. The headquarters and the main naval infrastructure of the Russian Black Sea Fleet was established in the area of Sevastopol, a major harbour on the Crimean peninsula. Russian maritime presence in the Eastern Mediterranean was perceived as a threat to the colonial empires of Great Britain and France, and between 1853 and 1856, the bloody Crimean War was fought between Russia on the one side and Great Britain, France and the Ottoman Empire on the other side. The geo-strategic importance of the Turkish straits was also recognised by Winston Churchill as First Lord of the Admiralty in the First World War, when he ordered the disastrous landing at Gallipoli in 1915. Whoever controls the Black Sea region, can project power in the Balkans and in Eastern Europe, as well as in the Eastern Mediterranean, the South Caucasus and the Middle East. Since the Black Sea is home to three NATO members, Romania, Bulgaria and Turkey, and to partner countries of the Alliance (Ukraine and Georgia), hostilities in the Black



Sea region will automatically impact NATO's interests. For Russia, the Black Sea area is also essential if it wants to play a major role and regain its status of world power. It is no coincidence that Russia militarily intervened against Georgia in 2008 and against the Ukraine in 2014. Moscow annexed the Crimea, wages hybrid warfare in Eastern Ukraine and occupies South-Ossetia in Georgia, thus successfully preventing NATO's further enlargement in the Black Sea region.

Energy Security

Another hot topic in the Black Sea region is energy security: since the 1980s, offshore drilling for petroleum has been going on off the coast of the Ukraine. Discovery of new, massive oilfields in the area stimulated an influx of foreign investment and led to a (peaceful) territorial dispute with Romania which was resolved in 2011 by an international court redefining the exclusive economic zones between the two countries. The Russian annexation of the Crimea cast a shadow over the Black Sea and Caspian Sea energy corridor. Exploration, production, and transportation between the Caspian Sea basin and Europe has become a lot more complicated, while the EU's dependency on Russian gas continues to present an obstacle for Central and Eastern European regional energy security. To minimise Russia's influence on Southeastern Europe's energy sector, the EU should support oil and gas development around the Black Sea, including in Georgia, Romania, and the Ukraine. It could also diminish its dependence on Gazprom by expanding the network of gas interconnectors in the Black Sea and Central and Eastern Europe to allow the import of gas in the South-North, North-South, and West-East directions. From an Atlantic point of view, Gazprom's Turkish Stream gas pipeline from Russia to Turkey poses a threat to energy security around the Black Sea basin. To address this challenge, NATO boosted its presence in the area and expanded its naval and air force cooperation with Romania, Bulgaria, the Ukraine and Turkey. In this context, Exercise SEA SHIELD 2018 was held in the Black Sea from 7 to 13 May 2018. Naval assets from seven allied nations and NATO's Standing Maritime Group 2 trained maritime capabilities and combat proficiency. 21 naval ships,

10 fighter aircraft, a submarine, and 2,300 servicemen took part in this Romanian-led exercise. Rear-Admiral Daniel Căpățîna, the commander of the exercise, commented that 'By organising and hosting the SEA SHIELD 2018 Exercise, the Romanian naval forces, together with NATO allied forces, are contributing to strong cooperation in the Black Sea region and to the continued improvement of procedures that ensure safe and secure maritime activities'.

Russian Maritime Security

The Black Sea region is also a vital zone of interest for Russian maritime security. The Mediterranean Sea offers direct access to the Atlantic (via the Gibraltar straits) and the Indian Ocean (via the Suez Canal), and also to important regions like the Middle East, Southern Europe and North Africa. Moscow's viewpoint is that Russia must be able to act on the world seas anytime, anywhere, if it wants to be safe and acknowledged as a global power. And although the point of gravity in Russia's long-term maritime strategy is shifting from the Mediterranean and the Atlantic to the Arctic and Indo-Pacific regions, the Mediterranean Sea is the only sea accessible from the Black Sea, home to Russia's Black Sea fleet in the Crimea. However, the Achilles heel of Russian maritime operations in the Mediterranean is the Turkish Straits, a series of waterways that connect the Mediterranean to the Black Sea that forms an integral part of the sovereign sea territory of NATO member Turkey, subject to the Turkish regime of internal waters. Due to the strategic importance of the Straits, it is governed by the Montreux Convention of 1936, seriously limiting the use of the Straits by Russian military vessels.

Even more, the Straits are only a few kilometres wide and can easily be blocked, thus preventing the Russian fleet from setting sail into the Mediterranean.

The war in Syria proved that Russia intends to hold on to its access to the Mediterranean via the Black Sea. Under a 1971 agreement, the USSR established a Material-Technical Support Point for its navy in the port of the Syrian city of Tarsus. It is the only remaining refuel- and replenishment spot of the Russian Navy in the Mediterranean since the Russian fleet was expelled, first from Albania, later from Egypt, and is therefore of great strategic importance for Russia. The ongoing enlargement and modernisation of the Tarsus infrastructure and of the Black Sea fleet leaves no doubt about Russia's intentions towards the Black Sea and the Eastern Mediterranean. NATO, too, is preparing for a possible confrontation in the Black Sea region. At the Warsaw summit of 9 July 2016, NATO heads of state and government

Photo: NATO/GBRN LPhot Paul Hall



During a passing exercise (PASSEX) with Georgian Coast Guard vessels a Georgian boarding team boarded the Bulgarian frigate BGS DRAZKI (front, shown here conducting a sail pass with HMS DUNCAN).

stressed the evolving challenges and deteriorated security situation in the Black Sea region and stated their intention to support regional efforts by Black Sea littoral states aimed at ensuring security and stability. On the fault lines of the EU, Russia and Turkey, the Black Sea has become another zone of friction between NATO and Russia.

Military Operations in Urban Terrain

Doug Richardson

Thousands of years ago, the Chinese military theorist, Sun Tzu, wrote in his book *The Art of War*: “The worst policy is to attack cities. Attack cities only when there is no alternative.” That maxim held good until the 20th century, with most armies trying to avoid urban combat. This is not a practical tactic in modern warfare.

In 1960, 25% of the world’s population lived in cities. Today that figure has risen to more than 50%, and could rise to 85% by 2025. Already, 28 cities around the world each have more than 10 million inhabitants, so are classified as megacities. This trend of global urbanisation means that current and future warfare is likely to involve fighting in cities.

urban centres of Homs and Aleppo, and to the suburbs of Damascus. As this article was being written in March 2017, the Iraqi city of Mosul was under attack by an Iraqi-led coalition seeking to liberate it from the forces of the so-called Islamic State (ISIL), and some 70,000 civilians from that city and its environs had fled the area.

become three-dimensional, with combat operations that would cover a much wider area on open terrain becoming effectively compressed into a few square kilometres. Unless the attacker opts to use massive artillery strikes and bombing to level each building, effectively creating a traditional two-dimensional battlefield, soldiers have to think in terms of advancing vertically as well as horizontally.



Iraqi Special Forces soldiers assigned to assist US forces begin a house-clearing operation in Fallujah, Iraq.

In recent decades, a growing number of cities have become battlegrounds. Stalin-grad, Berlin, Hue, and Beirut have taken their place in the history books. More recent campaigns in cities such as Sarajevo and Fallujah are the stuff of study in military colleges, while in Syria the indiscriminate use of heavy artillery, bombing, and air-to-surface missiles in the last few years has inflicted massive damage to the

Urban combat can be a slow process involving a battle of attrition that results in human casualties among both the combatants and the local population, as well as a high level of destruction to buildings and other infrastructure. Large numbers of ground troops are needed to attack, clear, and hold cities, and it can be difficult for the attacker to differentiate between combatants and non-combatants, and to engage the opposition forces without harming innocent civilians.

A normal battlefield is two-dimensional. An area of terrain needs to be seized only once. But the presence of multifloor buildings in a city means that each small area of terrain may have to be captured several times as a building is systematically cleared floor by floor. The conflict has

Restrictions on Weapon Performance

An urban environment can place significant restrictions on fields of view and fields of fire, factors which limit the effective range of individual and crew-served weapons. These problems can be partially overcome by setting up observation and/or firing positions on tall buildings or high ground.

Weapon performance can be degraded by urban conditions. Smooth surfaces such as walls increase the chance of ordnance ricocheting, while impact-fused explosive rounds fired against rubble may not detonate. Night vision goggles and thermal sights may be dazzled by city lights, or by background illumination, such as fires.

While shorter-barrelled personal weapons such as carbines and sub-machine-guns may be handier when used inside buildings or in other cramped conditions, their lower muzzle velocity will reduce penetrating power against enemy body armour or the internal walls within buildings.

The mortar is the most practical indirect-fire weapon in urban combat. Its high angle of fire allows its projectiles to reach street-level areas that are masked by surrounding structures. Rounds fitted with variable-time fuses can be set to burst above enemy positions on the tops of buildings.

Snipers can be very effective in urban settings, causing casualties and reducing enemy morale. During Russian operations against Chechnya Fajr in the 1990s,

Author

Following an earlier career in engineering, **Doug Richardson** is a defence journalist specialising in topics such as aircraft, missiles, and military electronics.

Range and Power From Brno

Meeting Real 21st Century Needs

FK Brno (FKB) was founded in the city of Brno, in the Czech Republic, in 2012, with the intention of introducing new and innovative weapon systems and components that better fit the real needs of the 21st century theatres of operations, from experience gained and lessons learned in recent conflicts, for example in Afghanistan and Iraq.

Under the heading of "New and Innovative" FKB has developed several new calibres and projectiles, including the 6.2 FK Rifle, 7.5 FK pistol, the 10mm FK pistol, and the 8.6 FK Rifle / machinegun. There are also: a new pistol with a proprietary recoil system; a new sniper rifle; and a new SMG is in the pipeline, along with several new components and accessories, sighting systems and optics.

The markets to which these weapons appeal are global, but the strongest are the SF community and the private US market. The most popular product is the 7.5 FK pistol



highly-specialised systems used by SF units around the world - are generally only effective out to about 25 metres, if that: but experience acquired in Iraq and Afghanistan showed that most engagements occur at between 75 and 150 metres. More importantly, the pistol has to be an effective stand-off weapon in the field, for example should the operator lose his or her primary personal weapon - and not just with the range, but with the power. And all of this must be in a very small, ergonomically sound and compact package. The psychological effect on the soldier must not be underestimated; it's like having a backup rifle on your belt that also works inside buildings.

Considering the power for a moment, we are talking about a military projectile that will incapacitate an enemy combatant wearing full gear and a 3A ballistic vest at 100 metres or more, and will



system, which includes a new sighting system and a folding stock. What is special about this pistol as a weapon system is that it is the only pistol system on the market today that has a true effective range of more than 100 metres - and by "effective" we mean whereby the user will be able to actually engage the target at that range, without training, make accurate and pre-

cise contact with it and incapacitate it with a single round hit. This is made even simpler and easier if the shooter is using the very compact, lightweight proprietary folding stock, along with the butterfly sight or the new red dot sight.

There is some debate over the need for a pistol to shoot out to 100 metres, but current NATO systems - and even the

create a wound cavity that resembles that of rifles. This calibre has more energy at 150 metres than a 9mm NATO round has at the muzzle of the pistol, yet the special recoil system makes it usable even by novice shooters.

There are currently no products on the market today that can compete with this system.

Photo: US Marine Corps



A US M1A1 ABRAMS tank uses its 120mm main gun to fire into an enemy-occupied building during Operation Al Fajr in Fallujah, Iraq. Tanks can serve as artillery in support of infantry units, but the latter must play a complementary role by making sure that the vehicle is not attacked by RPG-armed or missile-armed enemy forces.

Chechen snipers often disrupted Russian attacks by targeting officers and radiomen. They sometimes fired at Russian soldiers with the intention of wounding rather than killing their victim, in the hope that first-aid crews and rescue personnel would arrive and become further targets. Operating in support of infantry, tanks can act as mobile artillery able to deliver concentrated and effective fire against enemy-held strongpoints. However, they need to be supported by infantry in order to ensure that they are not engaged by hand-held or portable antitank weapons such as rocket-propelled grenades (RPGs).

breech-loading 60 mm mortars on its MERKAVA tanks. Another potential problem is that tanks may be unable to depress their armament low enough to engage hostile forces lurking in basements. This is particularly an issue for users of Russian tanks and their derivatives, since these have only a modest depression capability.

The presence of dismounted troops or even civilians near tanks creates a potential problem, since many AFV self-protection systems such as explosive reactive armour (ERA) or counter-munition-based installations such as the Russian DROZD and German AWISS could pose danger to

anyone who is positioned close to a tank when these defences are triggered.

Command and control of forces is a challenge when operating in urban terrain. Units may have to disperse and become separated, but buildings, walls and other urban features are likely to interfere with communications. These terrain features may also limit the useful range of front-line EW systems such as COMINT receivers and tactical jammers.

EW must not be neglected in urban warfare, where the electronic threat can take novel forms. During the United Kingdom's long counter-insurgency campaign in Northern Ireland, the Irish Republican Army (IRA) used teenage boys to monitor British troop movements. Known to the soldiers as "dickers", these boys used cellphones to report the current position of British patrols. Man-portable systems are needed in order to detect and jam enemy radio and cellphone communications, and to jam communications links used to detonate improvised explosive devices.

Urban Canyons and Their Impact On Sensors

"Urban canyons" can limit the usefulness of GPS receivers by restricting their view of the satellite constellation. Maps can act only as a partial navaid, since they will show the street layout and, if up-to-date, can help ground forces to determine their location and orientation within the city, and to keep track of the areas and individual buildings that have been cleared. However they will give no indication of the function or internal layout of buildings (including combat-relevant features

Unhealthy Environment for Tanks

One problem faced by tank crews is that their armament cannot be elevated high enough to engage many types of rooftop and upper-floor threat. During their military operations in Grozny, the Russians used ZSU-23-4 SHILKA self-propelled quadruple 23 mm air-defence systems to engage such high-elevation targets. Operation Peace for Galilee in 1982 and Operation Defensive Shield in 2002 saw the IDF using the 20 mm VULCAN cannon of the M163 self-propelled anti-aircraft gun to engage snipers.

The limited elevation of a tank's main armament makes it difficult to use indirect fire to engage targets positioned behind buildings. The need for an indirect-fire capability is the reason Israel installed



Photo: US Army

US soldier using a shotgun to breach a door lock during a house-by-house clearance operation in Aksabah, Iraq.



Photo: ST Electronics

ST Engineering Electronics developed the Forward Sensor System (seen nearest the camera) and the Tactical Throwing Sensor (seen further from the camera) as mobile reconnaissance robots able to provide real-time video of an area of interest before military personnel are sent in.

such as internal shafts and ducts), and will not show subsurface features such as subways, sewers, and other tunnels. Close air support (CAS) for urban operations is made difficult by the fact that streets of tall buildings act as "urban canyons", reducing the ability of aircraft to manoeuvre, and makes them vulnerable to attack by anti-aircraft guns, MANPADS, or even RPGs hidden on high buildings. However, it does allow air commanders to focus their assets against specific locations rather than a large area. Laser-guided or GPS-guided ordnance offers the high accuracy needed to allow targets to be taken out using relatively-small or even inert munitions, thus reducing collateral damage. If necessary, these weapons can be delivered from high altitude. As a result, bombers such as the B-52 can be assigned to the CAS role. Thermobaric weapons are proving valuable against urban targets. Warheads of this type release an aerosol cloud of gas, liquid or finely powdered explosive which flows around objects and into cavities and structures. When ignited, this produces a plasma cloud that reaches temperatures of 2,500 degrees Celsius or more, with a burn time longer than that of conventional high explosive. The associated pressure wave has a longer duration than that from high explosive, and produces most of the warhead's lethal and destructive effects. Manufactured by KPB, the Russian RPO-

A SHMEL man-portable rocket launcher delivers an unguided thermobaric warhead against targets located up to 600 m away. It has been followed by an improved RPO-M SHMEL-M variant that offers improved ergonomics and an 800 m range. The blast effect of these two weapons has been compared to that of a 152 mm and 155 mm artillery projectile respectively. The equivalent US weapon is the NE (Novel Explosive) version of the Talley Defense Systems Shoulder-launched Multipurpose Assault Weapon (SMAW). Used in combat in Fallujah during 2004, its warhead produces an over-pressure wave capable of collapsing a lightly constructed building.

US thermobaric weapons suitable for use against urban targets also include the AGM-114N Metal Augmented Charge (MAC) Thermobaric HELLFIRE, which was specifically developed for use against enclosed structures. Its pressure wave is reported to be effective against enemy forces within bunkers and multi-room complexes.

Use of Unmanned Aerial Systems

The Israel Defence Forces were among the first to realise the usefulness of UAVs in locating and monitoring surface targets prior to and during urban assault operations. The lesson was swiftly learned

by other armies. During the second battle of Fallujah in November 2004, the attackers used UAVs as part of their 24 hour surveillance coverage, and were able to pre-identify more than 300 enemy defensive positions. Since most of the 300,000 Iraqi civilians had fled the city, the US forces and their allies were able to subject these locations to an aerial and artillery bombardment before and during the assault.

Violent non-state actors such as ISIL and Hezbollah have adopted UAVs both as reconnaissance systems and as attack weapons. Some of these UAVs have been supplied by countries that support the insurgents, while others are commercially available drones. ISIL is known to have used quadcopter drones against Iraqi forces attempting to recapture Mosul. Some were used for reconnaissance, while others dropped grenades on the attacking forces.

A major limitation of UAVs during urban conflict is that they cannot see inside buildings or improvised fortifications. However, ground-based robot vehicles provide a workable solution. These can take the form of small wheeled or tracked vehicles fitted with video cameras or other sensors, or even hand thrown sensor packages that can be lobbed through doors or windows.

Infantry-Intensive Operations in Urban Areas

Combat in urban areas is primarily an infantry-intensive operation, involving small units. It can rapidly transition between relatively low-intensity and high-intensity conflict, involving high operational tempo that allow little time for decision making. Control may sometimes devolve down to squad level, with communications with higher levels becoming degraded.

Faced with a dense network of streets, alleys, and corridors within buildings, units may become disoriented and confused, increasing their difficulty in distinguishing between other friendly forces and enemy personnel. Units taking significant casualties may be more inclined to "re-interpret" or even ignore rules of engagement, especially if the enemy does not observe the established rules of war. Entering suspect houses or other buildings through doors and windows is dangerous, since these could have been booby trapped with explosives. A safer technique is to cut holes in the walls, through which soldiers can enter the building, pass from room to room, or even from one building to another in order to avoid using streets

that could be subjected to opportunistic or pre-planned enemy fire. The Israel Defence Forces (IDF) used such techniques in Jenin during Operation "Defensive Shield" in 2002. But as the long-running operation to recapture Mosul has shown, the defenders are able to adopt similar tactics, creating routes along which their personnel and supplies can move without being detected.

The need to create improvised entry points into buildings has spurred the development of specialised equipment intended to reduce the risk posed to the attackers. Wooden doors, deadbolts, knobs, hinges and padlock hasps can be defeated by shotgun-fired munitions such as the US Army's M1030 anti-material cartridge, but walls required a more powerful weapon, such as Rafael's SIMON. Adopted in a slightly modified form by the US services as the Rifle-Launched Entry Munition (RLEM), this is a rifle-launched projectile incorporating a shaped-explosive charge and a nose-probe-mounted detonator which initiates the warhead at the optimum stand-off distance. Being a projectile, it does not require the user to get close to the wall, so reduces the risk to combat engineers.

Jointly developed by Dynamit Nobel Defence (DND), Rafael Advanced Defense Systems, and Singapore's Defence Science and Technology Agency (DSTA), MATA-DOR (Man-portable Anti-Tank, Anti-DOoR) is a 90 mm calibre shoulder-fired weapon. Designed to defeat armoured personnel carriers and light tanks, it can also blast an opening greater than 450 mm in diameter in a double brick wall, or act as an anti-personnel weapon against enemy personnel behind the wall. A countermass made of shredded plastic is launched out of the rear of the weapon when it is fired, allowing MATADOR to be fired safely from within an enclosed space. Wherever possible, multi-storey building should be cleared from the top down, with soldiers attacking the upper floors, then working downwards. This tactic clears high positions as soon as possible, making them useful for observation or sniping, and denying their use to the defenders. It also facilitates the use of hand grenades for room clearing, removing the risk that a grenade thrown up a flight of stairs will roll back down the stairs and explode near friendly forces.

As buildings and streets are cleared of enemy combatants, the attacking force must deploy stay-behind forces to make sure the enemy doesn't return. If additional personnel are unavailable to tackle this job, the numerical strength of the attack-

ing force will effectively decline as front-line soldiers are detached to handle this important secondary role.

The intense close-quarter combat likely in urban attacks requires a steady flow of ammunition, grenades, demolition explosives, and other munitions, along with the medical supplies needed for what could be a high rate of casualties. Soldiers may require urban-specific support equipment such as ladders, grappling hooks, and ropes, while knee and elbow pads and eye protection may prove useful in preventing minor injuries.

The use of sound suppressors (silencers) on small arms will reduce acoustic effects when weapons are fired indoors,

Challenges of the City

Poor sanitation in many urban centres in the developing world, along with environmental hazards such as contaminated water and toxic industrial materials, can create health problems for soldiers, as can infections picked up while operating in sewer systems. Built-up areas can typically be 10 to 20 degrees warmer than open terrain. This may increase soldier fatigue, and will create the need for additional drinking water.

The media can be a problem during any military operation, but particularly during urban warfare. If the attacker denies access to foreign journalists, the enemy

Photo: Israel Defence Forces



An Israeli paratrooper fits a Rafael SIMON wall-breaching munition to his personal weapon. The long nose probe will detonate the weapon's shaped-charge warhead at the optimum distance from the target. In US service, a variant of this weapon is known as the Rifle-Launched Entry Munition (RLEM).

or in other enclosed spaces such as tunnels. This will make it easier for soldiers to hear spoken commands, the words of enemy personnel or third parties such as hostages, or other sound cues. Greater use of non-lethal weapons should allow attackers to temporarily incapacitate people in a room, giving time that might allow them to distinguish between civilians and combatants.

When fighting at close quarters, muzzle blast and backblast from their own weapons can cause minor injuries to attacking soldiers, as can fragments from the blast of munitions detonated against an enemy position that may be only a few metres away. Falling debris, rubble, ricochets, shattered glass, fires, and accidental falls from heights will all add to the casualties experienced by the attacker.

may have been given an excellent propaganda opportunity. This is a problem that the IDF has faced in several of their recent military campaigns. By allowing TV crews limited access to the territory under its control, the other side was able to ensure that a steady stream of imagery showing wounded civilians (rather than wounded combatants) arriving at hospitals or treatment centres could be seen on TV news programmes around the world.

One thing seems certain; urban combat is here to stay, along with the challenges it poses. According to the American military theorist Robert R. Leonhard: "Just as the [US] Army learned to own the night instead of fearing it, so also must we own the city. Tomorrow's objective is not the top of a hill; it lies in the middle of a city block, surrounded by noncombatants." ■

Serbia Evaluates Defence & Strategic Choices

David Saw

The world is changing, and for Serbia that means it must generate a vision for the future and escape from the unpleasant history of the recent past, with its negative social and economic legacy.

Over the next few years, Serbia will have to get its economy back on track, it must deal with unemployment and its social consequences, and reform its governance. It must also decide whether it wants to be part of the European mainstream or whether it prefers to look eastwards and forge a stronger relationship with Russia. Serbia's leadership has some critical choices to make as regards the future direction of the country, and this will happen over the near term, for the simple reason that timing is too sensitive to postpone these decisions. The crux of the matter is whether Serbia is willing to embark on internal reforms in the political, legal, economic and industrial sectors and deal with the consequences, whether positive or otherwise.

After internal reforms, the Serbian government must then seek to define its place within the European space. According to the EU, "on 21 January 2014, the first Inter-governmental Conference took place, signalling the formal start of Serbia's accession negotiations." In reality, this was the start of talks between the government of Serbia and the EU that aimed to establish the legal and financial basis for Serbian accession to the EU. One issue that remains an obstacle is the question of relations between Serbia and Kosovo; what the EU is seeking is the normalisation of relations between Belgrade and Pristina. What the EU wants is a legally binding agreement between the two, covering recognition of Kosovo by Serbia, and the creation of mechanisms to resolve disputes between the two countries. There are still a number of unresolved disputes between the six West Balkan countries seeking EU membership; these are Albania, Bosnia, Kosovo, Macedonia, Montenegro and Serbia.

Joining the EU?

From the perspective of the EU, their objectives in the West Balkan region are to bring stability to the area, combat Russian influence, deal with the migration crisis as

Photos: Serbian Armed Forces



The main fighter of the Serbian Air Force is the MiG-29, but the fleet had been reduced to three flyable aircraft, plus another that could be returned to service following a complete overhaul.

immigrants seek to transit the West Balkan area to head towards Western Europe, deal with transnational crime centred on the West Balkans and handle concerns over the political situation in Turkey and the impact that it might have on the Balkans and Europe beyond. Another factor of importance for the EU is that an EU post-Brexit expansion will be seen as a positive and necessary step.

Although the EU acknowledges the importance of the West Balkan region, the process of becoming an EU member-state remains time consuming. In January 2018 Reuters interviewed European Neighbourhood Policy and Enlargement Negotiations Commissioner Johannes Hahn who disclosed that both Serbia and Montenegro could join the EU by 2025. This was said to be a realistic, but still ambitious, timeline for both countries to become EU members. While joining the EU represents a logical course of action for Serbia, there is absolutely no interest in joining NATO. Serbia joined the Partnership for Peace programme and the Euro-Atlantic Partnership

Council in 2006, while deepening cooperation with NATO through an Individual Partnership Action Plan signed in January 2015. However, as NATO puts it: "NATO fully respects Serbia's policy of military neutrality." Added to which, the legacy of the NATO bombings of Serbia in 1999 is still too real and too recent to contemplate any closer relationship with NATO. However, it is fair to say that both the EU and NATO do increasingly see Serbia as a force for stability in the West Balkans.

Economic Questions

If Serbia is expected to contribute to stability in the West Balkans it can only do so if its economy is performing effectively. Unfortunately for Serbia, its economy was until quite recently in deep trouble and had been so for many years. Although there is some nostalgia for the former Yugoslavia, especially for its economic stability, the reality of the situation was that the Yugoslav economy was in a disastrous state prior to the breakup of the country. The Yugosla-

vian economy was a variant of the socialist command economic model and it inevitably shared the inefficiencies of that model. One of the main sources of revenue for Yugoslavia was remittances from Yugoslavians working abroad; this, added to whatever foreign currency was gained by conventional exports, increasingly became absorbed by payments to cover Yugoslavia's burgeoning foreign debt. Real incomes were declining along with the standard of living, unemployment and underemployment was rising, and foreign debt was in excess of US\$21Bn; it was becoming increasingly hard to make the necessary payments. By the end of the 1980s, the inflation rate is reported to have reached 1,000%!

Then politics took command. In 1989 Slobodan Milosevic became president of the Republic of Serbia, leading eventually to the violent breakup of Yugoslavia. The conflict commenced in June 1991 and continued until the signing of the Dayton Peace Accords in 1995. Then came the war in Kosovo between 1998 and 1999, and the NATO military intervention.

The cost of these conflicts was devastating; between 1991 and 1995, over a million people lost their jobs and Serbian GDP fell to 55% of what it had been in 1989. The NATO bombing campaign over Serbia in 1999 caused grave damage to both infrastructure and industry. This added to sanctions which further imperilled the Serbian economy. It was only with the fall of Milosevic in September 2000 that steps could be taken to halt the social and economic collapse threatening Serbia. Achieving economic recovery was a much harder proposition and the Serbian government is still working towards that objective today.

Serbia would eventually turn to international institutions, such as the International Monetary Fund (IMF) for economic assistance. This was particularly important as the local economy started to experience problems. According to the IMF, "In 2014 Serbia's economy was in serious trouble. Following the 2008 global financial crisis, the country's economy stagnated, while weak public institutions, collapsing tax receipts, and overspending by government and state-owned enterprises resulted in a rapid build-up of public debt. Recognising the unsustainable situation, the authorities adopted an ambitious programme of fiscal adjustment, financial sector strengthening, and broad-based economic reforms. The IMF supported the programme with economic advice and monitoring, along with precautionary financing."



Serbia had a very effective integrated air defence system, in which the 2K12 KUB-M was an important component. Now this air defence system is in need of modernisation.



The Serbian Army is in the process of acquiring some 1,500 SCAR L 5.56x45mm assault rifles from FN as part of a programme to equip 1,500 troops with advanced weapons and systems.

The IMF structured a US\$1.32Bn support programme, with the programme being successfully completed in February 2018. The IMF commented that: "After three years of effort under the programme, the economy has turned around. The fiscal accounts, with the second-largest deficit in Europe in 2014, boasted a surplus in 2017. Economic confidence has improved with stronger investment both from foreign and domestic sources. Unemployment is near historic lows, and falling. Banks are solid, and nonperforming loans are now below their pre-crisis levels."

These are positive developments, but there is much still to be done. There must be ongoing reform of institutions and public services, corruption must be fought, state enterprises must be reformed or privatised, and infrastructure must be improved. Fortunately Serbia has much to offer foreign investors, and should the economy continue to develop, that should create a solid foundation for EU membership and the anticipated benefits that should entail. The signs for the future are good, though; GDP growth in 2017 was 3%, with a growth rate of 3.5% expected in 2018.

Defence Context

The Stockholm International Peace Research Institute (SIPRI) Military Expenditure databases provide a comprehensive picture of military expenditure, in terms of military expenditure as a percentage of GDP, and in terms of actual money spent in constant 2015 US dollars. Looking at the figures for Serbia is instructive; the figures demonstrate that military expenditure has, with some exceptions, been on a downward path since 2000. In 2000 military expenditure as a percentage of GDP was 5.2% and in cash terms that amounted to US\$1,317M. The next year saw military spending as a percentage of GDP decline to 4%, equivalent to US\$1,049M in constant 2015 US dollars.

The figures for 2009 showed slighter decline: expenditure was 2.3% of GDP, worth US\$854M. More of the same in 2010, down to 2.2% of GDP and worth US\$829M. From 2011 onwards, expenditure figures are primarily about declining resources. That year, expenditure was 2.1% of GDP, and this was worth US\$796M. For 2012, expenditure was still 2.1% of GDP, but this only generated US\$769M. In 2013 military expenditure as a percentage of GDP was down to 2%, delivering US\$745M. A boost to 2.1% of GDP came in 2014, providing a little more money at US\$752M.

Since 2014, military expenditure has been further reduced; in 2015, it was equivalent to 2% of GDP, amounting to US\$724M, while the figures for 2016 were 1.9% of

Another factor that needs to be taken into account is the Serbian defence industry, which is regarded as a key national strategic asset. The defence industry in Serbia can trace its history back to the mid-19th century and, post-1918, the defence industry in Royalist Yugoslavia could meet most ground forces needs, as well as producing combat aircraft and naval vessels up to destroyer class. Post-1945, with the establishment of the Socialist Federal Republic of Yugoslavia (SFRY), the Tito government looked to rebuild an indigenous defence manufacturing capability. This industry was seen as an essential component of the SFRY policy of territorial defence and industrial self-reliance.

Inevitably, the breakup of Yugoslavia and the resulting conflicts impacted on the defence industry, but it survived and these days in Serbia it is seen as a vitally important national asset. Obviously, as defence spending in Serbia has contracted that has increased the financial pressure on the domestic industry. Fortunately, the industry has proven to be very successful in terms of export markets in recent years, with the government being prepared to invest money to further develop the industry.

In March, Prva Petoletka-Namenska (PPT Namenska) in Trstenik, Serbia, opened a renovated production plant that was the result of a €2.2M government investment. PPT manufactures grenade launchers, RPG-7s, 60 mm MO6, MO6C and M57 mortars, 81 mm M69BK and 82 mm M69A mortars and 120 mm M74 mortars. In addition, they manufacture aircraft landing gear, the MILOSH unmanned ground vehicle and a range of civil products.

Serbian Defence Minister Aleksandar Vulin opened the renovated PPT Namenska facility and spoke on the current state of the Serbian defence industry. He stated that "Last year (2017), the value of defence industry exports was about €570M, which is 17% more than in the record year 2016 and almost three times more than in 2012. This year we expect the total exports to exceed €600M."

Exports markets for Serbian defence equipment, both new and surplus, have included Bangladesh, Cambodia, Cameroon, Congo, Ethiopia, Iraq, Kenya, Myanmar, Nigeria, Saudi Arabia and Sudan amongst others. Exports to the Middle East have been particularly important for the Serbian defence industry and have included both new production and surplus equipment.

The Serbian government is also looking to further develop the defence industry. Minister Vulin added that: "We are looking forward to new investments, new



Photo: Serbian Ministry of Defence

120mm M74 mortars manufactured by Prva Petoletka-Namenska (PPT Namenska) in Trstenik, Serbia. The sand colour on the mortars gives an indication as to their final destination. In 2017 Serbian defence exports amounted to €570M; in 2018 they are expected to exceed €600M.

The figures for 2002 show a slight rise in expenditure: expenditure as a percentage of GDP was 4.2% and in cash terms that was worth US\$1,160M. Then came a decline, expenditure as a percentage of GDP was down to 3.4% equivalent to US\$1,016M. The next year saw military expenditure at 3% of GDP, equivalent to US\$939M. In 2005 military expenditure was down at 2.4% of GDP or US\$787M, the figures for 2006 were military expenditure at 2.3% of GDP, although this was worth US\$794M. In 2007 there was a rise in expenditure, it was equivalent to 2.4% of GDP and this was worth US\$895M. Then came a slight decline in 2008 to 2.3% of GDP, worth US\$869M.

GDP and US\$714M. According to SIPRI, Serbia had military expenditure, in constant 2015 dollars, of US\$710M in 2017. Once the Serbian economy got into trouble and the Serbian government was forced to seek IMF assistance in 2014, it was inevitable that there would be no additional funding for defence. The Serbian military is also a fully professional force which brings many advantages, although personnel costs are higher even with reduced numbers compared to the previous model of a mixed professional/conscript force. Reduced funding also creates a problem in that Serbia has a lot of legacy equipment that, at best, needs upgrade and modernisation, and at worst is functionally obsolete and ought to be disposed of.

technologies, business partners, but complete control and full ownership of the state of Serbia in the defence industry shall remain." As such, Serbia is open to joint ventures for its defence indus-

Mi-17 helicopters and four Mil Mi-35 attack helicopters. Serbia already operates a fleet of 10 Mi-8 and Mi-17 helicopters, having received its last two Mi-17V-5 variants from Russia in June 2016.



In December 2016, Russia offered Serbia a package of equipment including MiG-29 aircraft, T-72S tanks and 30 BRDM-2 armoured reconnaissance vehicles.

try, but intends to keep a 51% holding in its defence companies. Thus far, the best recent example of international collaboration between Serbia and a foreign partner is the 2014 military cooperation agreement with the United Arab Emirates (UAE) under which the UAE is funding the development of the Serbian Advanced Light Attack System (ALAS) missile family.

Acquisitions

Ideally the Serbian Armed Forces would like to embark on a comprehensive set of programmes to acquire new equipment, modernise existing inventory and retire obsolete systems. Unfortunately that is not a viable proposition due to the limited acquisition spending that can be supported by the defence budget. However, Russia has proven to be a major source of equipment recently, reflecting the traditional links between Serbia and Russia and Serbia's strategic position in the West Balkans.

In early April, Serbian Defence Minister Aleksandar Vulin met with his Russian counterpart Sergey Shoygu, with expanding defence cooperation being a key topic. One major programme under discussion was the acquisition of four Mil

The Serbian Air Force MiG-29 fleet had been reduced to three flyable aircraft in the form of two MiG-29Bs and a single MiG-29UB, with an additional MiG-29UB that could be returned to flying condition subject to an overhaul. In an effort to bring the MiG-29 fleet up to strength, Russia offered Serbia six MiG-29 aircraft. The offer was accepted in December 2016, and in October 2017 all six aircraft were delivered to Serbia. The aircraft were supplied in a disassembled condition and are due to be modernised to the MiG-29SMT standard. In January 2017, Serbia announced that Belarus would be supplying them with eight surplus MiG-29 aircraft.

Russia also agreed to provide Serbia with 30 T-72S tanks and 30 BRDM-2M armoured reconnaissance vehicles. Serbia had attempted to get ground-based air defence equipment included in the Russian offering, but this was not achievable. On the other hand, Belarus was prepared to offer two BUK-M1 batteries, like the MiG-29s on offer; these would be supplied gratis, but Serbia would have to pay for the overhaul and upgrade of the systems in Belarus. Serbia is certainly interested in acquiring more air defence equipment from either Russia or Belarus,

but in the end it comes down to what is on offer and what it would cost to bring such systems to the standards required by Serbia.

While the willingness of both Russia and Belarus to supply equipment on favourable terms is a welcome development, they are not the only players vying for influence in Belgrade. In June 2017, China donated €900,000 worth of equipment to Serbia, including snowmobiles, rubber boats and explosives detectors amongst other systems – further proof that Serbia and the rest of the West Balkans is becoming prime strategic real estate.

This influx of foreign equipment is extremely useful, but it is not enough to allow the Serbian Armed Forces to reach the level of capability that they want. Progress towards this objective can only be made if the large quantity of legacy equipment, either of local manufacture or sourced from foreign suppliers, is modernised. Air defence missile systems and the accompanying ground-based air defence net of the Serbian Air Force are prime targets for modernisation, in particular the 2K12 KUB-M (SA-6) missile system.

As far as the ground forces are concerned, the BOV M-80A Infantry Fighting Vehicle (IFV) fleet is being slowly upgraded to the M-80AB1 configuration. This features enhanced protection and mobility, plus a significant increase in firepower through the installation of a new 30 mm cannon, plus the MALJUTKA 2T5 anti-tank guided missile system which has a range of up to 5,000 metres. Another major programme is the gradual upgrade of the T-84 tank fleet, which will see the integration of an advanced fire control system and new day/night sights, offering a major boost in first round hit probability.

The next few years appear to offer Serbia great promise. The fact that the economy is growing again at a significant rate is a very positive achievement; this should also make Serbia a favourable destination for Foreign Direct Investment (FDI). Such FDI is also likely to find its way into Serbia's defence industry, which will increase both the capabilities and competitiveness of the Serbian defence industry. Economic growth will also help the Serbian Armed Forces, in that there will be more money for defence expenditure and potentially a much greater range of indigenous defence solutions to choose from. Finally, EU membership in 2025 will give Serbia the economic and strategic stability that it has been seeking for many, many years. ■

“As submarines evolve, so must the techniques to find them.”



RADM Andrew Lennon. As commander, Submarines NATO, Lennon is responsible for operational tasking of submarines assigned to the alliance.

ESD: Admiral Lennon, what is the role of COMSUBNATO?

Lennon: COMSUBNATO is NATO's only submarine operating authority, responsible for operational tasking of all assigned submarines. The staff is manned by about 30 professional submariners from all 13 submarine-operating NATO nations. And I'd like to point out that I am greatly impressed by their professionalism. Our waterspace management region stretches from the Arctic to the Eastern Atlantic, the Baltic, the Mediterranean, and into the Northwestern corner of the Indian Ocean. We organise major submarine exercises and we are responsible for de-

Interview with Rear Admiral Andrew Lennon, Commander Submarines NATO (COMSUBNATO), on board NATO's Standing Naval Maritime Group 2 flagship, the Royal Navy's Type 45 destroyer HMS DUNCAN.

velopment of submarine-related policies, plans, doctrine, tactics and procedures. COMSUBNATO also serves as the Submarine Movement Advisory Authority to de-conflict undersea transits and operations among Allied nations and partners.

ESD: What is the training value of exercises such as Dynamic Manta 2018?

Lennon: Exercise Dynamic Manta 2018 is NATO's premiere anti-submarine warfare (ASW) exercise, complex and resource-intensive, conducted in the Mediterranean and an opportunity for the COMSUBNATO staff and the participating navies to practice their maritime and wider theatre skills in a live environment to evaluate and raise their proficiency. As you know, anti-submarine warfare is fairly complex. Finding and tracking a submarine requires multiple assets, for example ships, fixed- and rotary-wing aircraft and even other submarines. Detecting a submarine and to carry out coordination at the highest level is quite demanding. This year's edition sees a strong contribution from no less than ten NATO nations. With such an amount of assets, our team does extensive preparation and planning to maximise the quality of the series in order for every crew to benefit. The more realistic we make interactions between ships, air-

craft and submarines, the better we will be prepared to deal with live operations.

ESD: What does the exercise demonstrate about the maritime security challenges which exist in the Mediterranean or beyond?

Lennon: ASW is an important capability for NATO's maritime component. Dynamic Manta is a part of a long series of live training exercises that we have conducted for decades to ensure NATO is ready to defend allied nations. This exercise allows our navies to continue to practice anti-submarine warfare with coordination of air, surface, and subsurface assets in order to quickly and effectively respond to a wide variety of surface and sub-surface threats in an increasingly complicated maritime environment. As submarines evolve, so must the techniques to find them. These tactics, techniques and procedures are tested and practiced in exercises like Dynamic Manta. That is why people want to come to this exercise.

ESD: What is the Alliance's current level of ASW capability development?

Lennon: There is a clear recognition from the Alliance that ASW is critical, proof being that so many NATO navies assigned



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assets to this year's edition of Dynamic Manta. It is a domain that we still own. However, if we are not careful, the level of that dominance could get lower. Consequently, staying on the cutting edge of technology is vital to maintaining the upper hand over potential adversaries. But assessing naval strength is not simply a matter of counting numbers of ships and submarines; the quality of the platforms is important, and their capabilities. So we have to continue to think about our forthcoming investments.

ESD: I suppose NATO is forced to revive its sub-hunting skills that in the past lay somewhat dormant.

Lennon: Over the past decades, the Alliance has been presented with a variety of challenges. Navies were engaged in what are termed "reassurance missions", with their tasks focused on other maritime security tasks such as counter-piracy operations in the Indian Ocean and Horn of Africa which is why some high-end warfighting skills did atrophy somewhat. In the last few years though, NATO's maritime command has refocussed on more complex warfighting skills like ASW through exercises like Dynamic Manta and Dynamic Mongoose in the North Atlantic. There are also several other national exercises in which NATO units participate. Realistic and increasingly complex exercises provide a venue for excellent training and the opportunity to keep skills sharp. This regular practice and training combined with new investments in ASW assets on the national side ensure NATO is capable and ready.

ESD: What are your thoughts on the current state of submarine training?

Lennon: In today's world everything is so complex that our sailors need to carry out highly technical tasks. As such we need well trained and very sharp people who understand their tasks and missions. Developing the proficiency of our sailors is imperative. COMSUBNATO will continue to emphasise high-end warfighting skills, providing training and practice for NATO and value to nations. DYMA is especially praised for its realism.

ESD: One sees a build-up in Russian submarine activity in both the Atlantic Ocean and the Mediterranean. How is NATO responding?

Lennon: The Russians are investing heavily in their maritime capabilities. Russia has put to sea quality submarines in the last years, such as improved Kilo class (Project 636M) submarines, capable of firing

KALIBR sea-launched cruise missiles, and the BOREI class (Project 955/955A) submarines carrying the RSM-56 BULAVA 30 submarine-launched ballistic missiles. The increase in the Russian Navy's "out-of-area" deployments requires our attention. We have to maintain a persistent presence on and below the ocean waters with continued submarine patrols, preferably combined with aerial surveillance of Russian movements. Therefore we must remain a modern, capable and credible force that requires investments in state-of-the-art systems and technologies.

ESD: How do you see NATO submarines contributing to sustained assurance measures?

Lennon: Submarines are a key part of NATO's strategic maritime plan. While I cannot discuss specific operations or plans, rest assured that NATO submarines are contributing to sustained assurance measures. Submarines provide direct support to NATO's operations with intelligence gathering, surveillance and reconnaissance operations on activities.

ESD: How can COMSUBNATO meet all these challenges and contribute to NATO tasks in the maritime environment?

Lennon: Protecting the maritime domain and ensuring security at sea is imperative. Not only are Russian submarines returning to Cold War levels of operational activity, but these submarines have made a major jump in technological performance. In order to be prepared, our primary goal is to assure freedom of navigation and safe access for all. To do this properly we must have a good idea of what is going on under the water as well as on and above it. Robust situational awareness is key to understanding the environment. NATO's submarine forces have already taken a forward-looking approach, investing in modernisation to ensure that their forces are able to meet the challenges that future maritime operations will require.

ESD: In which areas would you wish to see improvements?

Lennon: As an Allied Maritime Command we must have credible ASW skills in all of the areas where we operate in, or that we may need to operate. NATO needs to increase its ASW capabilities, bolstering forces at sea in general and in anti-submarine warfare efforts in particular, such as looking at sensors, sonar, weapons control, quieting technologies, undersea drones, and communications systems to help its submarines maintain their edge. That requires investments in state-of-the-art systems and technolo-

gies. Each of the Allied nations needs to make its own decisions on what platforms, capabilities and technologies to acquire. I would like to see strong investment in high-end detection systems and secure, resilient communications systems.

ESD: What new capabilities and technologies can ensure that NATO is ready to meet future needs?

Lennon: I am well aware that acquiring new platforms is a political question for many navies. Dedicated ASW units and towed array systems are very expensive equipment indeed. What we may need to do is to be more innovative, looking at clever and inexpensive ways and systems such as use unmanned and remotely operated robotics like UAVs, UUVs, etc.

ESD: How does COMSUBNATO plan to build upon its engagement with submarine-operating nations, both within the alliance and with partner nations?

Lennon: Staying on the cutting edge of technology is vital to maintaining our edge over potential adversaries. We rely on open communications with the national submarine force commanders to ensure our continued success. The relationships established between the various command staffs are vital to efficient operation. We hold annual staff and commanders' conferences as well as maintain regular contact and engagement through the exercise programme and support to NATO Maritime Security Operations including Operation Sea Guardian.

ESD: Can you give us an insight into where COMSUBNATO is heading?

Lennon: The future looks promising. It is very clear that the submarine-operating NATO nations consider the functions of COMSUBNATO to be highly important. This is reflected not least by the fact that we see so many navies contributing to this year's edition of Dynamic Manta. A key component of NATO's response is to synchronise our presence and posture throughout Europe and be ready to deliver the message that we are here and committed to the alliance's member states and partners and capable to deter any adversary. Operational excellence is achieved through exercise planning and execution, coordinated operations, and continued improvement.

ESD: Admiral Lennon, many thanks for granting this interview.

The interview was conducted by Guy Toremans.

The Canadian Submarine Force: A Strategic Security Asset for Canada

During Exercise DYNAMIC MANTA 2018 ESD spoke with Captain Christopher Robinson, Commander Canadian Submarine Force.

The Royal Canadian Navy's VICTORIA class (ex-RN UPHOLDER) submarines have experienced a difficult time since they were acquired from the Royal Navy in 1998. The subsequent discovery of leaks, ship valve cracks, and even a dented hull in one boat, was but the beginning of a litany of problems that maligned the programme. On top of that, HMCS CHICOUTIMI suffered a fire during its delivery voyage from the UK in 2004 – an incident that sidelined the rest of the Royal Canadian Navy's (RCN) submarine fleet while the boat was towed back to Scotland. But all that is history now. Since 2014, the Canadian Submarine Force has maintained a steady state, that is to say, it reached its goal to have three of the four submarines available for operations, with the fourth in deep maintenance. This allows the RCN to turn the proverbial page of the embittered VICTORIA class programme.

ESD: Captain Robinson, the Royal Canadian Navy certainly reached a turning point in the troubled history of its submarine force. Today we see them on long deployments. What is the current status of the four VICTORIA class boats?

Robinson: The RCN is operating the VICTORIA class submarines in a cycle that sees two boats at high readiness – one on each coast – a third boat at standard readiness conducting basic training, and the fourth in deep maintenance. Currently [as of March 2018] HMCS CORNER BROOK is docked at Victoria Shipyards Co. Ltd in Esquimalt, undergoing her Extended Docking Work Period (EDWP) and due to return to operational service in 2019; HMCS VICTORIA is in operational preparations and our two high-readiness boats are HMCS WINDSOR and HMCS CHICOUTIMI.

HMCS CHICOUTIMI sailed Esquimalt in mid-September 2017 on a routine seven-month deployment to the Asia-Pacific region and returned to her homeport Esquimalt on 21 March 2018. HMCS CHICOUTIMI's 197-day deployment was designed as a routine Canadian Navy unit's – be it a surface combatant or a submarine deployment to help to signal, as outlined

in Canada's Defence Policy, the strategic importance of the Asia-Pacific region to Canada while reinforcing Canada's commitment to the maintenance of regional peace and security. This was the first time in 50 years that Canada has deployed a submarine across the Pacific and the first time ever for a VICTORIA class boat. The mission of HMCS CHICOUTIMI was planned more than a year ago and in-

terranean Sea for the first time. HMCS WINDSOR already deployed previously to the European theatre, in 2015/2016, but operated only in Atlantic and northern European waters. On this deployment to take part in a major NATO exercise, HMCS WINDSOR was re-tasked on a mission to try to track a "surge" of Russian subs that had deployed into the North Atlantic.



The crowded bridge of HMCS WINDSOR when the submarine left Augusta Naval Base on 6 March 2018 with Captain Chris Robinson in the centre

involved re-establishing naval relationships with Asian nations. The mission marked the longest deployment of a VICTORIA class submarine to date. Our sub visited Hawaii, Guam, and Yokosuka (Japan) – the first visit by a Canadian submarine since HMCS GRILSE's portcall in May 1968. I cannot give exact details about what the sub was doing, or where, but that part of the mission package included the surveillance of vessels at sea.

In February 2018, the second 'high-readiness' submarine, HMCS WINDSOR, got underway for an extended deployment to the European theatre, bringing another first for the RCN, namely with a VICTORIA class boat operating in the Medi-

ESD: As you mentioned earlier, HMCS CORNER BROOK is undergoing her EDWP. Can you provide some details for what this includes?

Robinson: The submarines' EDWP includes the replacement of external structures and the sonar bow dome, a combat system upgrade, the installation of the Mk48 Mod 7AT heavyweight torpedoes, the BQQ-10 sonar suite, a modern satellite communications system, and communications intercept capabilities. HMCS CORNER BROOK is the second boat to complete this fit, HMCS WINDSOR being the first.

HMCS WINDSOR was the first of the service's four VICTORIA class boats to be fit-

By 2035, the four VICTORIA Class submarines will be well over forty years old.

Therefore, the Canadian Ministry of Defense is already considering possible replacements. One of the procurement requests concerns (some sources say up to 12) new diesel-electric submarines.

If Canada pursues a future submarine programme and has no domestic submarine construction capacity, it will either buy newer platforms on the international secondary market or conclude a contract with a foreign shipbuilder to build new platforms, with possible construction support from Irving Shipyard in Halifax. Possible candidates include Saab Kockums from Sweden, the French Naval Group (ex-DCNS), Navantia from Spain, Fincantieri from Italy or thyssenkrupp Marine Systems from Germany.

ted with a Lockheed Martin AN/BQQ-10 (V)7 sonar processing suite, a variant of the US Navy's Acoustic Rapid COTS Insertion (ARCI) programme, thus boosting the submarine's detection and discrimination capability. This fit was completed during the boat's intermediate work period, before her sailing on the current deployment. The upgraded sonar enables the crew to pick up contacts at a longer distance and detect the tell-tale sounds of engines, even the noises of bearings, air pumps and hydraulic motors, to determine the classification of a ship, sometimes even the exact ship. HMCS WINDSOR also became the first of the class to receive the new autopilot system, which supports tasks such as depth-keeping. When at periscope depth, one must have enough mast showing above the water to effectively see around, yet not so much that you're giving away radar detection opportunities. This is difficult, particularly at low speed. So anything one can do to improve one's ability to have accurate depth-keeping is tactically relevant.

The other two boats will complete the fit over a series of intermediate work periods coming up.

ESD: How do your submarines contribute to the Canadian Navy's tasks in today's maritime environment? What are your subs' primary and secondary missions?

Robinson: The VICTORIA Class submarines represent the Royal Canadian Navy's key contribution to the country's deployable strategic military assets. These capable long-range, open-ocean submarines are extremely versatile, allowing them to operate for periods of up to 45 days. They can perform various missions, including surveilling Canada's coastlines, supporting maritime law enforcement and other governmental departments, counter-terrorism, supporting special operations forces (SOF) and performing constabulary roles in support of the Royal Canadian Mounted Police (RCMP), anti-narcotic operations, Department of Fisheries and Oceans' patrols, and illegal immigration

interdiction operations, and covert surveillance patrols. They have participated in key continental defence and security activities such as Operation CARIBBE,

and they have deployed internationally – conducting, for example, operations in European waters as well as providing a Canadian submarine presence in the Asia-Pacific via the HMCS CHICOUTIMI's deployment.

ESD: What does your experience gained so far tell you about your submarines' capabilities?

Robinson: HMCS WINDSOR's and HMCS CHICOUTIMI's deployments prove the capability and agility of our navy operating globally. While operating at sea, the VICTORIA class have unparalleled capability to exploit tactical stealth and silence in order to achieve optimum operational and strategic effect in the maritime domain. Prior to



Commander Peter Chu (left), Commander HMCS WINDSOR, and Captain Christopher Robinson, Commander Canadian Submarine Force, during the pre-sail briefing on board HMCS WINDSOR



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Photo: MARCOM HQ, Northwood, UK



HMCS WINDSOR under way for exercise **DYNAMIC MANTA 2018**

HMCS CHICOUTIMI's Asian deployment, the longest VICTORIA class single deployment was a 101-day North Atlantic patrol by HMCS WINDSOR in 2015. Through these deployments, the RCN has demonstrated a capacity to operate the VICTORIA class at extended deployment ranges, with persistence and deployments happening simultaneously and overlapping.

ESD: What are your prime concerns?

Robinson: My prime concern is to assure that the submarines have the highest possible operational readiness and the capacity to carry out their assigned tasks. This is quite a challenge, because to attain such a level it is imperative that my personnel have an optimal level of training. We look for very committed people who can cope with a less comfortable

standard of life. The hard style of life on board and the personal sacrifices that every submariner has to face each day are critical factors. Anyone wishing to join the submarine force should have a sense of adventure and be highly motivated.

ESD: Which upgrades have the submarines received so far?

Robinson: Since 2010, we have conducted incremental upgrades on the submarines every time we do their regular maintenance under the VICTORIA class Submarine In-Service Support Contract (VISSC) with Babcock Canada Inc. These upgrades include L-3 MAPPs auto-pilot and fire suppression systems, new operator consoles, computers, and electronic enclosures; an Ultra Electronics Maritime Systems submarine towed array sonar sys-

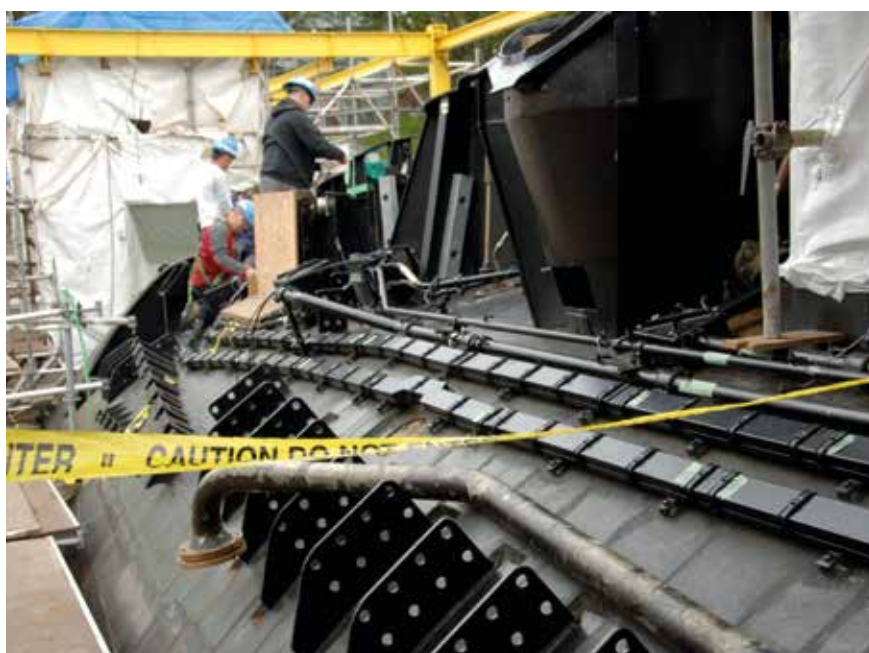
tem (SUBTASS), Mk 48 Mod 7 advanced technology torpedo conversion kits and a Lockheed Martin BQQ-10 sonar suite and submarine fire control system (SFCS). Future upgrades are to involve the installation of new displays, sonar processing upgrades, control and image display for search-and-track periscopes and integration with ESM systems.

ESD: Are the efforts to improve their capabilities and extend their operational lives continuing?

Robinson: Canada's June 2017 defence policy "Strong, Secure, Engaged" announced that the VICTORIA class submarines will undergo incremental modernisation in the mid-2020s, which will ensure their continued effectiveness out to the mid-2030s. This will be accomplished via the VICTORIA class modernisation project. Work is still being defined but may include hull, machinery and electrical (HM&E) maintenance, repair and preservation of the inner and outer hulls, upgrade or replacement of the alternators and batteries, upgrades to the combat data system, the hull, flank and towed hull, suite as well as the electronic warfare suite. In April 2015 we began planning for a major Submarine Life Extension (SLEX) programme for the VICTORIA class submarines in order to extend the service life of the class even beyond 2035.

Work is expected to include hull, machinery and electrical (HM&E) maintenance; repair and preservation of the inner and outer hulls; upgrade or replacement main diesels, alternators and batteries; upgrades to combat data system, hull, flank and towed arrays, communications suite as well as the electronic warfare suite.

The interview was conducted by Guy Toremans.



HMCS VICTORIA during her EDWP in Victoria Docks, Esquimalt

From Light to Heavy: Military Trucks from North America

Sidney E. Dean

Military trucks are utility vehicles most often used for transportation of personnel, equipment or supplies. A recent trend for logistics vehicles is optionally unmanned operation.

Most are unarmoured, although some do carry integrated or add-on armour to protect occupants from small arms, fragmentation or concussion. Although military trucks are generally not intended as combat vehicles, there are exceptions. Perhaps the most famous is the US-built HUMVEE, which is designed as a transport but can be armoured and equipped with crew-served weapons to operate as a light combat vehicle. Overall, military trucks are most readily classified according to size and capacity: light utility vehicles (pickup trucks, SUVs, HUMVEEs) for personnel and smaller logistics payloads; medium lift/capacity trucks; heavy and super-heavy lift trucks (including tractor-trailers, carriers for armoured vehicles). While many trucks are all-purpose transports, some can have specialty configurations (for example, ambulance, fuel tanker, cement mixer).

A recent trend for logistics vehicles is optionally unmanned operation. This can take the form of fully autonomous operation, in which a vehicle independently drives to its destination, or manned-unmanned teaming, in which one or more robotic vehicles form a convoy behind a manned lead vehicle. The current focus is on the latter, as autonomous driving technology is still in its early stages. The primary motivator behind this trend is personnel safety. Unmanned or partially manned convoys – perhaps escorted by armed UAVs – would expose fewer soldiers to IEDs and other forms of ambush. They would also potentially allow the military to reduce the number of soldiers assigned as truck drivers; this would permit more personnel to be trained and deployed as combat troops or in high-



Photo: Oshkosh

The Joint Light Tactical Vehicle (JLTV) manufactured by Oshkosh.

demand combat support functions such as drone or cyber operations.

This article discusses the most important truck types employed by the armed forces (in particular the ground forces) of Canada and the United States, including some recent and ongoing procurement projects.

Canadian Military Truck Inventories and Procurement

Light Utility Vehicles

The Canadian Armed Forces (CAF) deploy the Light Utility Vehicle - Wheeled (LUVW) based on the Mercedes G-WAGON. Procurement began in 2003. There are two variants: the command, control and reconnaissance vehicle and the military police vehicle. Each variant seats four. The 1,500 kg vehicle can be equipped with a modular armour kit for personnel protection.

The CAF also use a Militarised Commercial Off-The-Shelf (MilCOTS) variant of the Chevrolet SILVERADO 2500D pickup truck. It is employed primarily by military police

and reserve units due to its limited off-road capabilities.

The gap between these light vehicles and the medium utility vehicles is filled by the Light Support Vehicle – Wheeled (LSVW). Based on the Italian Iveco M40, the LSVW can carry a payload of 1,500 kg and can be used for both personnel and cargo transport. In addition, it can tow an 850 kg trailer or a 105mm artillery piece. In addition to the general cargo carrier, the CAF employ an ambulance variant. Procurement of 2,815 vehicles began in 1993.

Medium Utility Vehicles

The Medium Support Vehicle System (MSVS) programme is replacing the CAF's Medium Logistics Vehicle – Wheeled (MLVW) acquired in the 1980s. The replacement programme received initial approval in Ottawa in 2006. As a first measure, 1,300 MilCOTS type 7000-MV trucks were ordered from Navistar Defence Ltd. Delivery of the vehicles, which are based on the company's 7400 SFA 6x6 model, was concluded in 2011. The vehi-

Author

Sidney E. Dean is President of Transatlantic Euro-American Multimedia LLC and a regular contributor to ESD.

Photo: US NRL



The Family of Medium Tactical Vehicles (FMTV) is licence-produced by Oshkosh and based on the Steyr 12M18 6x6 truck.

cles have an overall length of 11.1 metres and a maximum towed load of 10 tonnes. There are six variants, with crew and passenger capacity ranging from a single driver to a total of 23 personnel on board. In 2015, the CAF contracted with Mack

the ground, and they will transport equipment and supplies at home and abroad. Delivery of all kitted shelters was completed in 2016. SMP deliveries are ongoing and are expected to be complete by late 2019 (one year later than initially intended).

Photo: Canadian Army



The Mercedes G Wagon Light Utility Vehicle - Wheeled (LUVW) is powered by a 2.7-litre, five-cylinder, turbocharged diesel engine. It can be outfitted with a tailored armour protection systems kit.

trucks for 1,537 medium-capacity Standard Military Pattern (SMP) logistics trucks; the contract also covered delivery of 300 trailers, 150 armour kits for truck cabs, and five years of in-service support. In addition to the trucks and trailers, the MSVS programme also procured ISO-container-based "kitted shelters" to be configured for medical, support and command functions in the field. According to the CAF, the new vehicles and their ancillary equipment will provide lift and logistical support on

There are five variants of the vehicle, which is based on Mack's KERAX 8x8 truck: cargo; cargo with crane; mobile repair team; load handling system; and gun tractor. Vehicle length lies between 10 and 11 metres according to variant. Crew size/personnel capacity varies from 1 to 27. The rated capacity is 9.5 tonnes.

Heavy Utility Vehicles

As a Heavy Logistics Vehicle - Wheeled (HLVW) the CAF still employ the UTDC 24M32 introduced in 1990. The vehicle is a

heavily modified Steyr 1491 6x6; more than 1,200 were licence-built in Canada. Variants include: general cargo transport; recovery vehicle; bridge transporter; mobile repair shop; fuel and water tanker; and drone launcher/recovery vehicle. Payload varies between 10 and 16 tonnes; additionally, the truck can tow a 15-tonne trailer including artillery trailers. The engine's starting mechanism has been modified to allow operations in temperatures as cold as 40°C. The CAF also operate 86 Armoured Heavy Support Vehicle Systems (AHSVS) based on the Mercedes-Benz ACTROS. The AHSVS consists of an armoured heavy-lift cab which can tow a variety of trailers and wheeled containers.

Specialised Vehicles

The BV 206 tracked carrier is an all-terrain transport vehicle designed to function on- and off-road under almost any ground conditions, but it is utilised primarily for winter and Arctic operations. The Bv 206 consists of two cars coupled together by a central, articulated steering assembly. Hydraulic cylinders are used to steer the vehicle and turn the cars relative to each other. Each element is equipped with two broad tracks which also enable amphibious operations; all four tracks are powered. According to the CAF, the large track area allows the vehicle to travel over deep snow and soft ground that would be impassable to almost any other tracked or wheeled vehicles. Variants include command post, transport, and ambulance. Capacity consists of a two-person crew plus 15 passengers. The vehicle has a 330-kilometre range, and can master a 31% gradient and 35% side slope. The CAF maintains 78 Bv 206 units, which are manufactured by Hägglunds.

US Military Truck Inventories and Procurement

Light Utility Vehicles

Replacement of the venerable multiservice HUMVEE by the US armed forces is in its early stages. The HUMVEE's successor, the Joint Light Tactical Vehicle or JLTV, was put through its paces by the US Army and US Marine Corps between February and April of this year. A total of 39 vehicles were successfully tested in "real-world" scenarios at the Twentynine Palms Marine Corps Air Ground Combat Center in California.

Like the HUMVEE, the new light truck is conceived as a multimission machine. The JLTV comes in two basic variants: the two-door Combat Support Vehicle (CSV) and the four-door Combat Tactical Vehicle (CTV). The M1279 Utility CSV seats two soldiers in the cab and features an open flatbed cargo area with 2,300 kg capacity for a variety of payloads. While intended

primarily as a transport vehicle, prototypes mounting short-range air-defence missiles and 105mm howitzers have been presented. The CTV is a closed vehicle with a 1,600 kg payload capacity. It comes in three distinct "Mission Package Configurations". The M1280 General Purpose vehicle is designed to carry four combat equipped troops, but is not designed as a combat vehicle. The M1281 Close Combat Weapons Carrier also seats four, but is armed with top mounted TOW missiles. The M1278 Heavy Gun Carrier is mounted with a crew served weapon on a manned or remotely operated turret (machine gun or grenade launcher).

Benefits of the JLTV versus the Humvee include: a higher wheelbase for improved mobility; greater protection against IEDs and mines; more comfortable ride, reducing crew fatigue; improved networking capabilities; greater fuel efficiency; increased on-board power production; modularity to accept future weapon systems and electronics. The JLTV entered Low Rate Initial Production (LRIP) in 2015. The Full Rate Production (FRP) decision is expected this year, now that testing has concluded. IOC for the army is 2019, with the first 500 vehicles equipping a brigade of the 10th Mountain Division. IOC for the USMC is 2020, with the first 69 vehicles equipping a bat-



Photo: Canadian Army

The Canadian Army utilises its Bv 206 tracked carriers primarily for winter and Arctic operations.

talion of the II Marine Expeditionary Force at Camp Lejeune, North Carolina. The US Army plans to purchase 49,000 JLTVs, with final deliveries in the mid-2030; the USMC will procure 5,500 by the end of 2022. The US Air Force plans to procure some 140 JLTVs for nuclear site security forces and personnel recovery units.

Medium Utility Trucks

For the US Army, most medium transport capacity is fulfilled by the Family of Medium Tactical Vehicles (FMTV). Based on the Steyr 12M18, the US FMTV is currently licence-built by Oshkosh. The first vehicles entered US Army service in 1996, with more than 74,000 delivered to date. In Sep-

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Photo: Oshkosh

Built by Oshkosh, the M1070 Heavy Equipment Transporter (HET) is used for overland transport of M1 ABRAMS main battle tanks and other heavy equipment.

tember 2017, the army placed the latest orders for an additional 1,200 vehicles. The FMTV is divided into two major categories: the 4x4 Light-Medium Tactical Vehicle with a 2.5-tonne payload capacity, and the 6x6 Medium Tactical Vehicle (5 tonnes). A total of 25 variants have been developed, including open-bed and enclosed cargo carriers, dump trucks, and chassis for HIMARS rocket artillery and MEADS missile launchers. All FMTV trucks are C-130 transportable. Some variants can also be airdropped or sling-loaded under a heavy lift helicopter. Variants with armoured cabs or full vehi-

cle armour are available. In February of this year, the army awarded Oshkosh the contract for the FMTV A2 programme. According to the Request for Proposals (RfP) issued by the army in 2016, the FMTV A2 will feature higher capacity suspension, wheels and tyres; integrated underbody protection; increased engine power; a higher-capacity alternator; an upgraded data bus; and various safety enhancements. Billed as a "next-generation" family of vehicles, the FMTV A2 programme will include 16 truck variants and three trailer variants.

The US Marine Corps' equivalent medium

utility truck is designated the Medium Tactical Vehicle Replacement (MTVR). Designed and produced by Oshkosh, the MTVR family of trucks entered service in 2001. Procurement is ongoing. More than 11,000 have been ordered to date, including 1,900 vehicles for the US Navy Seabees combat engineers.

The all-terrain 6x6 vehicles are rated for a 7-tonne payload off-road and 15-tonne on the road. Variants include standard and extended cargo carriers (4.67- and 5.49-metre wheelbase); dump trucks; wreckers; tractors; and the Mk37 HIMARS resupply vehicle with its companion Mk38 cargo trailer. The Mk37 flatbed and the trailer can each carry two MLRS Family of Munitions (MFOM) pods, each containing six preloaded rockets. The Mk37 includes an integrated HIAB crane for loading the MFOM pods into the HIMARS launchers. The Mk28C engineering vehicle comes in several subvariants used primarily as engineering vehicles, but also as water and fuel tankers. Oshkosh has also developed a prototype 8x8 MTVR variant with a 16.5-tonne payload capacity for hauling flatbed and containerised loads (6-metre ISO).

MTVR cabs can be fitted with a weapons mount. All vehicles produced as of 2003 can be outfitted with the Oshkosh MTVR Armour Systems (MAS) modular protection kit. A separate modular armour package is available for the rear compartments of MTVRs used as personnel transports.

Heavy Utility Vehicles

The 8x8 Heavy Expanded Mobility Tactical Truck, or HEMTT built by Oshkosh is considered the workhorse of US Army combat divisions. The Army's Programme Executive Office for Combat Support describes the heavy logistics vehicle as the key combat service support enabler for all brigade combat teams. The payload capacity is 11 tonnes. The all-terrain vehicles can climb a 60° gradient and ford 1.2-metre-deep water.

The HEMTT label actually encompasses 11 distinct vehicles based on the same all-terrain chassis: five different cargo truck models with integrated load-handling cranes (specialised on various cargo types such as ammunition or large spare parts); tractors; recovery vehicles; fuel and water tankers; a tactical fire fighting truck; the M1120 Load-Handling System (LHS) capable of self-loading containers onto its flatbed; the M983 Light Equipment Transporter (LET) A2 PATRIOT tractor, used to tow trailer-mounted PATRIOT missile launchers and PERSHING II missile launchers; the M1977 Common Bridge Transporter for carrying ribbon bridge elements; the M985 Guided Missile Trans-

Photo: Canadian Army



The Canadian military calls the Mercedes-Benz ACTROS "the best-armoured cab in the world." The 8x8 trucks can carry 16 tonnes and drive through water more than a metre deep.

porter to resupply MLRS weapon systems (the M985's onboard crane removes the spent MFOM from the MLRS launcher and replaces it with a fully loaded pod) and to resupply PATRIOT missile launchers.

Since 1982, Oshkosh has delivered more than 27,000 new or recapitalised HEMMTs to the US Army; 13,000 are in service. The currently built model is the HEMTT A4 which features improved power and manoeuvrability compared to previous models.

HEMTT is augmented by Oshkosh's 10x10 Palletized Load System (PLS) with a 15,000 kg payload capacity. More than 8,400 of the flatbed vehicles (designated M1074 and M1075) and 15,000 trailers (M1076) have been delivered since 1992. The M1074 is equipped with an integrated crane; its primary mission is ammunition resupply for field artillery units. The M1075 lacks the crane; it is used for general long-haul transportation missions (often in conjunction with an M1076 trailer) and for tactical supply missions. It also hosts several engineering modules (such as the concrete mobile mixer module or the bituminous distributor module for road construction/repair operations) and is the prime mover for the M7 Forward Repair System. The ongoing PLS recapitalisation programme will refurbish older PLS vehicles to 0 miles/0 hours and to the current A1 configuration (replacement of current components with a CAT 15 engine, electronic transmission, ABS and traction control, and a larger cab).

The USMC uses an even heavier system than the Army. The Logistics Vehicle System Replacement (LVSR), also produced by Oshkosh, is a family of 10x10 tactical trucks with a 20,000 kg on-road, 15,000 kg off-road payload capacity. More than 2,000 vehicles were produced between 2005 and 2013; while not currently in production, Oshkosh retains the capability of resuming deliveries. Payload options include flatbed cargo and trailers, ISO containers, bridging equipment, boats and fuel containers. There are three variants: the MKR15 recovery vehicle capable of towing a 50,000 kg vehicle; the MKR16 tractor; and the MKR18 cargo carrier with an integrated hooklift cargo handling system. The MKR16 and MKR18 tow the same M1076 trailer utilised by the Army's HEMTT.

Overland transport of US Army M1 ABRAMS main battle tanks and other heavy equipment – including armoured fighting vehicles, self-propelled artillery and engineering equipment – is conducted by the M1070 Heavy Equipment Transporter (HET). Built by Oshkosh and featuring a 700 hp Caterpillar C18 engine,

the 8x8 HET is coupled to a DRS M1000 semi-trailer which carries the actual load. Together the tractor and trailer constitute the HET System or HETS. Official payload capacity is 63 tonnes, although higher payloads – up to 80 tonnes – can be accommodated at the cost of speed. In addition to road transport of heavy equipment and combat vehicles, HETS also recovers and evacuates these from the battlefield. The front and rear axles of the M1070 are steerable, facilitating off-road manoeuvring; the fully loaded HETS can master a 15% gradient. Modular armour kits can be applied to the cab, which can seat up to six people (or four seats plus two bunks). The HETS can be airlifted via C-17 or C-5. Over 4,000 M1070 have been sold to the US Army since 1992. Of these, 1,591 are the newest variant, the M1070A1, delivered to the Army between 2010 and 2014.

Autonomous Capabilities

The US armed forces have been pursuing unmanned ground vehicle technology for more than a decade. In 2014, the US Army's Tank Automotive Research Development and Engineering Center (TARDEC) conducted experiments with convoys of up to seven autonomous vehicles driving at speeds up to 40 mph. The trucks successfully negotiated oncoming traffic, followed rules of the road, recognised pedestrians and avoided obstacles in an urban environment. The autonomy was enabled through add-on kits installed in standard utility trucks. Situational awareness was provided via GPS, Light Detecting Radar (LIDAR), Automotive Radio Detection And Ranging (RADAR) and commercially available automotive sensors.

Similar experiments continue in pursuit of what the US Army now calls the Autonomous Ground Resupply (AGR) concept. The goal is for one manned vehicle to lead convoys of seven unmanned trucks (leader-follower operations). The army built the core architecture for AGR in 2017 in the first of three programme phases. The next two phases will focus on software improvements and on refining autonomous decision making. The US Army expects to spend US\$95M on AGR research between 2019 and 2021. TARDEC plans to conduct a 12-month technical demonstration in 2019–2020. Industry partners include Robotic Research LLC (autonomy kit), Oshkosh Defense (bywire remote control kit as backup), Lockheed Martin (systems integration), and Carnegie Mellon University's National Robotics Engineering Center (software). ■

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“Nationally, the focus is on security islands.”

Photo: Bundesheer/Julia Weichselbaum



Interview with Lieutenant General Norbert Gehart, National Armaments Director, Austria

ESD: In many Western countries, the changed security situation in Europe has prompted governments to provide additional resources for defence and armaments. To what extent and in what way has this trend affected your country?

Gehart: National political interests and security needs lead to close neighbourly co-operation, particularly in the field of border management. Nationally, the focus is on the establishment of so-called "security islands." These sanctuaries will be improved

military facilities in Austria in order to support state structures and organisations in crisis situations.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Gehart: Additional funds will be provided for future projects concerning multipurpose helicopters and to improve the mobility of the Austrian Armed Forces (for example HÄGGLUNDS, PANDUR EVO and other trucks and vehicles).

ESD: Which of these are carried out in international partnerships, and who are your partners?

Gehart: At HÄGGLUNDS we have Sweden as our partner. For this system the establishment of a HÄGGLUNDS user group is considered. For helicopters, the aim is to work together throughout the life cycle of this system, but the planning phase is not yet complete. The cooperation within PANDUR EVO takes place in a specially established PANDUR user group with the following members: Austria, Belgium, Czech Republic, Portugal, Slovenia.

ESD: In what way do you intend to consider the PESCO concept?

Gehart: Within the PESCO framework, Austria is already involved in the following four projects:

1. Military Mobility
2. Competence Centre of the EU Training Mission
3. Operational military disaster control package
4. Platform for the exchange of information on cyber threats and incident responses. For the future, Austria's objective is to expand cooperation within the framework of the permanent structured cooperation.

Photo: Bundesheer/Gunter Pusch



"The cooperation within PANDUR EVO takes place in a specially established PANDUR user group with the members Austria, Belgium, Czech Republic, Portugal and Slovenia."

**The interview was conducted
by Peter Bossdorf.**

Powering the Battlefield

Tim Guest

Whether today's individual dismounted soldier, any one of the multitude of A and B vehicles on the battlefield, or static unit bases and field emplacements, the reliance of any military on reliable stored and generated power sources has increased dramatically as the number of powered devices involved in modern warfare has grown.

A manpack radio, a simple torch, a strip or surgery light in a field hospital, a vehicle-mounted artillery fire engagement system, a laser range finder and more, so much more, all rely on electrical power to play their role on the battlefield. And that was last year's battlefield; the connected battlefield of today involves more sensors and more networked connectivity and greater power demands than ever before. Future soldier systems place greater power-generation and storage demands on the individual dismount than in the past, and vehicles, often operating in a silent-watch mode, where onboard systems are fully functioning, but the vehicle's engine is off, need stored power, that is, batteries, that will not be drained in such scenarios, or fail when they're urgently needed.

To meet such demands, new innovations and ongoing R&D in battery and battery charging technologies are making headway and doing their best to keep pace with ever increasing needs.

This article looks in general at the power needs of the individual soldier and then at some of the latest developments in stored power/battery and charging solutions for the military – people and vehicles – as well as a couple of developments in power-generation solutions.

Setting the Scene: Individual Soldier Needs

Losing power to critical systems at the wrong moment is a situation to be avoided at almost all costs. Power, whether from a stored or generated source needs to be available when required for a wide range of operational needs, whether powering a manpack radio, night vision goggles, a

Photo: iStock



Modern battlefields are hungry for electricity.

mobile surgical unit, or a battle management system, not to mention vehicle batteries themselves. In the case of the individual dismounted soldier, carrying primary and back-up batteries places a considerable weight burden on troops, depending on the anticipated duration of a particular mission; the longer the mission the greater the number of spares that must be carried. From simple AA and CR123 batteries to larger radio batteries, individual soldiers can end up carrying more than 50 batteries into battle. In Afghanistan, US troops often carried 4.5 kg to 13.2 kg of batteries, depending on mission type and duration, and British troops have been reported as carrying as much as 12.3 kg of batteries for a 36-hour patrol operation to power all their electronic devices. If stored power system weight can be reduced, however, it will have a positive impact on the dismount's fighting capabilities rather than hindering mobility and even risking musculoskeletal injury. With today's soldier typically carrying between 30 kg and 50 kg of equipment, anything that can be done to reduce this weight burden should be considered. One way of reducing the battery burden is for equipment manufacturers, where possible, to reduce the power

consumption of sensors and devices, as well as increasingly making use of low-power components in dismounted system designs. But even with such approaches, the nature of the battlefield and behaviour of the average soldier can render assumptions made in the lab pretty much redundant. For example, a study by the US Army Communications Electronics Research, Development, and Engineering Center (CERDEC) showed that soldiers often avoid the risk of critical equipment and sensors failing at moments when they are needed most and in an instant, by discarding non-rechargeable batteries well before they have fully discharged. This action makes sure the batteries in place when they enter the fray are fully charged. Indeed, in one particular evaluation, 50% of discarded batteries tested were still over 50% charged. Though undesirable and creating a greater logistics and weight problem to supply more non-rechargeable, primary batteries to the power-hungry battlefield, this situation and 'survival approach' by troops is totally understandable.

The more efficient batteries, in terms of weight and cost, are secondary or rechargeable batteries, which are suited to supply higher power equipment rather than for

Author

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low power applications. Using secondary rechargeable batteries reduces the weight and logistics burden considerably, although it does necessitate having chargers and spare batteries, together with managing an efficient recharge cycle. Multi-battery chargers, which take power from a variety of sources, along with improvements in the number of

Photo: Saft



Saft's new XCELION 6T-E, high energy Li-ion battery provides double the useful capacity of lead-acid batteries in the same footprint.

charge cycles and regular increases in secondary battery power densities in recent years, have led to rechargeable batteries being the preferred and best option for pretty much all major soldier equipment. Compared with primary batteries, these latest re-chargeable power sources offer major through-life cost benefits and weight reductions.

Small, light and rugged rechargeable batteries with a working life in excess of 24 hours that can recharge from almost any USB-equipped power source are compelling alternatives to carrying pockets full of AA primary batteries. These secondary batteries can rely on laptops, solar panels, or vehicle cigarette-lighter sockets for their recharge. When it comes to larger batteries and the need to recharge multiple devices, soldiers can now use centralised recharging systems that can supply the right level of recharge to a wide variety of devices. Centralising power in this way makes it easier to achieve a higher overall power density for a given weight, which can lead to further power burden benefits. Centralised power units also enable the use of innovative technologies, such as fuel cells, to power equipment, or re-charge distributed batteries used on critical equipment such as radios. It also offers the best approach to reducing total weight burden through use of high power-density main batteries and provides an approach suited to topping up from external sources such as fuel cells, vehicles, solar arrays and other alternative emerging forms of power generation, for example, wind.

Battery Storage – Implications for Defence Organisations

(sb) For two main reasons, battery storage is a significant issue for defence organisations. Broad technological advances have led to the military using a greater number and wider range of battery-powered devices and equipment than ever before, so there are simply more batteries to store. But also, armed forces may need to store their batteries in a wide variety of operational environments.

In general, batteries prefer to be stored at relatively cool temperatures, because internal chemical reaction rates slow down at lower temperatures: for every ten degree drop in temperature the reaction rate halves. The main problem with storing batteries is that they self-discharge, losing capacity, albeit recoverable when cold; and if stored at higher temperatures they can permanently lose capacity which is not recoverable by re-charging. Depending on the chemistry, most batteries require storing at temperatures between about five to 15 degrees Centigrade. At significantly lower temperatures, perhaps -10 or -20 degrees, condensation problems arise: as the battery is brought out of very cold conditions and starts to warm up, condensation forms on it, which can be very damaging.

In addition to the temperature considerations, there are also issues around the state of charge of the batteries. With primary batteries, there is obviously no choice; they have to be stored in a fully charged state. But rechargeable batteries, depending on their chemistry, respond best to being stored in different states of charge. Lead acid batteries, for example, need to be stored fully charged. Storing them in a discharged state causes a process called "sulphation" and other problems that affect the capacity. Nickel cadmium batteries can be successfully stored whether they're fully charged or fully discharged. Lithium-ion batteries, on the other hand, should be stored in a 40% to 50% state of charge. If stored at 100% they tend to lose capacity, especially if stored at higher temperatures. But if they're stored at a very low state of charge then there's a risk of them dropping below two volts and once that happens, there can be issues regarding their serviceability.

The good news is that the length of time for which batteries can be stored, if treated properly, is increasing all the time. In the last few years there has been a massive increase in reported shelf lives. Some lithium batteries that now have a shelf life of 20 years, and the shelf life of alkaline manganese batteries was five years not so long ago, whereas a 10-year shelf life is now becoming the norm for this chemistry.

With so much information that defence organisations need to understand when it comes to storage, how are battery manufacturers helping them? "To help our own customers, including the UKMOD and the defence primes, we provide battery handling notes for most of the batteries that we design and manufacture", says Gavin Durham, Research & Quality Manager at Lincad in the UK. "But in addition, having identified an increasing demand for the storage and maintenance of batteries, we introduced a new service last year for existing and new customers to Lincad, including third party battery manufacturers and suppliers. With our dedicated facilities and skilled personnel, including a Dangerous Goods Safety Advisor, we are now able to safely and securely store batteries of any chemistry, including lithium-ion, at our HQ in Surrey."

Complementing this battery storage service, Lincad also opened a new Service & Maintenance Centre last year. "So, we don't just design and manufacture batteries", adds Durham, "We are also responding to the growing requirement for through-life support". Providing military power management solutions since 1986, for applications ranging in size from portable equipment to artillery pointing systems to robotic vehicles, Lincad exhibits at Eurosatory 2018, in Hall 5a on Stand 719.

Many such secondary systems are still in development, and for the foreseeable future deployments of mixed central and locally stored power systems to meet all user needs can be expected. At the same time as such innovative power supplies are evolving, military equipment for the individual dismount, particularly high-power critical systems such as radios, need to be designed in a way that optimises power management and use and prepares them for use with central power systems and recharging solutions in the future.

Re-Charging Case in Point

One recent recharging development is Arotech's Power Systems Division's Epsilon-Electric Fuel Ltd, being selected to provide the Canadian Armed Forces with a battery charging solution suited to its Integrated Soldier System Programme. Epsilon won the contract from the Canadian Department of National Defense (DND) worth some US\$3M in its initial phase for the development and provision of an innovative



Bren-Tronics, Inc.

Intelligent Military Batteries & Charging Systems™

charger designed to meet the operational and technical needs of the Canadian Armed Forces Integrated Soldier System Suite (ISS-S) Programme. It includes 400 charger units, spares and other services, as well as options to order up to an additional 350 chargers within the next four years.

Epsilor's new charger supports the LI-145/LI-80 family and BB-2525/U conformal wearable batteries used by the Canadian forces, as well as by various NATO armed forces. It is based on a 12-channel charger, packed in a rugged tactical case that will enable soldiers to charge large numbers of batteries in depot as well as in the field and in moving vehicles (charge on the move). The charger, which is designed to receive power from different sources such as an electric grid and different vehicle sources with flexible input voltage, is intended to improve tactical flexibility and the energy independence of its users.

Under the Canadian ISS Programme thousands of dismounted soldiers are expected to be equipped with state-of-the-art C4I systems that include battle management system, intelligence, surveillance and reconnaissance, and target acquisition equipment. As ISS energy components support all wearable electronic equipment in long dismounted operations, the Canadian Armed Forces identified battery recharging as a critical capability of the ISS and decided to obtain a dedicated multi-channel charger that will support its soldiers in the field, in vehicles, in forward operating bases and for high volume recharging of thousands of batteries simultaneously.

As the Canadian Armed Forces are among the most active in NATO, with a full service record in all recent major NATO conflict areas, including the former Yugoslavia, Iraq, and Afghanistan, as well as in worldwide UN peace keeping missions, the success and effectiveness of this charging system will no doubt be of interest to other NATO countries.

Epsilor already provides a wide variety of primary and rechargeable batteries, chargers and power management solutions, to leading military customers worldwide including NATO forces, Israel Defense Forces and other military customers in Asia and South America. The company offers a complete range of standard batteries and chargers compatible with NATO equipment such as LI-145 series, BB-2590 series and batteries for Harris and Thales handheld radios (PRC-152/PRC-148). Another company at the forefront of lithium-ion battery technology and design is Lincad, which develops bespoke batteries, chargers and power management systems for military and other specialist applications in accordance with UK Defence Standards and US Military Standards. The majority of Lincad's products contain high energy density Li-ion technology, although the company will apply the most suitable electrochemistry for any particular customer requirement. Earlier this year Lincad won a power management contract with Leonardo to supply latest Li-ion batteries and other power management equipment for the Type 163 Laser Target Designator system. Lincad already supplies the British Armed Forces with its flagship FAST CHARGER, which is capable of the independent recharge and management of up to four batteries at any one time. This solution was designed for the UK MoD to meet



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the battery charging and management requirements of Lincad's LIPS (Lithium Ion Power System) suite of batteries, and was a replacement for the previous CARAVEL single channel battery charger, used operationally by both British and international armed forces for more than 12 years.

In May, Li-ion battery solution specialist Saft announced its new XCELION 6T-E, high energy Li-ion battery capable of providing double the useful capacity of lead-acid batteries in the same footprint. The 24V battery is designed for applications with military vehicles, as well as rail, marine and hybrid gen sets that require higher levels of storage capacity and longer silent-watch periods. The high energy capacity and cranking capability provide stationary and other power systems with a battery solution ideal for long silent-watch missions with multiple batteries in parallel. Smart battery features enable communication with the end user, providing information about the battery's state of health, state of charge and other functions. The 80Ah, 2.1kWh Li-ion battery weighs 20 kg. In addition to the integral Battery Management System (BMS) and battery-level safety features, the XCELION 6T-E uses Saft's super-phosphate technology, which offers enhanced safety with exceptional lifetime reliability and stable internal resistance.

Recent Vehicle Battery Developments

While standard alkaline and lead-acid batteries continue to play the major part in soldier and vehicle stored power solutions, Li-ion batteries have established their place in the powering of a wide array of soldier devices and military electronics. One leading player in the development of latest battery technologies is Bren-Tronics, which has well established successes and ties with many defence forces around the world. One of its latest successes was the award of a US\$6.2M contract with the US Army, awarded by the US Army Contracting Command through the National Advanced Mobility Consortium, for the high-volume, automated supply of military 24V Lithium-Ion (Li-ion) 6T batteries. This is a battery, which provides twice the energy with less than half the weight of traditional lead-acid 6T batteries. It also has the highest energy capacity of any 6T battery available in the US while being a true drop-in replacement for the current lead-acid 6T battery with a wide variety of applications including: vehicle starting, auxiliary power, silent watch, ground station power and directed-energy uses.

Two versions of the 24V Li-ion 6T battery have been made by Bren-Tronics over the past few years, one optimised for high-



Photo: Bren-Tronics

Bren-Tronics' 6T BRENERGY batteries power approximately 95% of US Army tactical ground-vehicle platforms.

power and the other for high-energy, and delivered over 500 worldwide. Under this new contract, the company will develop the existing Li-ion 6T battery design and manufacturing processes further to create mass production capabilities at its Commack facilities on Long Island. In the final requirement of the US Army contract, the ability to produce 2,000 Li-ion 6T batteries per month will be demonstrated. The company said that the 6T battery is used in approximately 95% of US Army tactical ground-vehicle platforms, so the contract to create manufacturing capability for 2,000 Li-ion 6T batteries per month validates the long-term need and the US Army's commitment to this new technology. They also said that conventional lead-acid 6T battery solutions are challenged to meet today's military power requirements and will not achieve the Army's next-generation power demands.

In a further vehicle battery development, Advanced Battery Concepts (ABC) recently won a US\$689,000 'cost-plus-fixed-fee' contract to provide 4HN and 2HN batteries to the US Army Tank Automotive Research Development and Engineering Center (TARDEC). Under the contract, awarded this spring, ABC will engineer, design, and assemble 4HN and 2HN research and production batteries based on its innovative GreenSeal technology. This is aimed at helping the US Army achieve all aspects of a new directive to replace flooded lead-acid batteries with absorbent glass mat (AGM) batteries, and ABC will do this by leveraging its advanced GreenSeal bi-polar technology to produce bi-polar, AGM, valve-regulated, lead-acid (VRLA) 4HN and 2HN batteries. These samples will demonstrate improved safety, power, capacity, vibration resistance and shelf life at the same as improved cost-per-kilowatt hour that the army is currently paying. Successful

completion of the project could lead to a supply contract for ABC to meet the army's annual demand for the continued supply of 4HN and 2HN batteries. The company said that the batteries will be designed for overall improved performance in a vibration-resistant package, aimed at 'containing' the acid in the event of a puncture and enabling it to continue operating for a short duration. The lack of free acid escaping improves soldier safety in a firefight and the continuing operation of the equipment will give a better chance for soldiers to respond effectively in any given situation.

One of the major suppliers of battery solutions to the US DoD is Exide Technologies; one of its recent high-level contracts was with the US DoD's Defense Logistics Agency (DLA), which contracted the company to supply 6TAGM military batteries under the terms of an ongoing three-year, US\$4M contract beyond 2020 with two, one-year option periods. The new contract is the latest development in Exide's 25-year-long partnership with the DLA. The company already supplies the DLA with batteries for military vehicle applications, primarily for the support of the US military's fleet of rolling stock vehicles for the DoD and other agencies. Exide is the only full-line supplier of qualified 6T batteries (6TL, 6TMF, 6TAGM) in the industry. The 6TAGM military battery itself is designed and qualified to meet stringent military specifications; it is primarily for use by military services and military manufacturers in tanks and armoured vehicle applications and similar equipment.

Power Generation

A discussion about power requirements would not be complete without some mention of power generation. Such a wide subject requires its own attention but a

couple of innovations beyond the normal petrol and diesel genset, used for a wide range of applications, deserve mention. Military vehicles have power requirements that are driven by their need to power the vehicle itself as well as a plethora of on-board devices such as sensors or communication and weapon systems that all require a continuous power supply. Keeping all the batteries for such devices charged, usually means the engine has to be started or running, but this creates noise and emissions, consumes fuel and can give away the unit's position to the enemy. To overcome this and ensure the reliable availability of on-board devices in standby mode, vehicles ideally need to carry an additional power supply, though batteries as a sole energy source discharge too quickly and will not be sufficient. Military diesel generators which have been used to re-charge secondary batteries are very heavy, consume large amounts of fuel and generate visible emissions, all of which adds to the logistics burden and risks detection. Alternative power generation sources such as solar and wind do have their place but are often inconvenient and, as sole energy supply, being weather-dependant makes them unreliable. Idling engines to ensure recharging is also a traditional approach but this adds wear and tear on various engine and gear box parts, particularly in cold weather.

German power specialist SFC Energy's approach to this has been the development of its EMILY fuel cell family. The EMILY 3000 for instance provides quiet, continuous and reliable power, fully automatically, without requiring any user intervention. It is a ruggedised fuel cell power generator that provides power for mobile equipment like communication, night-vision and navigation systems and on-board devices regardless of weather and climate.

It offers weight reductions up to 80% compared to generators and provides extended mission retention time enabling all devices to recharge and function through fully automatic, efficient recharging of batteries without any emissions and without having to start the engine for recharging. Supply interruptions during operations are eliminated and a reliable and long-term energy supply is guaranteed. The EMILY 3000 is said to be acoustically non-observable, compared to a generator, offering near silent running - 39 dB(A) in 1m distance and operates undetectably in reconnaissance applications.

At the start of the year, SFC Energy received an order from the Bundeswehr's Federal Office for Equipment, Information Technologies and Usage (BAAINBw) for the supply of off-grid power solutions to run devices onboard military vehicles, as well as to

soldiers in the field. The order worth some €860,000 followed a December 2017 €3.6M order from the BAAINBw for the same EMILY 2200 fuel cell systems. EMILY 2200 has been assigned a NATO stock number (NSN) and according to the company is the only fuel cell in Germany to have achieved this high level of standardisation. According to the company the EMILY 2200 fuel cell system is a highly efficient, silent, environmentally friendly power generator that provides reliable power to electric and electronic defence devices in the field, anywhere and anytime; it can be vehicle-based, stationary, or as used as a static battery charger.

One key recent power-generation development for future soldier system support has been the Fokker Aerostructures (acquired by GKN) lightweight diesel-fuelled power source, the E-LIGHTER. This man-carried power generation device has been developed to provide an answer to the challenges of Dutch troops carrying up to six or seven different primary and secondary batteries into theatre. This diesel-fuelled power generator provides a revolutionary lightweight power source, weighting only 1.8 kg, that offers over 400 Wh/kg during 48 hours of operation. Refuelling is easy, as diesel is widely available in most operational surroundings. The E-LIGHTER is said to significantly reduce the personal energy-related logistic challenge, while reducing the load that needs to be carried offering advantages that directly translate into increased operational effectiveness and efficiency of the dismounted soldier. The main characteristics of the E-LIGHTER are a 50% weight reduction compared to batteries (1.8 kg fully charged, 1.23 kg on average); an output of 15W, 15VDC; fuel: diesel or JP-8, and the provision of over 400 Wh/kg at 48 hours of operation. These specs make it suitable for 12-72 hour missions. The E-LIGHTER was developed as part of the Dutch Improved Operational Soldier System (VOSS).

Onward Power Developments

One new battery development being looked at by the industry sees Ultralife Corporation developing a new Lithium Thionyl Chloride M1 battery to provide longer life power for a wide range of military devices. According to the company the new battery is its highest density product so far and its lightweight and power specs make it suited for remote sensing and surveillance applications, to name but two. The company said that while temperature and operating voltage have been known to affect performance and runtime of earlier Li-ion batteries, the new Lithium Thionyl Chloride chemistry used in the M1 range, provides resilience in both humid and



Photo: Epsilor

Epsilor won a contract from the Canadian Department of National Defense (DND) for the provision of a charger for Canada's soldier system.



Photo: Epsilor

Epsilor's charger supports batteries used by various NATO armed forces. It is based on a 12-channel charger and comes packed in a rugged case.

frigid environments. Three variations of the M1 battery are being produced, weighing from 3.3 kg to 10 kg.

With future soldier systems requiring the most innovative power supply architectures to support the individual soldier and more sensors and devices onboard the average military vehicle, R&D into new stored and generated power solutions continues apace. Battery developments for both military and civil sectors are moving fast and alternative modes of power generation, including field solar and wind solutions for military use are already being tested and fielded.

Power to the battlefield is one of the most critical areas in current military technology and the importance of R&D and innovation in this sector are at the forefront of ensuring superiority in any future field of combat. ■

“There is no option to increase funds.”



Photo: MoD Greece

Vice Admiral HN (retd) Kyriakos Kyriakides, General Director for Defence Investments and Armaments, Greece (left), during a meeting with Brigadier General Hurbert L Ebraly from the French DGA

ESD: In many Western countries, the changed security situation in Europe has prompted governments to provide additional resources for defence and armaments. To what extent and in what way has this trend affected your country?

Kyriakides: Indeed, many western countries, including EU member states, are facing a multitude of challenges today, both internally and externally. In this context, the EU and its member states have a duty and responsibility to protect their citizens and promote European interests and values. As a consequence Greece has one of the highest defence spending rates in NATO and the EU. However the amount of available funds for defence and armaments has been fixed in the Medium Term Framework of Fiscal Strategy 2018-2021 and there is no option to increase them. On the other hand, considering the changing security and political situation in Europe, the reallocation of the existing funds is being considered in order to materialise investments with greater added value. Moreover, and taking into account the European Defence Action Plan, Greece plans the domestic procedure so as to exploit the funds that are going to be available by the European Defence Fund for Research and Development.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Interview with Vice Admiral (HN) retd. Kyriakos Kyriakides, General Director for Defence Investments and Armaments (GDDIA), Greece

Kyriakides: Greek armament programmes focus on upgrading the existing weapon systems. At the moment, the most important armament programme, in financial terms, is the upgrade of the F-16 aircraft through a government to government agreement.

the harmonisation of requirements and capabilities of the member states will allow the more efficient use of available defence resources on a European level. Taking into account the binding commitments of PESCO, Greece has elaborated a National Implementation Plan (NIP), to implement

Photo: Hellenic Air Force



"At the moment, the most important armament programme, in financial terms, is the upgrade of the F-16 aircraft through a government to government agreement."

ESD: In what way do you intend to consider the PESCO concept?

Kyriakides: PESCO established a permanent framework for defence cooperation among those member states willing and able to jointly develop defence capabilities and invest in shared projects. Greece, a European country with strong armed forces, participates and actively supports PESCO in order to address current shortfalls on military capabilities and support EU missions and operations. In that context, Greece believes that the cooperation and

these commitments and recently the NIP has been reported. According to the binding commitments, Greece has made available deployable formations for the realisation of the EU Level of Ambition, while at the same time Greece participates in 10 (2 as a leading nation) out of the 17 first wave PESCO projects. Regarding the future national projects, all relevant factors will be considered on case by case basis.

The interview was conducted by Peter Bossdorf.

Field Camps – Operators Can Expect New Technologies

Stefan Nitschke

Field camp technology is changing almost as quickly as military missions create new operational requirements.

Removing Old Thinking

Most of the technologies that will determine the future of military field camps to be operated in conflict zones in the next decade are already in place. Industry developed a variety of robust and highly flexible technologies to sustain a high standard of living. Among them, a secure power supply is given the highest priority. Drawing from

realities. So it makes sense to rethink the usefulness of protective measures individually, depending on the threat level.

Looking at previous military campaigns, various after-action reports devote a paragraph to how scary and dangerous conflict zones like Afghanistan or Mali can become for Forward Operating Base (FOB) installations in the event of terrorist attacks. Some reports declared field camp concepts obsolete, giv-

thinking, where the modern field camp is modular in character, fed by new forms of electricity, water, and food supply, and less vulnerable to attacks, the latter referring to better sensors and hardening.

The agenda discussed in this briefing provides a glimpse of how planners and operators of field camps in conflict zones can increase their suitability, habitability, and effectiveness while reducing vulnerabilities to a maximum.

Coping with New Needs

If the concept of "permanence" in crisis regions or war zones, as often mentioned



Graphic: Obermeyer Planen + Beraten GmbH

Today's field camps benefit from technologies that make them deployable at a moment's notice.

military operations in the past, combusting fuel to produce electricity has been an inherently inefficient and polluting process. Although this methodology enables electricity to be supplied on demand, it is about to be replaced by cleaner and more cost-effective energy.

Another major issue is protection. Previous requirements often did not match with rapidly emerging threats, mostly terrorist attacks. Planners must work within today's

en the lack of protective measures like ballistic protection. Additionally, reports note that sensors often did not provide continuous cover of events in the immediate vicinity of such installations. An ISAF source quoted: "There was a lack of night vision, thermal, or network cameras employed for gathering real-time, HD [High Definition] quality surveillance video and high-resolution imagery." One conclusion drawn from these reports is that there is a constant need for network deployment concepts, as readiness for different kinds of completely new threats has to be further improved.

Asymmetric threats in Afghanistan, Mali, and the Middle East sent classic field camp architectures to history's graveyard and led to the emergence of a new type of



Photo: Saab

Field camp installations in conflict zones need to be protected against rapidly emerging threats. Shown is the GIRAFFE AMB radar deployed by the Australian Army in Afghanistan.

Author

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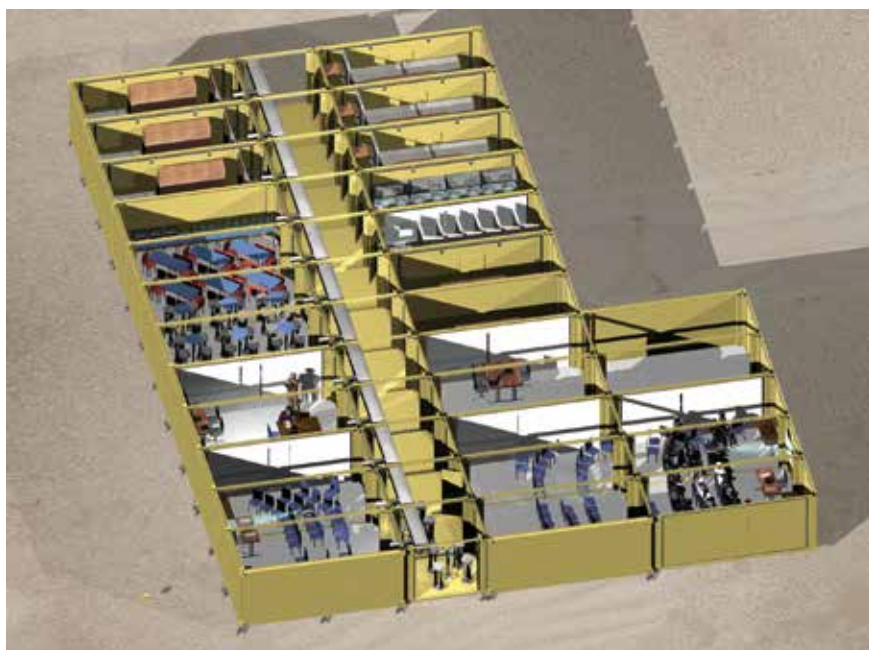


Photo: Drehtainer

Protected module consisting of ISO containers

by United Nations (UN) officials, is at best a reference to past years or even decades, there are arguments to think about today's needs. The role of military field camps is often underestimated, defence contractors say.

Operation HERON in Mali explains how rapid deployable tents, shelters, and modular containers demonstrated their advantage over previous concepts. With a number of deliveries completed for military field camps and several more under way, Losberger RDS reckoned it was ready to address exactly these needs. The result is the TAG NG and TMM series of tents that company officials hope to promote for some future programmes, some of which call for newer products to replace legacy systems. With a range of optional accessories such as lighting, heating/air conditioning systems, electrical distribution, TAGs are the logical answer for any deployment situation like that in Mali.

The tent manufacturer, with a focal point of rapid deployable tents, noted that "inflatable tents provide the best solution." The manufacturer added that the technology inherent in these tents overcomes adverse environmental and weather conditions, like temperatures of up to 48°C, heavy winds, and dust, outperforming other concepts available on the market.

Mobile shelters are an extremely important issue. They play an important role in the event a military commander needs to mobilise, deploy, manoeuvre, and sustain forces. Most of them are steel or lightweight aluminium alloy shelters that are designed to have a high strength-to-weight ratio and range from small, trailer-mounted types through 20-foot

ISO containers. A key military requirement, they can be positioned by crane or forklift to the largest ISU airlift slingable units moved into position typically by a CH-47 CHINOOK heavy-lift transport helicopter.

The containerised solutions delivered by Drehtainer provided evidence of exactly

pany since 2016) and Veolia Water Technologies can do more than required by the military customer, providing potable water in the event of high levels of contamination, whether biological or chemical. Adopting WEW's 'drop & go' delivery methodology makes potable water a commodity that can be made available in conflict zones or in disaster relief situations quickly and easily. At DSEi 2017 in September, the company noted that fully integrated water storage, treatment, and delivery systems are the "last mile" items for the modern field camp infrastructure.

Essential for field camps is electricity. According to industry, "Renewables are a challenge." So, mobile energy systems can be used in remote areas without infrastructure. There is no need to bring in and install diesel generators and fuel any more. In some Humanitarian and Disaster Relief (HADR) missions, this was a time-consuming process; but, in a military conflict, transport routes, when blocked or destroyed, can pose a severe problem. Therefore, mobile photovoltaic (PV) systems can fill a gap here.

Because so many field camps have been far from urban areas in a number of military deployments, manufacturers like smartflower energy technology GmbH in Aus-



Photo: Multicon Solar AG

The Multicon Solar Multicontainer can be transported anywhere in a simple and cost-effective manner.

this trend that puts the focal point on 'buzz words' like availability, rapid deployability, protection, and easy maintenance.

Another issue that should certainly not be overlooked is that of potable water, which is a vital ingredient of modern military field camps. The military acknowledges that this issue comes "very early" in the process of planning and constructing field camp infrastructure. "We are talking about needs that shape daily operations in a field camp," a NATO official said. Modular solutions on offer by WEW (a Thielmann Group com-

pany or Renovagen in the United Kingdom (UK) are developing ultra-light and highly mobile PV systems that require no external input. smartflower's main project is named REMULES (Renewable Mobile Ultra-Light Energy System), combining "aeronautical techniques" with "[PVs] using a novel [...] technology," modules without any glass sheets, and extremely lightweight semi-flexible foil laminates.

Described as a "complete, 'all-in-one' solar system contained in a box," it includes all the necessary components and has sepa-



Photos: smartflower energy technology GmbH

With a net system weight of 190 kg, the REMULES 'plug-and-play' photovoltaic system can be set up in just 10 minutes.

rate battery units to ensure the direct availability of electrical power. With its output of 2 kW, the system can "operate stand-alone or in co-generation with other generators," the company noted. REMULES was extensively tested during the multinational exercise CAPABLE LOGISTICIAN 2015 (CL 15) in Hungary in June 2015. It formed part of the Smart Energy Camp deployed during the CL 15 exercise, during which scenarios included responding to power cuts, diesel and water contaminations, and generator breakdowns.

An interesting innovation is Renovagen's Rollarray Isogen Transportable Solar Power Plant. Combined with inverters and a large battery pack, it creates an easily transport-

able self-sufficient solar power system capable of generating 10 times more power than competitive products. Deploying a huge solar array measuring 5 m in width and up to 200 m in length, this solution represents "by far the largest containerised deployable solar array yet conceived," the company said. Renovagen envisages that this technology could revolutionise the cost-effective and environmentally friendly provision of large amounts of off-grid power in remote locations.

However, renewables are bulky and expensive. So, industry is keen to develop 'easy-to-handle' solutions, among them transportable and lightweight PV systems. Two new product lines, a fuel cell-based

Photo: Renovagen Ltd.



A unique, patented technology enables entire solar arrays to be made rollable.

generator from New Energy GmbH (delivering up to 1.2kW and 500W energy) and a new mobile energy supply for sani-

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Protection makes the difference.





Air-transportable generator trailer (Grünenfelder) configured by M. Schall GmbH for EU Battlegroup field camps. Two such generators can provide electricity for a large protected tent module.

tary/medical facilities from HYREF GmbH are part of this revolutionary process. The former option is the least attractive from a military standpoint, considering the two key requirements that were drafted for mobile energy systems: easily transportable (including airdrop) and able to function in extreme conditions such as mountainous terrain (snow and ice), desert regions (sand, dust) and coastal areas (salt in the air). The solution on offer by steep GmbH from Germany is the steep Mobile Solar Energy System. It consists of a fully mobile and quickly operational container equipped with a solar panel and a tent that provides space for control duties.

In summary, mobile energy systems operate self-sufficiently, are quick and easy to transport, and function in a range of operational scenarios. Energy experts said that costs of PV and Concentrated Solar Power (CSP) have been declining substantially in recent years. This trend is expected to continue.

Growth Goals for Portable Energy

Portable energy concepts, namely lithium-ion (Li-ion) batteries and fuel cells, offer unparalleled advantages to the military. At DSEi 2017 in London, Epsilon Industries Ltd. from Israel made an interesting note: "In the next five years, the usage of lithium batteries

will further expand to heavy-duty platforms, such as [...] shelter applications." According to the manufacturer, the new generation of lightweight Li-ion batteries is much more powerful than traditional lead-acid batteries. SFC Energy AG believes long power autonomy is key for operating military field camp installations. In April 2015, the company unveiled its EFOY TroTrailer concept, a trailer-based hybrid power source integrating an EFOY Pro 2400 Duo fuel cell with two or four fuel cartridges, up to four solar panels for optimum power flexibility, two or four batteries, and a 60-Amp solar charger. This combination generates up to 1,000 Wp (Watt Peak) total power. "As long as the sun shines, the required power will be produced exclusively by the solar modules, with zero fuel consumption," the company noted, adding that the fuel cells will automatically start operation and fill the power gap if the solar modules do not deliver enough power.

Thales incorporated its DYON technology into a deployable (fixed or tactical) smart energy communications container for in-theatre operations. This solution was extensively tested by the French Armed Forces. It improves the autonomy and resilience of a containerised communications capability, optimising energy consumption and using renewable energy sources to further reduce costs. Thales sales executives said



Basstech's Hubmaster RACKBOX NATO Storage Container.

the containerised communications capability combines low-energy generators with high-efficiency Li-ion batteries. They added that the smart energy management system automatically optimises energy production, storage, and consumption. Communications operators with no additional training can control and monitor the system from a small, dedicated console inside the container and track energy status from their own consoles as required.

Details Emerge of New Protective Measures

Detector technology, in the form of ground-based radars (GBRs) or thermal imaging cameras, can do a lot. When installed in field camps, such equipment can form passive target detection systems able to find their targets in complete darkness and against significant background noise. Any of these measures will include the fusion of information derived from multiple sensors, said Jean-Claude Griess, Sales & Marketing Manager of the electro-optics and radar specialist Belgian Advanced Technology Systems (BATS). "New threats that need to be detected [in close vicinity to field camps] include small drones and other unmanned vehicles." But there also is a requirement to detect and neutralise rocket, artillery and mortar (RAM) projectiles and their firing positions.



ALDEBARAN RAPTOR-series LED floodlights (left) consume less than one-sixth of the energy of comparable halogen floodlights, while generating up to 40% more light at the same time. Note the X-PECT lens system (right) that collects the produced LED light and delivers the required illumination.



One solution can be found in Saab's GIRAFFE 4A radar that was used to detect and track very small unmanned aircraft during live customer trials in autumn 2013. In the lab, the 4A radar showed twice the range of the company's GIRAFFE AMB (Agile Multi Beam) radar, Saab Electronic Defence Systems said. It monitors the 360-degree air volume for air targets and simultaneously locates and warns against incoming RAM projectiles. With an instrumented range of 75 km, it can also detect and track small unmanned aircraft in high-clutter environments.

Another issue is decontamination. Kärcher Futuretech (KFT) developed the MEP Cage Module System. The company is pitching the solution as a "flexible configuration of individual modules" known as cages, to allow it to be deployed "in line with changing demands." The modules can be "simply mixed and matched," according to the company, plus they offer enough space for other devices, chemicals or accessories, as required by the individual scenarios. A variety of items typically seen in military field camps can be decontaminated, including vehicles, road sections, interior spaces or individuals. Field camps, like other military installations, may be facing additional threats, and there are persistent questions as to whether some

of them can be eliminated by additional means: counter-drone and counter-IED (C-IED) methodologies; barriers; and weapons for self defence. Ebinger Prüf- und Ortungstechnik GmbH, promoting its handheld UXO PIDD 2 detector, noted at the Industry Day at the NATO Military Engineering (MILENG) Centre of Excellence (COE) in early December 2016 that "detector technology needs to be consistently improved to better cope with completely new threats," also referring to field camps in warzones. Another manufacturer, SENSYS Sensorik & Systemtechnologie GmbH, stated that the demand for items of this kind in the process of securing field camp infrastructures is growing. SENSYS offers a portable magnetometer survey kit for drone-based UXO detection, named MagDrone IV.

The use of barriers is not new, and industry noted that the demand for items of this kind, following the number of terrorist attacks in France, Germany, Spain, and the UK, is growing. Mifram's Modular Vehicle Barrier (MVB) can be part of this scheme. The barrier's 'L' shape stops vehicles travelling at high speeds by transferring the vehicles' horizontal momentum to vertical momentum, regardless of its speed, said the Israeli manufacturer. As a passive pe-

rimeter barrier designated as an 'anti-ram barrier', the MVB is capable of stopping all types of vehicles, ranging from motorcycles, land rovers, and all-terrain vehicles, to light trucks. Thousands of units have already been sold to the US military for protecting assets. In Iraq, the American military stopped trucks weighing dozens of tonnes efficiently by spreading a number of lines of MVB units, thwarting any chance of the truck creating the necessary speed and momentum. Meanwhile, the French Navy has also begun using the modular system.

Conclusion

It is clear that the route chosen by field camp operators will lead to substantial changes in the planning, design, and construction of such facilities, as well as investments in modern, threat-driven equipment. Deals with industrial suppliers will have an interesting side effect: both sides, military and industry, could strengthen their ties based on experience harvested in crisis zones and warzones around the world. This could result in the joint exploration and evaluation of new, alternative, fundamental technologies, a process that has never happened before. ■

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“Lithuania has been following NATO guidelines.”



**Interview with Colonel Valdas Šiaučiulis,
National Armaments Director, Lithuania**

ESD: In many Western countries, the changed security situation in Europe has prompted governments to provide additional resources for defence and armaments. To what extent and in what way has this trend affected your country?

Šiaučiulis: Following the Russian aggression in Ukraine and the annexation of Crimea, the security situation has prompted European countries to provide additional resources for defence and armaments. In Lithuania's case, we have already reached 2% of GDP spending on defence this year and we expect to maintain such level in the future. I would like to note that:

- Lithuania has been following NATO guidelines concerning these spending groups:
 - less than 50% of defence budget for the personnel (blue colour) and
 - more than 20% of defence budget for major equipment and weapon systems (red colour).
- In the times of very limited and insufficient defence budget (2010-2014), the Ministry of National Defence of Lithuania (MoND) established armament priorities and in line with the adopted approach prepared capabilities development and equipment acquisition plans. Additional finances started coming in as late as in 2015; thus only then could we start fully materialising our plans based on the priority list.

- Another point to underline is that the increased amount of defence budget and procurement projects (as well as higher degree of complexity of the projects) was one of the reasons why we started reorganising the defence acquisition domain. On 1 January 2018, Lithuania established the Defence Materiel Agency (DMA) the objective of which is to ensure simpler, more effective and clearer procurement processes. The foundation of the DMA ended the first round of reorganisation. We plan more improvements, and a second round of reorganisation is estimated to start on 1 January 2019.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Šiaučiulis: The most important armament programmes implemented in Lithuania are as follows:

- Infantry Fighting Vehicles (BOXER). Contract in place from the end of 2016. LTU MOD is acquiring 88 of IFV BOXER.
- Self-propelled Artillery (PzH2000) is another highly consuming area of defence budget resources. 4 howitzers are already in Lithuania and 12 are in the process of modernisation in Germany.
- Medium Range Air Defence. Lithuania's MOD is buying the NASAMS (Norwegian Advanced Surface to Air Missile System) MRAD system. The contract was signed in 2017. The FOC is planned in 2019.
- Host Nation Support (HNS). We have been focussing on infrastructure improvements related to training areas, air base and Enhanced Forward presence.

The main forthcoming programmes are:

- Utility transport helicopters. Lithuania's MoND is looking for the possibility to obtain new medium size transport/utility helicopters in order to replace its ageing inventory, however not earlier than 2022.

- All terrain 4x4 vehicles. It is another area which according to our estimates will require significant resources to be able purchase armoured 4x4 vehicles.
- Ammunition (filling ammo stocks). It is one of the realistic areas in which we see potential opportunities for cooperation (focussing mainly on bigger calibre ammunition such as 155mm).

ESD: Which of these are carried out in international partnerships, and who are your partners?

Šiaučiulis: Our main partners are:

- Germany, Netherlands & OCCAR: BOXER project;
- Germany & NSPA: PzH2000 project;
- Norway: NASAMS project;
- USA: armoured 4x4 vehicles procurement and improvement of anti-tank capabilities (JAVELIN, STINGER).

ESD: In what way do you intend to consider the PESCO concept?

Šiaučiulis: Lithuania is actively participating in the discussions and decisions concerning the implementation of PESCO aims and principles and has already demonstrated a positive intent to fulfil more binding commitments in the context of PESCO. We have made progress in the fulfilment of the commitments related to increasing expenditure on defence and participating in PESCO projects. Most attention and concentration of our efforts lay on our participation in priority (from our point of view) PESCO projects: Lithuania is the leading nation in the project “Cyber Rapid Response Teams and Mutual Assistance in Cyber Security” and a member of the project “Military Mobility”. Participation in these PESCO projects is very important as it enables us to be at a higher level of preparedness to respond to the threats we could potentially face.

**The interview was conducted
by Peter Bossdorf.**

New Artillery for the Danish Army

Michael Johnsson

2020 will be a year that Danish gunners have been looking forward to for many years, as Denmark will get modern artillery systems.

Since 2004, the only surviving artillery battalion has lacked big-calibre guns for battle support. The 1st Danish Artillery Battalion (1DAA) has trained hard on coordinating the fire from other nations' guns. From 2007 until 2014 personnel from 1DAA manned the Joint Fire Centre in the Danish battalion stationed in Helmand, Afghanistan, as a part of the British brigade Task Force Helmand. Being deployed to Afghanistan against Taliban insurgents, the Danish troops coordinated the fire support with GMLRS and 105mm light guns from the UK, M777 from the US and other fire support means on a daily basis.

1DAA deployed its own forward observers and joint tactical air controllers but could not deploy its own guns, as the few remaining M109A3s guns were not in an operational condition.

Since the 1990s the Danish Army has been looking for a replacement for the

M109A3s. After several attempts, the Defence Acquisition and Logistics Organisation (DALO) signed a contract with French Nexter in June 2017. The contract covers 15 systems, of which 12 systems will be assigned to 1DAA. The remaining three are for training, maintenance and development. The contract includes an option for the procurement of six additional systems. The end goal is to have 1DAA as a complete artillery battalion with 18 systems.

New Artillery System for the Danish Artillery

The preferred contender was Nexter's CAESAR, a wheeled lightweight self-propelled artillery system based on an 8x8 military off-the-shelf truck. The truck is from TATRA and will be delivered in a 400(+) BHP version with a fully automated gearbox.



With the full implementation of CAESAR in 2020, the Danish Army will soon be able to contribute with highly modern artillery assets to NATO's high readiness forces and other coalitions if required.

fire 39- and 52-calibre NATO standard 155 mm ammunition. The gun has a 23-litre chamber and is able to handle either bag charges or modular charges. It is equipped with a loading tray for the rounds on the right side and a loading tray for the charges on the left side. This reduces the physical stress on the crew while handling the gun.

The artillery system requires a four-man crew, and the complete system is fully autonomous. The Fire Support Division is developing a doctrine that takes full advantage of the new technology that CAESAR will provide in response to the threat spectrum against fire support systems on the modern battlefield. CAESAR will be equipped with the new battle management system including the THOR digital fire support system from SYSTEMATIC in order to digitise as many processes as possible.

When implemented, the forward observer should be able to send the fire mission digitally via the joint fire cell to the allocated guns. Via an interface between THOR and the fire control systems, the necessary data to the gun will be calculated, and the information needed for the message to the observer will be returned via THOR.

Deliveries of the 15 systems are expected to commence at the beginning of 2020. As can be expected, 1DAA will use an additional year for training and implementation of the new doctrine, before it can fully exploit its potential to deliver firepower – with its own guns.



Photos: NEXTER

The Danish version of NEXTER's 155mm CAESAR is mounted on a TATRA 8x8 truck and will have a four-man crew.

Author

Major Michael Johnsson is Head of Guns and Mortars Branch, Fire Support Division of the Danish Army Combat and Fire Support Centre.

In combat-ready state, CAESAR carries 36 rounds, 36 full-size charges and the crew members' personal equipment.

CAESAR has a range of 40(+) km. The gun is a 155mm 52 cal. which is interoperable with all NATO guns and ammunition compliant with the Joint Ballistic MoU. It can

Sensors for Armoured Vehicles

Doug Richardson

It is no easy task for AFV crews to follow a suitable route and to identify potential targets, as their operating environment is within a metal hull that at best offers a limited view of the outside world.

In combat, a tank or other AFV is only as effective as the sensors which allow its crew to navigate their vehicle, then locate, identify, and destroy targets. If one side in a conflict has better sensors than the other, the fight can become one-sided. Unless their vehicles had been modernised, Iraqi commanders of T-72 tanks probably had to rely on the TKN-3 sight, which was based on Russian image-intensification technology developed in the late 1950s. US crews reported that the thermal sights of their M1A1 ABRAMS tanks were able to detect Iraqi T-72s during Operation Desert Storm in early 1991, despite the presence of smoke from oil well fires and other obscurants. The US tank crews were able to identify and destroy their targets at long range, whether by day or night, but the sighting systems on Iraqi T-72s could not match this capability.

The classic method of obtaining situational awareness is for the driver and commander to have their heads out of their respective hatches, with the commander resorting to binoculars in order to locate and identify distant targets. However, this made both men vulnerable to snipers or to fragments from artillery rounds bursting nearby.

The need for the commander and driver to perform their functions from within the armoured hull required the use of built-in vision devices such as direct-vision blocks and periscopes. Direct-vision blocks made from armoured glass can often be used in locations where conventional periscopes cannot be fitted.

For the driver, the classic solution was an array of zero-power periscopes able to provide an adequate forward view when the tank was closed up, but for the commander, periscopes had to meet several conflicting

requirements. For the surveillance and target detection roles, they needed to provide a low magnification and a wide field of view, but the identification of targets required a higher magnification.

Periscopes

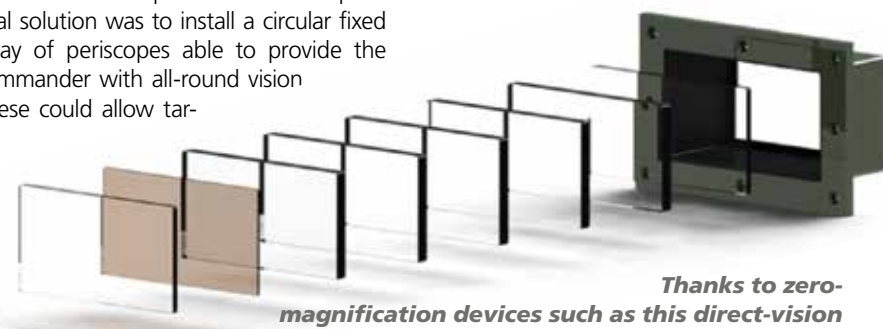
One solution adopted from the 1930s onwards was to install a low-power periscope that is trainable in azimuth. These allowed surveillance over a wide arc, but restricted the user's field of view. They also had the problem that there was no physical relationship between the position of the user's head and the direction in which the head of the periscope was pointed. This could create orientation problems. A more practical solution was to install a circular fixed array of periscopes able to provide the commander with all-round vision. These could allow tar-

get acquisition at short ranges, but needed to be supplemented by additional optical systems that offered higher magnification. Rotatable cupolas that combine a circular array of unit power periscopes with a single high-magnification periscope were introduced in the late 1940s.

An AFV moving off-road will suffer hull movements whose oscillations are undamped, at random frequencies, and of fairly high amplitude. For the gunner, oscillations in the longitudinal plane will change the angle of gun elevation, while oscillations in the horizontal plane will change the traverse. As a result, full stabilisation of the commander's and gunner's sights is now commonplace.

Another widely-used development is the independent commander sight (ICS). As its name suggests, this allows the commander to search for targets, then allocate the most important target to the gunner. This leaves the commander free to search for a fresh

Photo: Kent Periscopes



Thanks to zero-magnification devices such as this direct-vision block from Kent Periscopes, the human eye is still a useful sensor for the crew of an AFV. Layers of armoured glass serve to protect the user from small-arms fire or fragmentation threats.



Photo: Openphoto

This view of an advancing LECLERC MBT shows the location of the commander's EO system on the turret roof, and the gunner's sights.

Author

Following an earlier career in engineering, **Doug Richardson** is a defence journalist specialising in topics such as aircraft, missiles, and military electronics.

target that can be assigned to the gunner after the latter has engaged and destroyed the previous target. This "hunter-killer" capability increases the pace at which the vehicle is able to engage a series of targets. At first, ICS systems were fitted only to MBTs, but can now be found on lighter AFVs such as the German PUMA.

The use of active infrared systems based on an IR searchlight and an IR imaging system able to exploit the reflected energy allowed tanks to be driven at night, and targets detected. However, this solution was short-lived, since the energy from the IR searchlight could be detected by a suitable sensor, warning the enemy that a night attack might be under way.

Image Intensifiers

The development of night-vision (NV) technology in the form of thermal imagers and image intensifiers finally gave AFVs a proper night-fighting capability. Since these relied either on the thermal energy radiated by objects of interest, or on a much-amplified version of whatever existing light was available even on a dark night, they gave the enemy no warning that he was under observation.

Photo: Russian MoD



This artwork from the Russian Ministry of Defence shows the layout of the new T-14 ARMATA MBT. Note the EO sensor housing on the turret roof, and the array of periscopes above the sloped glacis.

For the driver, night vision is often obtained by removing one of the existing arrays of periscopes as night falls, and replacing this with an image-intensification or thermal sensor. The commander's and gunner's needs are normally solved by equipping them with sights that have NV capability. Some AFV EO systems have an auto-target-tracking (ATT) capability. These allow an optronics system to lock onto a designated target, then follow it. If the target becomes temporarily obscured behind cover, the sighting system can continue to track at a predicted rate. The use of an autotracker reduces the workload of the gunner, and even allows him to engage slow-moving air

targets such as helicopters. Like the gunner's sight, traditional driver's vision aids provide coverage of only the forward sector. That is satisfactory for conventional warfare operations, but a modern army may have to fight in urban environments in which an opponent may be able to stalk AFVs, approaching them from any direction then mounting attacks using man-portable guided or unguided weapons. AFVs committed to urban operations may also need to manoeuvre within narrow streets or other confined spaces. Both problems require that the vehicle be equipped with sensors that provide all-round coverage.

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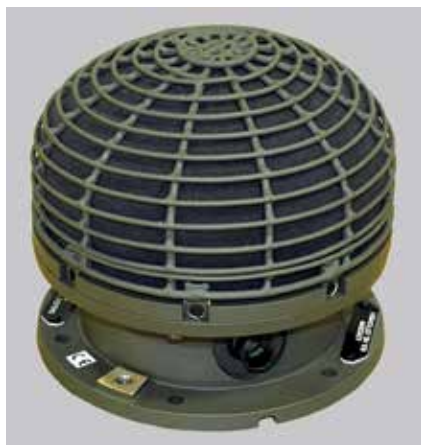
Situational Awareness

A brief survey of several current main battle tanks (MBTs) and infantry fighting vehicles (IFVs) will show how sensors are used on typical vehicles. Until fully-stabilised day/night vision systems for the commander and gunner became common, one early expedient was to allow the commander to use the gunner's NV sensor. For example, on the LEOPARD 2, the commander had a PERI-17 stabilised day sight, but was able to view night imagery from the gunner's EMES 15 stabilised day/night sight. The later LEOPARD 2 Improved build standard added a thermal channel to the commander's sight. Day/thermal cameras able to provide 360 degree situational awareness are a feature of the LEOPARD 2A7+ version. Imagery can be viewed on monitor screens located at all crew stations.

The driver of the LECLERC has two day periscopes, plus a TDD OB-60 day/night periscope. Each of the eight day periscopes available to the commander has a switch that can be used to slew the 120mm main armament onto the periscope's bearing. The commander's SAGEM HL-70 panoramic sight has x2.5 and x10 magnifications for day use, and an x2.5 image-intensification night channel.

The SAGEM HL 60 gyrostabilised gunner's sight incorporates a thermal camera and a Thales laser rangefinder. There is a direct day channel with x3.3 and x10 magnification, an x10 video day channel, and a thermal channel. It is linked to displays at the commander's position that allow the commander to engage targets using the main armament. The LECLERC Block II+ standard introduced SAGEM Iris second-generation FLIR cameras into the commander's and gunner's sights.

Photo: Thales



This acoustic sensor is part of the Thales UK's ACUSONIC shot-detection system that will be used on the UK's planned AJAX medium-weight AFV.

Photo: IAI Elta



IAI Elta's ELO-5220 OTHELLO and ELM-2133 WINDGUARD represent two technical approaches to the detection of hostile fire. The first is an EO system linked to a display within the vehicle; the other is a phased-array pulse Doppler radar that normally forms part of a defensive aids suite.

Photo: Elbit Systems



Elbit Systems' IRONVISION displays the external scene on the visors of helmets worn by the commander and driver of an AFV.

In 2006, Nexter Systems announced AZUR [Action en Zone URban], a LECLERC variant optimised for urban operations. Developed as a private venture, this includes a new panoramic sensor that allows the commander to make a swift visual scan through a full 360°. According to the IDF, the NV system that forms part of the KNIGHT Mk 3 computerised fire-control system of the MERKAVA Mk 4 MBT is based on advanced thermal technology. Unofficial reports suggest that the system uses dual-band thermal imaging optics operating in the 3-5 micron and 8-12 bands.

The MERKAVA Mk 3 introduced an Elbit Automatic Target Tracker (ATT) which operates using either thermal or day-sight imagery. Once the target has been acquired by the gunner, the system uses centroid tracking to maintain the line-of-sight lock, and will require the target should the latter have been temporarily obscured by terrain features. On the upgraded MERKAVA Mk 3 Baz, the autotrack facility is credited as being effective on targets located several kilometres away, and against helicopters. The MERKAVA Mk4 has a second-generation ATT that is designed to be more effective against low-flying helicopters.

Vectop's Tank Sight System (TST) for the MERKAVA Mk 4 consists of four cameras mounted in hardened casings. These provide all-round video coverage by day or night. A camera installed in the left side of the hull rear allows the driver to look behind the tank while driving backwards.

The MBT most reliant on sensors is Russia's new T-14 ARMATA. The turret is unmanned, and relies on an autoloader. Like the driver, the gunner, and commander are all located within the hull of the vehicle. Although equipped with periscopes that can be used for observation purposes, they rely on information from turret-mounted sensors that is shown on their flat-panel displays.

360 Degrees

The trainable housing for the commander's day/night EO sight is located on the turret top and can be directed over a full 360°. Mounted to the left of the main armament and protected by a two-piece armoured shutter, is the gunner's day/night sight, which can be slaved to the commander's sight. In addition to the traditional array of periscopes, the driver also has a FLIR and several TV cameras. An array of wide-angle

cameras provides 360° situational awareness. A day/night camera is mounted on the glacis, but several unidentified sensors on the turret are probably part of the DAS. As part of its plan to overhaul and upgrade its current fleet of BRADLEY IFVs, the US Army is planning a Lethality ECP (engineering change proposal) that will install a new Third Generation Forward Looking Infrared (3GEN FLIR) targeting sensor in both the gunner's primary sight and the commander's independent thermal viewer. The current FLIR is a single-band device that was designed in the 1990s, but the new sensor will operate in two IR bands (mid-wave infrared/long-wave infrared), and is expected to provide a clearer image.

The project will be based on horizontal technology integration, and involve the development of a set of common components that will fit into not only the two sights in the BRADLEY, but also two sights currently used on the M1 ABRAMS tank. In all cases the new FLIR will be compatible with the volume, weight, power and cooling requirements of the existing sights.

In 2016, Raytheon and DRS Technologies were awarded contracts by the US Army Project Manager for Terrestrial Sensors (PM TS) for the engineering and manufacturing

development phase of the common components (known as the B-Kit) that will be integrated into the upgraded sights, and could in future be used to upgrade Raytheon's vehicle-mounted Long Range Advanced Scout Surveillance System.

The commander and gunner of Rheinmetall's LYNX infantry fighting vehicle, first shown at Eurosatory 2016, both have access to the vehicle's Stabilised Electro Optical Sight System (SEOSS), a digital system based on TV and IR channels and incorporating an integrated laser rangefinder and fire-control computer. Displays within the fighting compartment provide the crew with a seamless 360-degree panoramic view. A Situational Awareness System (SAS) capable of automatic target detection and tracking is intended to minimise crew reaction time.

In September 2014, General Dynamics UK was awarded a £3.5Bn contract for the AJAX programme to develop the British Army's next family of tracked medium-weight AFVs. Thales UK will supply independently stabilised day/thermal sights for the commander and gunner. Based on the CATHERINE MP third-generation focal-plane array, the commander's ORION periscopic sight will provide 360° panoramic coverage and the ability to conduct hunter-



Photo: Microsoft

Microsoft's HoloLens "smartglasses" (a head-mounted display unit) forms part of the Ukraine's Limpid Armor system. It displays a video feed from a series of day and IR cameras on the outside of an AFV in order to provide all-round situational awareness.

killer engagements. The gunner will have a Thales DNGS T3 stabilised sight with day (HDTV) and thermal channels with a choice of MWIR or LWIR imagers, as well as an ATT capability. Imagery from any of the vehicle's sensors will be available to flat-panel displays at the driver's, commander's and gunner's positions. An array of Local Situational Awareness cameras - a combination of day and uncooled thermal sensors - will provide 360° coverage.

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DARPA's Ground X-Vehicle Technologies (GXV-T) programme is exploring ways of improving the situational awareness of the crew and passengers of future armoured fighting vehicles by exploiting visualisation technologies that were developed for the cockpits of combat aircraft.

Shot Detectors

Systems able to detect incoming enemy fire are being introduced on lighter AFVs. Rheinmetall's LYNX is fitted with laser warning sensors and an Acoustic Sniper Locating System (ASLS). The AJAX family is to be fitted with Thales UK's Acusonic sensor, a vehicle-mounted shot-detection system. Each vehicle will be fitted with three of these acoustic sensors, an array that will provide 360° coverage, giving the crew the situational awareness needed to react to the threat. The contract is worth £3.7M, and covers the procurement of 735 Acusonic systems.

Systems able to detect hostile fire are also being introduced for use on heavier vehicles, including MBTs. While many form part of an integrated DAS, others can be installed as stand-alone systems. For example, IAI Elta's ELO-5220 OTHELLO is a passive optical fire locator intended to detect the launch of anti-tank missiles, or rocket propelled grenades (RPGs), and locations from which cannon fire and gunfire are being used. It is designed to provide the azimuth and elevation bearing of the attack, and to classify the type of weapon being used. A typical installation takes the form of four detection units positioned to cover a complete 360° in azimuth, and a control unit that will display data on the detected threats.

Sensor Fusion

Sensor fusion – the process of combining imagery gathered in two or more regions of the spectrum – can produce a composite image that is more informative than that obtained from only one band, and less susceptible to the degradation caused by varying atmospheric conditions and unfavourable ambient temperatures. So it is hardly surprising that this technique is being applied to AFV sensors. One example is ISTECE ICE's SP0211 Fusion Periscope, a dual waveband driver's aid whose operating modes include thermal,

day, picture in picture, or fusion. The last of these uses a combination of thermal and day imagery. The sensor head can be rotated in the vertical and horizontal planes, and its output is presented on a wide flat-panel display. Several manufacturers are offering what is essentially the best method of providing situational awareness – giving the crew what is essentially the ability to see the external scene as if the vehicle's armour was transparent. Israeli company Elbit Systems developed its See-Through Armour (STA) to provide 360° situational awareness. The system combines a set of externally-mounted high-resolution day and night cameras with three displays mounted within the vehicle's hull. Each display can show an image of the external scene, which can be overlaid with smaller windows dedicated to functions such as front and rear panoramic displays. IRONVISION is a further development of this concept, and displays the external scene on the visors of the helmets worn by the commander and driver. According to Elbit Systems, the software devised to merge the images from the individual cameras uses an advanced distortion-correction algorithm to eliminate visual distortions and prevent motion sickness. Head-tracking technology allows the system to lock onto potential threats and targets seen by the commander. Developed by BAE Systems' HÄGGLUNDS subsidiary, the BATTLEVIEW 360 system combines a head-mounted display with an array of normal or IR cameras mounted on the outside of the vehicle. Sensors built into the helmet detect the direction in which the wearer is looking, and the system stitches together the output of several cameras to provide a wide-angle view of the battlespace. The system can combine visual imagery with geographical data and information on "blue" friendly and "red" enemy forces. A head-down touch screen display allows the vehicle commander to view the displays of other crew members, or even imagery from other ground or air vehicles.

BATTLEVIEW 360 has been successfully tested on a CV90, but its open architecture configuration allows it to be adapted to any type of vehicle. For example, it has been demonstrated on the US Army's BRADLEY IFV, and even integrated with a UAV in order to provide enhanced situational awareness for vehicle crews.

Microsoft's HoloLens "smartglasses" (a head-mounted display unit) are the central component of a similar scheme being developed by the Ukraine's Innovations Development Platform agency. Known as LIMPID ARMOUR, this uses a series of day and IR cameras on the outside of an AFV to provide a video feed that will create an all-round view of the external world. The system includes the ability to cue the vehicle's weapons, and incorporates a target autotracking capability. Under an Australian Government package of contracts awarded in 2016 to encourage defence innovation, Tectonica Australia was given funds to support its Hear and See Through Armour project. Working in conjunction with the Swinburne University of Technology, it is developing a system in which AFV crew members equipped with virtual reality glasses incorporating headphones will be able to see what is happening outside the vehicle, and will hear the appropriate directional sounds.

In the US, the Defense Advanced Research Projects Agency (DARPA) Ground X-Vehicle Technologies (GXV-T) programme is exploring ways of improving the situational awareness of the crew and passengers of future armoured fighting vehicles. Potential approaches include using visualisation technologies to provide high-definition, wide-angle visibility of external conditions. Sensors could use a variety of technologies, and should be able to identify and track allies and adversaries, while conducting terrain classification tasks that would be used to evaluate and plan optimal travel routes. Routine driving tasks could be automated, allowing drivers to focus on more strategic activities. Inevitably, there is a potential disadvantage to the growing use of AVF-mounted sensors – these devices are becoming a target for enemy fire. During current combat operations in the civil war in Yemen, Houthi forces are reported to have used sniper rifles or even collective small-arms fire against the optics of the gunner's and commander's sights of the LECLERC MBTs being used by The United Arab Emirates forces taking part in that conflict. The more sophisticated the tank, the more vulnerable it might be to such "low-tech" tactics. An ARMATA MBT whose sensors had been knocked out would no longer be a "super tank", but a near-impotent target awaiting destruction. ■



“Our top priority is the procurement of light armoured vehicles.”



Interview with Alma Ljuljanaj, Director General of the Directorate for Material Resources, Montenegro

ESD: In many Western countries, the changed security situation in Europe has prompted governments to provide additional resources for defence and armaments. To what extent and in what way has this trend affected your country?

Ljuljanaj: The Ministry of Defence of Montenegro takes its commitments in the framework of full membership of Montenegro in NATO very seriously. In this regard, the Ministry of Defence plans to gradually increase the share of defence expenditure to 2% of total GDP for defence purposes and 20% of the defence budget for equipment and modernisation by 2024.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Ljuljanaj: In accordance with the guidelines of the new long-term plan of equipping, Montenegro is ready to move into a new cycle of investment in the defence sector. These investments will focus primarily on meeting NATO capability goals that Montenegro took over after gaining full membership in the alliance.

In addition, Montenegro will also increase its capabilities to equip the Armed Forces of Montenegro to assist other state institutions to respond to crisis situations, such as search and rescue, firefighting, medical evacuation, freight transport, and more.

Accordingly, at the beginning of this year the Government of Montenegro signed a contract for the procurement of three medium multipurpose helicopters. The contract provides for the procurement of two new Bell 412EPI helicopters and one Bell 412EP helicopter with accompanying equipment. By purchasing these three mul-

tipurpose helicopters, the capacities and capabilities of the MNE Air Force and other military units will significantly increase, as the helicopters will be used to support land and sea activities, transport units, but also to assist civil institutions in the territory of Montenegro in case of need.

It is important to note that helicopters are designed, equipped and intended for frequent and reliable use both for the operational use of the Armed Forces of Montenegro but also for civil tasks. All three helicopters arrive in Montenegro this year. One helicopter was already delivered in April 2018, and the remaining two will be delivered in the fourth quarter of 2018.

In addition to this procurement, our Armed Forces have been equipped so far with several kinds of equipment such as 5.56mm armament, digital radio-relay systems, EOD equipment, CBRN equipment.

We plan to continue equipping our Armed Forces with some quantities of:

- Light armoured wheeled vehicles
- EOD equipment
- Communication equipment
- CBRN equipment
- Maintenance equipment

As far as light armoured vehicles are concerned, by 2020 we will procure them for the needs of our NATO-declared units. Within the Land Forces we are developing small, mobile, deployable, sustainable and interoperable units that will be equipped and trained according to NATO standards. Accordingly, one of our top priorities is procurement of light armoured vehicles.

ESD: Which of these are carried out in international partnerships, and who are your partners?

Ljuljanaj: Regarding the procurement of defence equipment and the development of defence capacities of Montenegro, we cooperate with a large number of coun-

tries. Without diminishing the role of other countries, assistance from the United States, the Federal Republic of Germany and the United Kingdom is of great importance for the successes in this field.

Military cooperation with the United States in the field of defence is versatile and based on the support provided by the United States to the process of modernisation of the Armed Forces of Montenegro and procurement of necessary assets. Over the past two years, for example, the United States has donated medical equipment, hardware and software for the Marine Information System (MIMS), various communications equipment, nuclear, biological and chemical defence equipment and anti-terrorist equipment under the Security Co-operation Programme.

Germany's major assistance to Montenegro first of all donated significant funds for the reconstruction of four warehouses for ordnance in Brezovik.

In addition, six light armoured vehicles MERCEDES G class will be purchased through a donation from the Federal Republic of Germany. This donation will significantly increase the capacities and operational capabilities of the Armed Forces of Montenegro.

The United Kingdom is the leading country in NATO Trust Fund (NTF) for the demilitarisation of surplus ammunition in Montenegro. With significant participation in donated funds, the United Kingdom is also coordinating the implementation of this important project in cooperation with the NATO agency NSPA. So far, about 122 tonnes of various ammunition surpluses have been successfully demilitarised, and another 330 tonnes of surplus are planned to be destroyed under this programme.

**The interview was conducted
by Peter Bossdorf.**

Standing Guards Supporting Ground Forces

Tamir Eshel

Sporadic outbreaks of violence, formerly known as "low-intensity conflicts", occur around the world, and modern military confrontations are deliberately designed to remain below the threshold of conventional, open interstate warfare.

When military forces are called to intervene in such conflicts, they often fight against irregular, yet well-trained and -equipped opponents, consisting of proxy fighters, mercenaries and Special Forces. In Ukraine, the Sahel, Central Africa, Gaza, Syria and Yemen, to name but a few of these "wars in grey zones", insurgents attack superior and well-protected armed forces.

Regardless of their affiliation, both regular soldiers and insurgents use modern, sophisticated weaponry to achieve gains. Insurgents are often, openly or covertly, supported by nation states which provide intelligence, cyber, electronic warfare in addition to traditional arms supplies and training. Advanced weapons, from shoulder-fired surface-to-air missiles to anti-tank weapons and even ballistic missiles, are smuggled into 'grey war zones' and territories used by insurgents – in attempts to counter the opponent's superior aircraft, helicopters and armour. Lacking the size and resilience of a military power, insurgents exploit speed, stealth, ambiguity, and deception to strike the enemy at a time or place or in a manner for which the enemy is ill-prepared.

Peacekeeping forces often face such perils. Contingency forces sent on such missions are often poorly prepared to face advanced threats, being equipped with hardware, and trained with techniques, tactics and procedures (TTP) designed to face a peer-like enemy. Nevertheless, with appropriate preparation, intelligence and protection, armed forces should be able to cope with the "vanishing enemy".

Maintaining battlefield situational awareness is of paramount importance for a combat force to deal with asymmetric threats. Surveillance by air and ground sensors, including radar devices that provide permanent coverage of large areas, helps detect suspicious activities and detect enemy movements or preparations for an attack or warn of an attack a few seconds

Photo: Kelvin Hughes



The BLIGHTER system analyses movement patterns using input from radar, cameras and other sensors.

Photo: IAI



The ELM-2112FP foliage-penetrating radar can detect movements inside forests and jungle.

before it hits. This denies the enemy the element of surprise, so that defenders can take cover, locate the enemy and react effectively.

Radar Sentinels for FOB Security

Radars of various types are used to secure forces in Forward Operating Bases (FOBs). Located in remote areas, or close to civilian populations, these applications require surveillance and target detection at relatively long range. Radars associated with these systems are containerised and integrate with long-range TV and thermal cameras and other remote sensors, such as hostile fire detection systems. Such systems detect and track moving objects around the FOB and contribute to an updated situational awareness for the FOB's security. When suspects tracked by the system enter the no-access zones areas around the FOB, an alarm is triggered and video images of the tracked objects are presented to the operators.

A typical system of this type is the B400 radar developed by the UK-based company Kelvin Hughes, now part of the European Hensoldt group.



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In FOBs close to inhabited areas, radar surveillance is useful in providing a 'Pattern of Life' (PoL), through continuously monitoring movements of people, vehicles and wildlife. Distinctive patterns are developed as activity changes throughout the day and night. PoL analysis is a unique feature offered by Kelvin Hughes, which developed this software for the BLIGHTER system. The application analyses movement pattern using input from radar, cameras and other sensors. According to Kelvin Hughes, the BLIGHTER radar is well-suited to PoL analysis, offering very low latency in access to track data. This system sends the target plots directly from its Doppler processing circuits within a fraction of a scan. The plot

pact Doppler radar units to detect vehicles which exceed the safe parameters set at the checkpoint. Particularly, certain anomalies can be automatically reported, such as vehicles coming in at high speeds, accelerating as they approach the checkpoint or travelling against traffic, which might be indicative of a potential attack with a vehicle-borne improvised explosive device (VBIED – car bomb).

Another application called KRAKAN adds weapons to FOB sensors, providing a semi- or fully-automatic forceful response. The KRAKAN's 'system of systems' integrates surveillance systems and remote-controlled weapon stations to enact semi-automatic force protection solutions protecting for-

range weapon system, it detects moving ground targets (people and vehicles) at a range of 4 kilometres (up to 10 km for large targets), and automatically delivers target coordinates for up to three objects, with a 3-metre accuracy. In this application, FARA-VR is effectively used in target acquisition for fire-support elements such as automatic grenade launchers (AL) and anti-material rifles to indicate the target location and range the weapons need for effective performance even at a low visibility level.

Persistent Surveillance for the Lower Echelon

Smaller Doppler radars are employed for border protection, site security and force protection to detect human activity, moving vehicles, aircraft and helicopters at great distances. Because of their ability to detect moving targets over long distances and in adverse weather conditions, tactical radar equipment is used on vehicles and/or on foot to monitor areas and collect intelligence. As such, radar stations supplement other sensors, especially when other sensors are restricted by weather conditions. Covering dozens of kilometres in range, such radars process and track hundreds of targets and are still able to prioritise and track the more important ones. For example, radar designed to detect low-flying aircraft and helicopters would often see birds or the movement of a tree canopy as false targets and would filter them out based on speed and movement rhythm. Yet, this radar can employ different filters to detect small, slow-flying unmanned aerial vehicles or low-flying helicopters. Classification is done by analysing the micro-Doppler data of an object. In this way, the small rotors of a drone can be detected, indicating that it is a drone. Other filters are used in radar equipment designed to detect missiles, artillery and mortars, where the blurring of the tracks requires rapid detection and response as soon as such fast targets cross the horizon.

In the early days of radars, this processing was carried out with dedicated hardware, since radars achieved wide large area coverage by using mechanical rotation. Mechanical rotation is still used today, especially with large counter-stealth arrays with L and UHF bands, which enable the detection of low-observable targets. But for most other applications, radars with active electronically scanned arrays (AESAs) open up exciting new possibilities for designers and users alike.

Another application that combines ground radar and weapon systems are remote-controlled weapon stations and active



Photo: Saab

Saab's GIRAFFE 1X can track hundreds of targets simultaneously.



Photo: Saab

Saab's GIRAFFE 1X mounted on a BARRACUDA vehicle

data define precisely where the target is, without the filtering and delay associated with tracked outputs, which are common for most ground-surveillance radars. Based on PoL profiles, such systems automatically spot divergence from the norm and alert the operator of such anomalies. Radar equipment can also be used to increase safety at checkpoints by using com-

ward operating bases in isolated locations. KRAKAN integrates all systems into a single control unit that scans the surrounding terrain for threats, warns soldiers of potential and imminent threats, and provides a variety of response options, including warning shots and deadly fire. The Russian FARA VR radar is also classified as weapon-integrated radar. Operated as part of a short-



Photo: via Author

The AISTENOK mortar-locating radar fits into several backpacks.

protection systems, such as the IAI/ELTA ELM-2180 WATCHGUARD sensor. A lightweight, man-portable Ground Surveillance Radar (GSR), WATCHGUARD employs an advanced AESA to provide persistent coverage of the targeted area. Operating in the X band, the radar can detect and track up to 300 targets simultaneously; it can detect a walking person at ranges of 4-7 km. WATCHGUARD can operate alone or with other radars to cover larger areas or a hemispheric dome, formed by four combined arrays to cover 360 degrees. In addition, IAI offers the radar with a slew-to-cue camera to provide visual positive identification.

A combination of different filters to optimise target classification make sure a radar is smart enough for the task at hand. Surveillance tools need to operate effectively and consistently in day, night and adverse weather, as well as in harsh environmental conditions like dust storms, heavy rain or arctic cold. They need to be effective even when facing interference, particularly in densely vegetated areas (such as bush, jungles, forests or orchards) as well as in urban terrain, where multipath reflections would hamper most RF sensor activities. These unique conditions offer benefits to those who use them in an unconventional way, such as for looking through walls, locating targets in buildings and detecting obstacles, mines or IEDs buried underground or within walls.

Vegetation poses major challenges for ground radar equipment, some of which can be overcome by the use of special radars designed for foliage penetration (FOPEN), such as IAI's ELM-2112FP. Unlike other ELM-2112 family radars which use

X- and C-band frequencies for optimised operation, the FOPEN radar operates in the L band using Frequency Modulated Continuous Wave (FMCW) to detect movement of personnel and vehicles tens of metres inside forests and jungle, from distances of several kilometres. The radar can continuously observe the area of interest and simultaneously track multiple targets with excellent reliability and no moving parts. It can be connected to a network of other radars, FOPEN or regular radars, to establish a secured surveillance area.

Threat Alert and Counterstrike

Traditionally, ground radars were too big to be considered tactical assets. They were based on land-based air defence systems developed for alerting and controlling the fire of air defence artillery (AAA) and surface-to-air guided missile (SAM) systems. Until the late 1990s, these large stationary or truck-mounted systems were used to provide early warning of artillery and rocket attacks or to direct artillery fire beyond sight.

The Russians were traditionally strong in artillery and air defence, and they developed highly effective radar systems to support these applications. The Russian 1L260-E is a system of this kind – a large and powerful radar providing long-range artillery support for Russian rockets, missiles and long-range artillery.

Mounted on a tracked vehicle, the system acts as a weapon-locating radar and supports heavy artillery, including mortars, multiple launch missile systems and tacti-

cal missiles. The radar can detect launch positions of enemy artillery and rockets, to provide firing units with short-range missiles and large-calibre rocket systems with the target data and firing directions needed to direct efficient fire deep into enemy territory.

Deployed in only five minutes, 1L260-E locates impact points at ranges of 50-70 km and is accurate enough to provide a mean burst target location error of 0.2% of the range. For the BM-30 SMERCH weapon system it generally supports, this means a miss distance of about 180 metres at a maximum range of 90 km.

Another Russian battlefield radar improving mortar and artillery accuracy is the Unified Automated Artillery Ballistic System (UAABS). In dismantled configuration, it supports mortars and towed artillery, and in vehicle-mounted configuration it supports self-propelled guns (SPG). Designed to generate ballistic data for the guns, UAABS measures the muzzle velocity of projectiles and mortar bombs, sums the deviation of that muzzle velocity of projectiles from its table value and computes the correction needed to be applied to the sight, to compensate for those variations. UAABS requires only a short burst of low

Photo: US Army



Introduced in 2004, the SRC ANITPQ-48 was the first lightweight counter-mortar radar. It saw combat service in Iraq and later in Afghanistan.



Photo: US Army

The AN/TPQ-50 is a spin-off of the AN/TPQ48.

power emission to obtain the projectile's velocity and is therefore suitable for covert operation under heavy electronic warfare. The AISTENOK radar is a portable radar unit that warns of mortar and artillery attacks at an early stage. AISTENOK, which operates at the level of the Russian battalion, serves to alert and locate sources of direct or indirect fire. AISTENOK is able to locate 81-120mm mortar bombs during their flight and thus accurately locate the

firing position of mortars, tanks and 122-155mm artillery at a distance of 5-10 km. With a total weight of 135 kg, AISTENOK can be taken apart and it fits into several backpacks carried by airborne soldiers or paratroopers.

While artillery fires are characteristic of organised military operations, mortars are often used by small formations and insurgents who approach their targets to launch a sporadic attack. Mortars are relatively accurate and have a high lethality, especially when bombs hit exposed targets without warning.

Weapon-locating radars are a critical element in force protection, particularly for FOBs which are frequently targeted by insurgents. However, traditional weapon-locating radars designed for the linear battlefield of the 1980s do not cover the full 360° area required for modern force protection.

Introduced in 2004, the SRC AN/TPQ-48 was the first 360° lightweight counter-mortar radar (LCMR), and it saw combat service in Iraq and later in Afghanistan. Designed as a static, solid-state system, this man-portable radar weighs only 120 lbs and can be deployed by two persons at vantage points on rooftops and hills, providing effective coverage of the protected sites. Once setup is completed within 20 minutes, the radar gives early warning of an incoming rocket, artillery or mortar grenade and locates the point of impact, then traces the origin of the indirect fire for a counterfire reaction. Two spin-offs of the original system, AN/TPQ-49 and TPQ-50, are now available, configured for expeditionary missions: tripod-mounted, mast-mounted on vehicles, and in fixed installations for use in counter-UAS systems.

The defence against unmanned air systems is a new requirement that has arisen in recent years. While the first solutions were based on the TPQ-49, which can only be used in standstill, more reliable C-UAS solutions require a permanently active sensor that can also be used when on the move.

RADA offers such applications for its Multi-Mission Hemispheric Radars (MHR) – a compact S-band, pulse-Doppler, active electronically scanned array (AESA) radar. As a software-defined radar, MHR is easily configured to take on new tasks, one of which was the counter-UAS mission. With its advanced beam-forming capability and powerful signal processing, the MHR radar can support different missions in a relatively short timespan. With four elements operating in sync, MHR supports high-precision weapon configurations such as air defence, counter-UAS and high-energy laser weapons that enable continuous target tracking while on the move.

The company offers its radars as an OEM sensor integrated into C-UAS systems from other suppliers, or as a separate RSK-55 sensor package consisting of four MHR elements coupled with an electro-optical sensor that is swivelled in the target direction by the radar command.

Another mobile C-UAS solution, currently under development by SRC, is SKYCHASER, a 3D multi-mission radar designed to detect and track low, slow and small targets (LSS). Based on software-defined, modular flat-panel arrays which generate multiple steerable beams in azimuth and elevation, the system will be configurable to address specific applications. According to the developers, the system is configured to cover the designated airspace in terms of volume and height, range and detection accuracy. Using steerable radar beams, the system will detect and track close pop-up targets and long-range targets while on the move.

Saab's GIRAFFE 1X is another mobile radar, used as a primary sensor supporting deployable or fixed short-range surveillance and Ground Based Air Defence (GBAD) systems. The lightest, most compact version of GIRAFFE, the 1X, can track hundreds of targets simultaneously, even in high-clutter environments. The system can be equipped with surface surveillance as well as sense and warn applications operated remotely or locally.

Unlike MHR and SKYCHASER, GIRAFFE 1X is a scanning radar that makes a full rotation each second. It is powerful and sensitive enough to detect all air and RAM threats, including low, slow and small targets at effective ranges, providing enough warning time for GBAD systems to respond under



Photo: Tamir Eshel

Rafael's DRONE DOME combines an MHR radar with a laser.

all weather conditions. Self-contained with C3 capabilities, the radar uses standard or custom data links to share and distribute target data with other weapon systems and C3 networks.

Photo: via Author

Sensors for Active Protection

In most applications, radar units are integrated into persistent surveillance and protection systems, as they are able to provide permanent coverage of large areas. The range and performance of such systems depends primarily on the peak power they deliver, while detection efficiency depends on the filters and signal processing to enable target acquisition and tracking at the lowest false alarm rate.

Some applications, such as active protection systems or vehicle autonomy kits, require exceptionally high sensitivity and an absolutely minimal false alarm rate. To achieve these levels, radar systems can be synchronised with other sensors, to provide fused and dependable situational pictures of obstacles or threats.

Active protection is a very demanding application for ground radar, because the sensor has to detect intruders at a safe distance from the protected platform and track them to see if they pose a threat, and then continuously plan the path of the target for the combat management system to plan the best interception solution. In addition, it needs to trace the target's trajectory to locate its launching point in order to enable the crew or other units to respond with counter fire.

Typical APS systems, such as WINDGUARD from IAI/ELTA, consist of four panel radars, each employing an AESA pulse-Doppler radar to detect and automatically track typical threats to combat vehicles, such as anti-tank rockets, missiles and tank rounds. After detecting and identifying a potential threat, the radar provides an early warning to the crew indicating the exact direction and elevation from which the threat originates. It also calculates the Time To Impact (TTI) and automatically activates reaction systems such as soft- and hard-kill countermeasures to protect against the threat. Scaled in size, IAI/ELTA used the WINDGUARD technology to provide C-RAM alerts to tactical units. With two or four flat panels mounted on a truck or an all-terrain mobility (ATM) vehicle, the ELM-2138M GREEN ROCK provides threat detection, locates artillery and mortar fire sources and assists friendly fires with target acquisition and detection of low-flying airborne targets such as UAVs, gliders and helicopters. The unit operates as a net-



Defence against drones is a new requirement that has arisen in recent years.

Photo: via Author



Radar-based platform protection of an M1 battle tank

worked sensor, equipped with processors to calculate the trajectory of ballistic munitions, the point of origin and to predict the point of impact. Linked to blue force tracking via the tactical network, GREEN ROCK can distribute timely and relevant warnings to the immediately threatened units.

Despite the advantages listed above, RF sensors are vulnerable to detection and countermeasures by jamming and deception. When faced with an enemy who lacks such sophisticated countermeasure tools, as is often the case in grey zone warfare, radars offer a clear advantage in increasing situational awareness and force protection. Nevertheless, troops confronted with a peer-like enemy or insurgents backed by

nations with such capabilities should consider changing TTP to limit their vulnerability to hostile electronic surveillance.

To alleviate the disadvantages of active radars, some systems can be employed selectively or complemented by passive electro-optical or other sensors, such as muzzle flash detectors, missile approach sensors or laser warning systems, to complete a hostile fire detection system. With this capability, radars provide an important early warning and orientation for other sensors or weapon systems, but they also expose the element to be protected to an enemy equipped with appropriate detection systems, countermeasures and weapons which home in on the emitting source. ■



“Romania initiated five major materiel programmes.”



**Interview with Andrei Ignat,
State Secretary and Chief of the Armaments Department
of the Ministry of National Defence, Romania**

ESD: In many Western countries, the changed security situation in Europe has prompted governments to provide additional resources for defence and armaments. To what extent and in what way has this trend affected your country?

Ignat: Based on political consent, 2% of the national GDP will be used for the defence budget as of 2017. This tendency is a steady one and there is nothing predicting any change any time soon.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Ignat: The Romanian armament programmes, which currently have political and legislative approval, are as follows.

- Multifunctional corvette
- Mobile coastal defence anti-ship missile systems
- IFV modernisation
- 8x8 APC and 4x4 LAV
- C41 systems with ISTAR integration capabilities
- HSAM SHORAD-VSHORAD integrated system
- MLRS.

ESD: Which of these are carried out in international partnerships, and who are your partners?

Ignat: Romania initiated five major materiel programmes which have been de-



Photo: Raytheon

The US Army has awarded Raytheon a USD395.8M contract for production of Romania's PATRIOT air and missile defence system. Announced by the Department of Defense on 24 May 2018, the contract calls for Raytheon to build Romania's first brand-new PATRIOT fire unit.

veloped as standalone projects. We are looking forward to developing common projects in the scope of the PESCO framework.

ESD: In what way do you intend to consider the PESCO concept?

Ignat: As stated above, we intend to use

the PESCO framework in order to develop partnerships with other European countries and to stimulate the Romanian defence industry to join multinational industrial initiatives.

The interview was conducted by Peter Bossdorf.

Brilliant Camouflage – Advances in the Art of Deception

John Antal

All warfare is based on deception. Becoming invisible to the enemy is the ultimate form of deception.

Camouflage is the art of concealment, and the ability to become invisible is an advantage that is being pursued by many nations. With today's precision weapons, what can be seen or identified, can be killed. Ground military units use radar and laser-scattering camouflage nets to inhibit detection from ground and air sensors. Hiding objects in the spectrum visible to the human eye can be handled by conventional camouflage techniques, but cloaking an object from radio, radar and heat wavelengths is the key to military invisibility. In the next 10-15 years, technological advances promise to provide military units with more active means to hide from the enemy. Research into active camouflage systems and invisibility is accelerating with the potential to change how wars are fought. Let us review some of the latest developments in smart, active camouflage and the possibility of invisibility in the battlespace.

Camouflage Inspired by Nature

For centuries, camouflage has been about adapting to our surroundings and blending in with the terrain and vegetation. In nature, through natural selection, those animals that could change their colour to hide in their habitats increased their ability to survive. The chameleon, for example, will change colours

to match its background. Similarly, the squid has a unique, natural ability that has made it an expert at hiding from its enemies. Learning from the squid, a team of researchers from the UK's Engineering and Mathematics Department at the University of Bristol have developed a breakthrough in camouflage. Their lat-

est research into the development of artificial cephalopod chromophores – the cells that allow squids to change colour – is laying the foundation for smart materials that will instantly change color to match the surroundings. This research was released in 2015 and published in a paper titled: "Hiding the Squid: Patterns in Artificial Cephalopod Skin," by Aaron Fishman, Jonathan Rossiter, and Martin Homer. The paper postulates "an application of smart materials, inspired by biological chromophores, to generate active dynamic patterns...and concludes with a discussion of the potential of our

system for future pattern generation in artificial skin." In 2018, the University of California at Irving (UCI) created a smart material that will render objects invisible to infrared light and thermal night vision devices. Engineers Alon Gorodetsky and Chengyi Xu of UCI published their paper, "Adaptive Infrared-Reflecting Systems Inspired by Cephalopods," in the journal "Science" on 30 March 2018. Gorodetsky and Xu propose that their study can "open opportunities for infrared camouflage and other technologies that regulate infrared radiation." Gorodetsky also reported: "We've developed stickers for use as a thin, flexible layer of camo with the potential to take on a pattern that will better match the soldiers' infrared reflectance to their background and hide them from active infrared visualisation...We're going after something that's inexpensive and completely disposable. You take out this protein-coated tape, you use it quick-



SAAB's ULCAS (Ultra Lightweight Camouflage Screen) in desert style

est research into the development of artificial cephalopod chromophores – the cells that allow squids to change colour – is laying the foundation for smart materials that will instantly change color to match the surroundings. This research was released in 2015 and published in a paper titled: "Hiding the Squid: Patterns in Artificial Cephalopod Skin," by Aaron Fishman, Jonathan Rossiter, and Martin Homer. The paper postulates "an application of smart materials, inspired by biological chromophores, to generate active dynamic patterns...and concludes with a discussion of the potential of our

Author

John Antal is an expert on military affairs. He has published 14 books on military and leadership subjects and over 500 articles in military professional journals and military technology magazines. He served 30 years as a soldier in the US Army, retiring as a Colonel, having commanded combat arms units from platoon to brigade.



Photo: Staff Sgt. Elizabeth Tarr, US Army

Camouflage, the art of not being seen, is vital to survive in today's battlespace. In this photo, an M1A2 ABRAMS tank emerges out of wooded terrain after soldiers assigned to the 4th Infantry Division's 1st Battalion, 68th Armour Regiment, 3rd Armoured Brigade Combat Team had concealed it to blend in with the surrounding environment at Presidential Range in Swietozow, Poland, on 20 January 2017. The vehicles and soldiers were part of a nine-month deployment in support of Operation ATLANTIC RESOLVE.

ly to make an appropriate camouflage pattern on the fly, then you take it off and throw it away."

Adaptive Camouflage

Vehicles need a different means of camouflage and researchers are developing adaptive camouflage to cloak vehicles. Adaptive camouflage uses optical technology to take the place of the image of what is masked with an image of the background. This can be accomplished by placing a thin screen between the observer and the concealed object and generating the image of the background in real time. BAE Systems has developed this concept into a prototype technology system called ADAPTIV for armoured vehicles. ADAPTIV generates real-time active camouflaging of military vehicles. BAE reports that their technology works by "using lightweight hexagonal pixels which are electrically powered by the vehicle's systems. The pixels are individually heated and cooled using commercially available semi-conducting technology. The hand-sized pixels are made of metal, so that they can sustain physical impact and provide defence against enemy ordnance. The entire system has been designed with ease of use in mind,

and the pixels are able to be easily and rapidly removed and replaced if damaged. Once mounted on a vehicle's hull or ballistic armour plates, ADAPTIV renders a vehicle invisible to infrared and other surveillance technology. Whether it is day or night, whether they are on the move or stationary, ADAPTIV provides vehicles increased stealth and greater survivability. ADAPTIV allows the vehicle to blend into the natural surroundings and significantly reduces detection." In demonstrations of the ADAPTIV system conducted in 2011, a tank with BAE's camouflage appeared as a civilian automobile in thermal and infrared imaging devices. The ADAPTIV active electronic-camouflage system also includes an Identification, Friend or Foe (IFF) system that will differentiate allies from enemies. Poland's OBRUM has been collaborating with BAE Systems on designing a Main Battle Tank (MBT), the PL-01, which employs ADAPTIV active camouflage. BAE says that ADAPTIV can be used for ground vehicles, ships and installations and reports that it is the latest breakthrough in stealth technology.

Active Cloaking

An object is observed when the electromagnetic waves scattered from that object are detected by the human eye or some other sensor. A device that can "correct" or cancel that scattering would hide the object. In 2013, George V. Eleftheriades of the University of Toronto reported that "to make our approach work for visible light, is to surround the

object with optical antennas and control what they radiate – colour, amplitude and delay – precisely." Active cloaking, therefore, would surround the object to be cloaked with electromagnetic sources specifically designed to cancel the electromagnetic field scattered by the object. In November 2017, researchers at Beersheba's Ben-Gurion University of the Negev in Israel created a "cloaking chip" that scatters and bends light around the object so that the light does not interact with the object. The Israeli study, titled "Invisibility: Cloaking Scheme by Evanescent Fields Distortion on Composite Plasmonic Waveguides with Si Nano-Spacer," by Yakov Galutin, Eran Falek & Alina Karabchevsk, claims their chip could be used to enhance radar-absorbing paint for stealth aircraft.

Metamaterials

The limitation of ADAPTIV and other cloaking systems is thickness and bulk. The normal condition of shining a light on an object is reflection and absorption. But what if you could create a material that did not reflect or absorb light? In 2006, physicist Professor Sir John Pendry from Imperial College London announced that it should be possible to bend light to create invisibility. Pendry pioneered the concept of designing metamaterials – materials that have optical properties not found in nature – to develop an "invisibility cloak". He received the Newton Medal, the highest honor of the UK's Physics Institute, for his "seminal contributions to surface science, dis-

Photo: Polish Ministry of National Defence



The OBRUM PL-01 is a Polish light tank that will use ADAPTIV active camouflage designed by BAE Systems.

ordered systems and photonics" which is the theoretical foundation of generating invisibility. Building upon the concept of bending light waves, researchers at the University of California at San Diego recently created a new metamaterial using an ultra-thin Teflon substrate that, when combined with ceramic cylinders, renders objects invisible to incoming waves. This metamaterial enables electromagnetic radiation to pass freely around the object. A study by LiYi Hsu, Thomas Lepetit, and Boubacar Kanté titled "Extremely Thin Dielectric Metasurface for Carpet Cloaking," proposed that "carpet cloaking with an extremely thin dielectric metasurface is possible." According to Kanté, this approach provides for a cloaking system that is both thin and does not alter the brightness of light around a hidden object. Many cloaks are glossy because they are made with metal particles which absorb light. The researchers report that one of the keys to their cloak's design is the use of non-conductive materials called dielectrics, which unlike metals, do not absorb light. This cloak includes two dielectrics, a proprietary ceramic and Teflon, which are structurally tailored on a very fine scale to change the way light waves reflect off of the cloak." Such a metamaterial could render many military systems nearly invisible to most means of detection and would have an immediate application in enhancing the stealth capabilities of aircraft and Unmanned Aerial Vehicles (UAVs).

True invisibility, the ultimate camouflage, is a property that exists at the atomic level. In January 2018, researchers at Northwestern University of Evanston, Illinois, published their findings in the online journal "Science" that offers another way to manipulate light to achieve invisibility. Their study "Building Superlattices from Individual Nanoparticles via Template-confined DNA-mediated Assembly" reveals an amazing breakthrough in developing metamaterials that combined DNA assembly with gold nanoparticles to produce stimuli-responsive metamaterials. This new method precisely arranges nanoparticles of different shapes and sizes and shapes in two and three dimensions, resulting in optically active superlattices. These optically active superlattices can be programmed to change into any visible colour. Professors Chad Mirkin, Vinayak Dravid and Koray Aydin used a process known as DNA assembly and "top-down lithography" to organise nanoparticles in two and three dimensions. "So now we have a type of architectural control where we can build crystalline-type lat-

tices with all the defined parameters that we want," reported Professor Mirkin, Director of the International Institute for Nanotechnology at Northwestern. The Institute is a global hub that currently represents and integrates over US\$600M in cutting-edge nanotechnology research and one of the largest nanotechnology research centres in the world. "We can make structures that nobody has ever even conceived of before; this is a true man-over-nature event."

The Chinese have also been hard at work to crack the secret of invisibility. Researchers at the State Key Laboratory of Millimeter Waves in Southeast University in Nanjing, Jiangsu province, China's leading institute on the research

globe are making key breakthroughs in new ways to develop metamaterials from exotic composites of metal, ceramic, Teflon and fibre components. These metamaterials are described best by author and physicist Michio Kaku in his book "Physics of the Impossible": "Think about the way a river flows around a boulder. Because the water quickly wraps around the boulder, the presence of the boulder has been washed out downstream. Similarly, metamaterials can continuously alter and bend the path of microwaves so that they flow around a cylinder, for example, essentially making everything inside the cylinder invisible to microwaves. If the metamaterial can eliminate all reflection and shadows, then it can render an object

Photo: SAAB



MARDER 1A5 armoured infantry fighting vehicle with the BARRACUDA camouflage system from SAAB during an exhibition by Bundeswehr Technical Center 41 (WTD 41) in Trier, Germany. The Bundeswehr introduced the system in December 2010.

of thin-membrane metamaterials for defence applications, publicly announced in March 2018 that they had developed a breakthrough metamaterial that would cloak military aircraft from radar making them stealth-like. Liu Ruopeng, the president of the Kuang-Chi Aircraft Company, who used to work at the Nanjing University laboratory, told the Chinese news website Ifeng.com that China was well ahead of other countries in applying metamaterials to aircraft. If this is true, then the Chinese military may adapt these new metamaterials to a wide range of aircraft and UAVs.

The theory of using metamaterials to create invisibility has now been mathematically proven. Scientists from across the

totally invisible to that form of radiation... At the heart of metamaterials is the ability to manipulate something called the 'index of refraction.' Refraction is the bending of light as it moves through a transparent media... If one could control the index of refraction inside a metamaterial so that light passed around the object, then the object would become invisible." The ability of science to manipulate this index of refraction is accelerating, and metamaterials that can manipulate light in unconventional ways have been produced. Harnessing metamaterials to block, enhance and absorb light is the next step in developing brilliant camouflage that will provide a powerful military advantage in the years to come. ■

“It is crucial for Latvia to improve host country support.”



**Interview with Aivars Purins,
Undersecretary of State for Logistics,
Ministry of Defence of Latvia**

ESD: In many Western countries, the changed security-political situation in Europe has induced governments to allocate additional funds for defence and armament. To what extent and in what way has this trend influenced your country?

Purins: Latvia has received strong political support for the increase in the defence budget from 2014. This gradual increase was approved by Parliament in 2014 before the declaration of the Wales Summit, where the Allies agreed to reverse the decline in defence budgets. Since 2014, when the defence budget was 0.94% of GDP, it has gradually grown to reach 2% of GDP in 2018. The gradual but strong increase in the national defence budget, unprecedented investment from NATO's security investment programme (for military infrastructure) and additional funds from the US have enabled Latvia to invest in a number of defence programmes, modernisation/upgrading of existing capabilities and development of new defence infrastructures.

In recent years, great emphasis has been placed on improving and developing new training infrastructures, storage and warehousing capacities. It is crucial for Latvia to improve host country support and infrastructure for the integration and training of staff. It was very important that Latvia received the NATO Forward Presence Group (eFP) in the summer of 2017. A much-needed infrastructure for eFP had to be developed in a relatively short time.

Latvia has become a more active user of multinational procurement agencies as a result of the increase in necessary procurement ac-

tivities and the willingness to achieve greater economies of scale in procurement. Latvia has significantly expanded its operations with the NATO Support and Procurement Agency. Latvia currently uses NSPA for ammunition procurement, the NATO logistics stock exchange for materials procurement and support partnerships for equipment maintenance and infrastructure development.

Additionally, Latvia is also exploring the possibilities of cooperative projects within the European Defence Agency. Up to date, Latvia has engaged in one joint procurement in 2014 using EDA framework - Carl Gustaf ammunition of Baltic and V4 states in 2014. Latvia is also exploring the possibilities for cooperation projects within the European Defence Agency. So far, Latvia has been engaged in one joint procurement in 2014 using the EDA framework - the Carl Gustaf ammunition of the Baltic and V4 states in 2014.

ESD: What are the most important armament programmes in your country, both current and forthcoming?

Purins: A number of armament programmes have started in recent years:

- **The Individual Soldier Equipment Programme** focusses on upgrading and gradually modernising soldier equipment;
- **The Radar and Sensor System** focusses on an upgrade of existing radar systems and the introduction of mobile sensor systems. It aims at increasing the Latvian Air Force's capability in air surveillance and defence.

- **The Introduction of Armoured Platforms** is a programme benefitting from the procurement of 123 armoured vehicles (Combat Vehicle Reconnaissance Tracked or CVRT) in 2014. It is surplus equipment from the UK. CVRTs are extensively overhauled and upgraded before delivery. The CVRTs are delivered to Latvia in several batches between 2015 and 2020. This programme has started the first phase of the mechanisation programme of the Latvian Land Forces;
- **The Introduction of M109 Howitzer platforms** is a programme which benefitting from the procurement of 47 type-M109A50e combat artillery systems, bought from Austria as surplus equipment to enhance Latvia's indirect fire capability. The current focus is on C2 integration and support platform acquisition.
- **The Command and Control (C2) Programme** aims to upgrade and modernise existing capabilities, including mission network, and further develop C2 capability for Armed Forces.
- **The Major Transport Fleet Upgrade Programme** pursues the acquisition of light and medium 4x4 tactical vehicles, 6x6 ATVs and trucks up till 15 tonnes to modernise the existing transport fleet of the Armed Forces.
- **The Replacement of the Existing Helicopter Fleet** is a programme which aims to replace the existing SAR/transport helicopter fleet (Mi17).
- **The ISTAR Programme** aims at up-

grading and enhancing ISTAR assets, including unmanned systems.

- **A Major Infrastructure Development Program** aims to strengthen Host Nation Support capability to receive Allied forces and enhance their training and integration opportunities in Latvia. The programme includes construction of barracks, development of new and enlargement of the existing training ranges and development of a number of shooting ranges across Latvia. The programme is supported also from the NATO Security Investment Programme and the US ERI Initiative.
- Continuous focus on ammunition acquisition.

Forthcoming programmes are the modernisation of Mine Countermeasure Ships (from 2020) and the introduction of a Medical Support Capability ROLE 2 (from 2021).

ESD: Which of these are carried out in international partnership, and who are your partners?

Purins: As of today, Latvia has not been engaged in any international partnership which can be explained by our focus on individual soldier equipment programmes and the fact that other major programmes have bene-

fited from surplus equipment procurements from our NATO and EU Allies. It has led to wider cooperation with a number of NATO and EU countries in such areas as training and maintenance: In the Indirect Fire Support Programme, Latvia has been closely cooperating with Austria; CVRTs have been procured from the United Kingdom; Stinger missile systems have been introduced into Latvian armed forces through a G2G contract with Denmark. Expansive cooperation has been also with other NATO member states, especially the US, on different support systems.

Latvia is extensively participating in NSPA and EDA joint procurement opportunities or using its partnerships for infrastructure development or maintenance services; however, none of the two organisations have been used fully for any of the armament acquisition programmes.

Nevertheless, we are constantly scoping joint procurement opportunities with regional partners in order to pursue economies of scale and potential similarity of armament that would ease maintenance of this equipment in the future.

Exchange of development and procurement plans is constantly on the agenda when Baltic and Nordic armament and capability

planners meet. A good example of these aspirations is a recently signed long-term joint framework agreement with Sweden and Estonia on the Carl Gustaf ammunition procurement. This agreement supplements the existing contract with EDA.

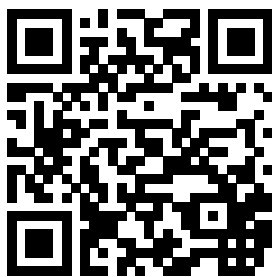
ESD: In what way do you intend to consider the PESCO (Permanent Structured Cooperation) concept?

Purins: Latvia recognises PESCO as a valuable promoter of European defence cooperation. Pursuing PESCO projects that deliver highly sought after capabilities both at national and supranational level and are compatible with ongoing NATO and EU initiatives is in our interest. Latvia has joined the Dutch led Military mobility project and MAS MCM project, led by Belgium in which we see very practical benefits for capability development in the future.

Our possible future participation in PESCO projects are interlinked with ability of projects to facilitate practical outcomes that corresponds to our national military requirements and defence development plans.

The interview was conducted by Peter Bossdorf.

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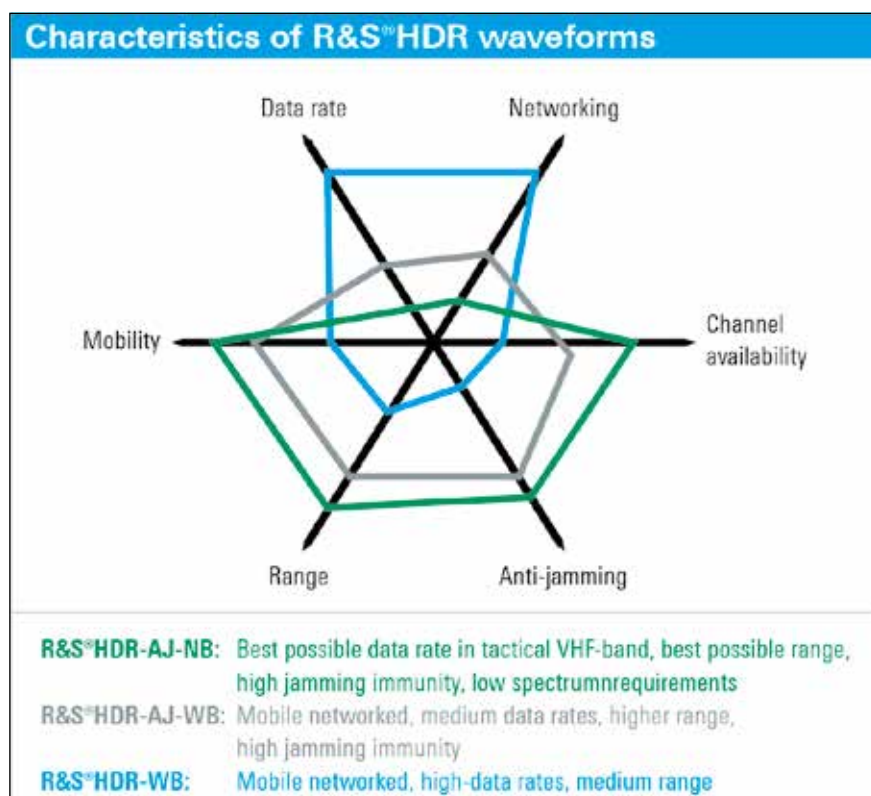
Software Defined Radio (SDR) is Changing the Face of Military Communications

Tim Mahon

Not only are the great institutions of defence having to come to terms with the fact that software can now provide all the functionality – and more – that certain items of hardware have to date, (and while doing so, embrace all the changes that will

challenges. Institutions evolving, manufacturers revolutionising what has been a relatively conservative industry segment – SDR deserves serious consideration as demand continues to increase. Europe has already made major contributions to both supply

TACT programme – Europe's largest software radio programme, which will equip the French armed forces from next year. As a result of development work carried out under CONTACT, Thales has developed the SYNAPS family of SDR, intended to provide military customers with the tactical network capability they require "for real-time collaborative combat." Launched at Eurosatory 2016 and demonstrated to more than 20 armed forces in France last year, "SYNAPS provides a unique collaborative combat capability based on real-time horizontal communications between all the units on the ground."



Graphic: Rohde & Schwarz

The Rohde & Schwarz high data rate waveform (HDR) family provides voice and data simultaneously at high speed with varying priorities. Advanced architecture empowers differential configuration within a single channel radio network.

bring to operations, doctrine and procurement practices) but the community in general is evolving innovative and even graceful solutions for the rigorous demands of the military, and some manufacturers are revolutionising the way they respond to the technical and procurement-related

and demand sides of the equation and is set to continue so to do. ESD looks at a selection of the offerings available from Europe and briefly examines what the future might hold.

Thales, by its own admission, is "the European leader and the world's number one supplier of military radio communication systems outside the US domestic market," with over 800,000 radios in service with the armed forces of over 50 nations. In 2012 the company won an award from France's defence procurement agency, the DGA, as prime contractor for the CON-

Graceful Solutions

Given that the great majority of military operations are now conducted by coalition forces, SYNAPS has been built around SDR/ Software Communications Architecture (SCA) technologies compliant with NATO and international standards, most notably the ESSOR (European Secure Software Defined Radio) high data-rate standard, developed by the armed forces of Finland, France, Italy, Poland, Spain and Sweden. ESSOR is a candidate for a forthcoming NATO specification and standard. Taking this into account, SYNAPS radios are re-programmable and ready to accommodate new standards in the future.

The family of radio communication systems offer user services including voice, messaging, video, chat and Blue Force Tracking simultaneously, with differentiated quality of service: the most critical data transfers are accorded priority status. SYNAPS also offers excellent range performance and protection against jamming on the battlefield, while optimising use of the frequency spectrum for the same amount of useful data throughput, company officials noted. The systems provide the optimum combination of data rates, security and connectivity and adapt automatically as operational deployments are reconfigured during a mission. The SYNAPS solution is scalable from small infantry or special forces groups up to joint brigade level deployments and is designed to accommodate all types of users, all platform types and all branches of the armed

Author

Tim Mahon is a UK based defence and security specialist and author of many expert articles.

forces as well as joint, combined arms and allied operations.

At the other end of the scale, from a corporate perspective, is DOMO Tactical Communications, a Danish company that appears to punch well above its weight and competes effectively with the 'big

Future Markets

Perhaps even more interesting than the development of the Domo SDR range, though, is McSparron's view on the way the future market is likely to evolve. "The high cost of developing custom silicon is

usefulness and success of a product will be defined by the innovation, efficiency and quality of the software running inside the SDR device," McSparron concluded.

Another name that has come increasingly to the fore in the military communications market recent years is the Finnish company Bittium, which also sees a vibrant and sustainable market for SDR, as a company spokesperson explained to ESD. "The SDR market will grow globally in the coming years, as armed forces are upgrading their 20-year old legacy Combat Net Radio-(CNR) based systems with new SDR-based equipment, which enable enhanced situational awareness, command and control, and improved interoperability." Coupled with the fact that military forces are increasingly being tasked with 'aid to the civil power' missions in humanitarian assistance, disaster relief and civil emergency management, and one has a recipe for a market characterised by ad hoc requirements for rapidly deployable solutions that can react to a wide range of voice, video and data communications requirements.

Bittium has a long history of R&D in SDR products and its current offerings include the Tactical Wireless IP Network (TAC WIN),



Photo: Elbit Systems

The Elbit Systems MCTR-7200 HH is a handheld variant of the E-LynX SDR family.

boys' in the market. Neil McSparron, the company's Chief Technical Officer, explained the Domo SDR product line to ESD, focusing on the most appropriate range for military applications, the SOL8SDR. "The SOL8SDR radio family is available in a range of packages – the smallest package is less than three cubic inches in volume and is aimed at integrators and covert surveillance applications. Other packages offer up to 4W of RF output power for long range links and DTC is now offering a new body-worn Special Role radio package for tactical operations – in the battlefield or in the disaster zone. The DTC SOL8SDR offers the ability to change radio waveform and software application on-the-fly, simply by selecting a different SDR application/personality via the web interface. The DTC SDR can be configured as a Mobile Ad-hoc Network (MANET) radio – carrying video, voice, serial data and, crucially, IP traffic through the DTC NETNode MANET network." This application uses a COFDM waveform and latest generation Error Correction coding – a combination that allows effective operation of the radio when non-line-of-sight, which capability in turn allows the user to communicate in situations in which standard waveforms simply fail to maintain the link. On the battlefield the ability to communicate non-line-of-sight is equivalent to the ability to communicate out of the line of fire – a key asset for operators.

reducing the number of suppliers who can afford to design, manufacture and test the latest silicon chips manufactured in 14nm and 7nm processes. This plays into the handful of companies that design and sell standard processor, complex DSP and programmable ASIC (FPGA) silicon products. Custom ASIC chips are still being designed and manufactured but increasingly they can only be cost-effective when targeting the highest volume consumer markets – such as mobile telephones. This seismic change to the silicon chip industry and the increasing dominance of programmable 'system-on-a-chip' suppliers are actually positive trends for the SDR market.

"We see an increase in SDR products and solutions. Increasingly companies playing in the SDR market will be differentiated by the quality of the IPR found in their applications – this ought to play into the hands of companies that have developed significant portions of their IPR in-house in a manner that can be easily ported between SDR platforms and have significant in-house expertise in waveform algorithms and video and audio codec design. Interoperability at the Internet Protocol and codec level will also become increasingly important as customers abandon older bespoke customer data interfaces for the simplicity and ubiquity of IP.

"The advancement of hardware will continue to play an important role – particularly the advancement of flexible and programmable RF devices but increasingly the

Photo: Domo Tactical Communications



The Domo Tactical Communications SDR benefits from a small form factor.

an SDR-based wireless broadband network system that supports MANET, point-to-point and point-to-multipoint network configurations with the same Bittium TAC WIN waveform, which is currently in use with the Finnish Defence Forces. Last August, the company's offering was expanded with the Tough SDR Handheld and Tough SDR Vehicular radios, which extend the TAC WIN network to individual soldiers and vehicles. The tactical network combining Bittium TAC WIN and Tough SDR products enable bringing broadband data transfer and voice to all mobile troops starting from brigade level and all the way across the battlefield.

The ESSOR Programme

Bittium is also one of the founding members of the European Secure Software Defined Radio (ESSOR) military SDR programme, the aim of which is to develop a European SDR technology in order to improve capabilities for cooperation in coalition operations. The first phase of the programme produced and validated the European High Data Rate Waveform, ESSOR HDR WF, which is also integrated into the Bittium Tough SDR tactical radios. These radios, together with the waveform, enable broadband data transfer, joint operations and direct communication between defence forces of multiple nationalities in international operations at levels from the individual combat vehicle to the battle group.

The Finnish Defence Forces (FDF) have sought to support their revised combat doctrine by turning to Bittium to supply modern, SDR-based broadband data transfer radios, for which the company signed framework agreement in August last year that envisages the purchase of up to €130M of Tough SDR units over the next decade. A second similar agreement will see the FDF procure additional TAC WIN systems to a total value of €30M between 2018 and 2022. TAC Win, already in FDF service, acts as the backbone for tactical data transfer in the command, control and communications system, which is currently being significantly overhauled.

Such success is not automatic, however, and the company shared its view with ESD as to the challenges the SDR market faces. "Adoption of SDR-based systems with continuous capability development with software is not only a technical challenge, but affects all aspects of what has become known as the DOTMLPFI model – doctrine, organisation, training, materiel, leadership, personnel, facilities and interoperability. As such it is a paradigm shift among end users. SDR products and systems should leverage rapid commercial technology evolution, and at the same time provide long life cycles."

At Rafael Advanced Defence Systems the company's SDR offering appears under the designation BNET, which the company describes as "an advanced broadband IP MANET SDR for tactical operations." "Providing a "new level of tactical communications," it enables all radios for land, air and maritime units to participate in a single scalable MANET. It offers multiple user benefits:

- Hundreds of users can be connected on a network, allowing not only simple planning for manoeuvre forces (infantry,



Photo: Thales Group

In November 2017 Thales demonstrated its SYNAPS family of SDR.

- mechanised armour and helicopters, for example) but also provides for the integration of potential future technologies and assets such as drones and advanced sensors;
- It supports large networks with very low latency – a crucial issue when considering the high capacity demanded of a battlefield network as more and more systems seek to access it. BNET provides for video streaming availability for every user, together with access to advanced applications in a wide variety of combat scenarios;
- Provides reliable broadband data for high mobility ground and air applications;
- Efficient and flexible spectrum utilisation and user-defined spectrum allocation;
- Caters for the integration and re-use of legacy and existing customer communications systems for optimum interoperability and force economics;

- Provides a self-learning, self-healing ad hoc networking capability, independent of infrastructure mesh architecture, automatic network deployment and obviates the need for preliminary planning and configuration.

BNET V (vehicular) and BNET AR (airborne) have already been fielded and are operational, according to a company spokesperson; although the company would not identify customers, it is a safe bet that the Israel Defence Force (IDF) is already a user. Within the next twelve months, the spokesperson confirmed to ESD, BNET HH (handheld) and BNET MPS+MPV (manpack for soldier and manpack for vehicular mounting) will be launched: the company's family of wideband waveforms for ground and air communications and narrowband waveforms is already available for use with the full range of BNET radios.

Rafael also sees a number of challenges in the continuing demand for SDR capability, the principal one of which is the necessity

Photo: Elbit Systems



Elbit Systems' MCTR-7200 in a vehicle-mounted configuration

for networks to be scalable up to hundreds of nodes without compromising performance or degrading data rate or latency. Coupled with the need to support voice, video and data services simultaneously while reducing network management and administrative overhead at the same time also complicates the picture, while smart usage of spectrum resources and a much more efficient approach to spectrum management in general is a common theme from users, the company admitted. Additional layers of complexity are provided by the desire for the network and its components to have a high degree of resistance to electronic counter-countermeasures (ECCM) and to be able to carry native IP applications without the need for gateways. Nevertheless, Rafael sees a healthy and growing market for its SDR offerings. "From our point of view, we see demand for modern tactical MANET radios mainly in Asia Pacific and European countries. We believe these may be driven by large

and constant improvement of the units' size, weight and power consumption characteristics.

E-LynX SDRs include:

- The lightweight PNR 1000 IP radio, providing 64-member ad hoc networking and automatic voice and data multi-hop relay, significantly enhancing situational awareness and operational effectiveness;
- The MCTR-7200 offers multiple configurations as a handheld or vehicular system. Featuring simultaneous voice, video and data services over a single narrowband tactical 25Hz channel, it also offers high-speed data over wide-band channels. Operating between 30-512MHz, the MCTR-7200 provides users with advanced integrated multimedia capabilities – a further enhancement factor for situational awareness. The radio provides ultra-high data rates up to 5.5 Mbps and embedded Blue Force Tracking over a decentralised MANET.

SVFuA will give the Bundeswehr all the tools it requires to establish and protect information superiority while simultaneously ensuring efficient interoperability and connectivity with allies during joint missions and for collective defence. The system operates on an SDR principle and offers secure, reliable and trustworthy communications up to the SECRET classification level: Rohde & Schwarz leveraged its own in-house cryptology development as a key national technology in creating this capability.

Rohde & Schwarz has had responsibility for the overall design of the system since 2009, with the first task focused on developing a prototype, proving the concept and proving the capability for the units to be produced. Certification in 2016 followed, with the Federal Office for Communications Security confirming the system met the SCA requirements for certification at the SECRET level – a prerequisite for customer acceptance. The advantage of the SCA certification is that it will be possible to port future national and international waveforms to the system, provided they are SCA-compliant. The first instalment of the SVFuA system will be delivered and installed by 2020 and the existing framework contract allows the Bundeswehr to order additional sets within a seven year timeframe.

Given the intense effort over a considerable period, the significant investment and the innovation that the company has brought to the SVFuA project, it is hardly surprising – but nonetheless gratifying – that the programme won the prestigious Technology of the Year award in 2017 at the Wireless Innovation Forum Conference on Communications Technologies and Software Defined Radio (WinnComm 2017). The award is presented to an individual or organisation selected by the members for "a breakthrough product or technology in the field of software defined or cognitive radio."

From vehicle mounted radios operating at prodigious ranges to handheld devices populating an ad hoc local network; from national waveforms to internationally accepted standards; from the most sophisticated mobile manoeuvre force to small infantry unit operations in harsh, remote environments – SDR is changing the face of battlefield communications. European armed forces are at the forefront of some of the most far-reaching changes that will characterise this quiet but profound revolution: and European companies are leading the charge to market dominance. ■



Photo: Rohde & Schwarz

The product of years of research and development, the Rohde & Schwarz SVFuA SDR will transform mobile tactical communications for the Bundeswehr.

modernisation programmes for battle management systems (BMS) along with a move towards reliance on network centric measures and the reduction of traditional manned resources," the company spokesperson concluded.

Elbit Systems has developed a range of SDR for the tactical communications market, which it characterises as "rapidly changing, requiring companies to keep track or market trends and provide customers with appropriate solutions." The E-LynX family of SDRs, "powerful machines with advanced waveforms and high flexibility, adapted for harsh environments," are already in widespread service, the company told ESD, while its continuing investments are focused on further waveform development, enabling its network services to cope with current and future warfare challenges

Munich-based Rohde & Schwarz has a long tradition of development and supply of advanced, innovative tactical communications systems and it is therefore no surprise that the company is a leader in the SDR field. In June last year the company won an order from the German Ministry of Defence to equip 50 command and control vehicles (PUMA infantry fighting vehicles and BOXER armoured logistics vehicles) with the armed forces' joint radio system. Known as SVFuA, the system is the first pillar in the MoTaKo 'Mobile Tactical Communications' project, which aims to modernise and digitise these services throughout the Bundeswehr. In implementing this contract, Rohde & Schwarz achieved a historic first, by porting diverse existing waveforms to the radios using international established software communications architecture (SCA).

Handheld CBRN Detection Instruments

Dan Kaszeta

It is not any great secret to anyone that sophisticated electronic devices are getting smaller by the year.

Miniaturisation has affected the development and manufacture of chemical, biological, and radiological/nuclear (CBRN) sensors in ways very similar to other segments of industry. Technical tasks that had once taken an entire room full of equipment are now done by gear that can fit into a suitcase. Likewise, systems and capabilities that once filled a table now fit into a small handheld device. This is an area where definitions should be applied and differentiations are important. The current state of the art varies widely and is different across chemical, biological, and radiological detection. Some types of devices are beyond the scope of this article. Many chemical and radiological devices are for use in civilian settings for industrial and safety use. While some of those may be relevant, a lengthy market survey of them is for another article. In addition, definitions of “handheld” vary somewhat, but for purposes of consistency, this article considers devices that fit in an average hand and, vitally, are intended for operation in one hand. Also, for purposes of brevity, this article focuses on electronic devices. This excludes a variety of small non-automated items, such as small chemistry kits, test strips, detector papers, and similar manual devices. This may be addressed in the future in another article.

Photo: US Army

previous decades, IMS instruments, which can quickly and effectively detect the major chemical warfare agents, needed radiation sources to quickly ionise air samples. This fact ensured a certain minimum size and weight (due to shielding), expense (such sources are not always cheap), and administrative burden (radioactive sources required licences and

Chemical Agent Detector, which resulted in such large volumes of sales that economies of scale heretofore unseen in CWA detection brought the sale price down considerably. With reasonably priced consumables and non-specialty batteries (any AA battery will work), there is much to like about the LCD. There are several versions of the LCD now in widespread



Two versions of the JCAD, also known as the Smiths Detection LCD

Chemical

The chemical warfare detection space now has a number of useful handheld products. The handheld market is dominated by Ion Mobility Spectrometry (IMS) instruments. An important evolution in chemical detection was the advent of useful chemical warfare agent (CWA) detectors that were able to do their job without aid of a radioactive source. In

inspections). However, non-radioactive ionisation, such as that produced by a technique known as “corona discharge” has allowed for smaller and cheaper instruments.

The handheld CWA instrument market is dominated by the same handful of companies that have traditionally dominated the market for larger instruments. Smiths Detection (UK/USA), is the single largest manufacturer of small CWA sensors in history. Smiths' LCD series of handheld detectors was the first major CWA detector that incorporated the corona discharge technology. In addition, the LCD was selected as the US military's Joint

use, with the LCD 3.3 being the current general market offering. The LCD 3.3 gets some rare publicity in being clearly visible in photographs of OPCW inspectors in Syria. LCD-series detectors are in service in dozens of countries.

Smiths' long-term competitors in the CWA detection space also have handheld products. Although the French firm Proengin's products do not really count as handheld, Bruker Daltonics (Germany/USA) and Environics (Finland) have viable products in this space. Bruker's μ RAID PLUS looks and feels very similar to the Smiths LCD and has similar performance as an IMS CWA detector and similarly us-

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Photo: GenPrime

The Prime Alert handheld biological instrument

es cheap commercial batteries. However, it has little market penetration and Bruker has not had the large volume of orders to give it economy of scale in production, so it is far more expensive. Envirionics has long had the CHEMPRO as part of its product line and it is an effective CWA detector. It has reasonable market penetration in many markets. Unlike the LCD, it has a radioactive source, which has deterred some customers. Chemring has the JUNO chemical detector, which is essentially the legacy of a failed JCAD bid. This product has had few sales. Other CWA detection manufacturers are focussing on larger systems.

It is important to mention handheld Raman spectroscopy devices. The IMS-based chemical warfare detectors all focus on detecting gas and vapour to give warning to troops. Raman spectroscopy is different and works by shining a laser onto solids or liquids to determine their characteristics. This technique works very well for identifying chemical warfare agents and toxic industrial chemicals in liquid form, but is an after-the-fact analytical technique, not a real-time warning technology. Some companies offer produce handheld Raman sensors. Excellent examples in this market segment include Rigaku (Japan), Serstech (Sweden), 908 Systems (USA), Cobalt Light Systems – now part of Agilent (USA) – and Thermo Fisher Scientific (USA). All have handheld systems designed to interrogate unknown liquids. Both Smiths and Thermo Fisher have small systems that can be considered handheld that use a similar technology called Fourier Transform Infrared, although some of these push the limit of what can truly be considered handheld. All of these have potential in

the CWA detection space, although they are marketed more towards emergency response and public safety users.

Biological

Biological detection lags behind the chemical and radiological detection. The amount of biological material in the natural environment is very large and the technical task of differentiating naturally occurring microbes from biological warfare agents is doable. But it remains the province of large, complex systems with multiple components and cannot be done in real time. Useful real-time detection and warning in the biological arena is still largely unobtainable, and the devices that attempt to do useful things in the “detect to warn” category are far larger than handheld items, mostly due to the volumes of air that need to be collected and concentrated for any useful sample to be analysed. In addition, the chemical processes that are needed to do proper analysis tend to involve handling of fluids and take significant time for reactions to occur. Finally, the threat from biological materials is somewhat different. For the most potent lethal threats, such as anthrax, there is a period of time between exposure and onset of illness, so that there is a window of time for treating the exposed person. These factors combine to mean that there has not been the same miniaturisation revolution in biological detection. Indeed, this market segment has contracted, as fewer government customers are spending money in this segment. Some companies, such as Smiths Detection, that once had biological detection systems (such as the BIOSEQ), have limited or withdrawn their product offerings.

There are handheld devices in the biological segment, but there are not many. And when they do exist, they are narrow in scope and functionality. One of the few devices in this area is the PRIME ALERT, a device made by the US company GenPrime. It analyses samples of powders or liquids for the presence of DNA, and is useful for analysis of suspected biological incidents. Anthrax, for example, will have a lot of DNA, whereas flour will have only a little and baking powder will have none. The remaining “handheld” devices are various detection assays, which, while you can hold them in your hand, are biochemistry kits that work with wet solvents and manual techniques and are not electronic devices.

Even the future shows little prospect of handheld devices in this area. The biological market sector is still focussing on larger systems that will, eventually, give some useful detection and identification capacity. A full market line-up of biological handheld devices may be decades away.

Radiological / Nuclear

Handheld radiation detection is nothing new. Handheld Geiger-Mueller tubes and similarly sized ion chamber devices have been the workhorse of radiation detection in the civil sector since the 1950s. These have historically tended to be approximately the size of a shoe box, and many of these devices are in use, produced by numerous small and medium-sized companies, largely for civilian regulatory safety use. One example is Ludlum, a US firm. However, the utility of a Geiger tube or ion chamber decreases with size, and miniature tubes are of limited value, although some are incorporated into military instruments for specialty purposes. For smaller devices, different technologies are used. Scintillation crystals made from a variety of materials, such as sodium iodide (NaI) and semiconductor materials, such as cadmium-zinc-telluride (CZT) are capable of useful detection of radiation with smaller instruments. Smaller scintillation or semiconductor detection devices have been common since the late 1990s. This is a large market with many product offerings. Much of this market is aimed at the significant ports and borders market, as much money has been spent in screening cargo for radiation sources. Some of the earliest small radiation detection products were designed for use by customs inspectors.

Handheld radiation sensors are subdivided into a variety of categories, with extensive overlap as many sensors have multiple operating modes. One category is dosimetry, which either in real time or in delayed-read fashion (after the fact) tells the user how much radiation they have been exposed to. Such items have existed for decades and are ubiquitous. Another category is detection and measurement, which detects the presence of radiation and quantifies it, usually in real time or very near to real time. Devices that were formerly the size of a shoebox now fit into the size of a 1990s telephone pager. The final category, which is by technical necessity more complex and expensive,

is isotope identification. These devices determine the identity of the source of radiation and can tell, for example, a radioactive iodine source for medical treatment from natural background radiation. Isotopic identification has progressed within the span of this author's career from large, complex systems operated by physicists to devices barely larger than a smartphone. Most of the key players in the radiation sensor market offer many differing products spanning those categories listed above. For many years, Canberra was a leading name in this area, as was Mirion. Mirion acquired Canberra in 2016 and the resulting conglomerate sells literally hundreds of products. The Canberra

UDR-13 is heavily used in the US military. FLIR has excellent offerings and pioneered the size reduction in isotope identification. Thermo Fisher Scientific sells heavily in the civil sector, with some products having been used in the military sector. Literally dozens of small and medium-sized enterprises operate in this space as well. These include Laurus Systems (US), Polimaster (Belarus), and Nucsafe (USA), as well as literally dozens of other companies.

New Prospects

What will this market look like in 10 years' time? For one thing, the broad progress made in electronics continues apace, and some aspects of sensors can continue to shrink in size and weight. However, radiation detectors are nearly as small as they can reasonably be without losing the ability to acquire signals. With chemical sensors, there is so much room for reduction without loss in sensitivity.

Nearly as importantly, cost tends to come down with miniaturisation and improvements to technology. In real terms, a useful chemical warfare detector is far cheaper than it was 20 years ago. This means that instruments that were once scarce on the modern battlefield can be proliferated around the battlefield. For the amount of JCADs the US Army has bought, there is no reason that every squad and every vehicle can have one. A 1980s mechanised infantry battalion may have had only a handful of chemical and radiological detectors, but its 2018 equivalent may easily have over a hundred for the same amount of money.

Another factor is communication and networking. Communications technology has progressed much faster than most elements of CBRN detection technology. There are no insuperable technical obstacles to prevent an entire armada of small detectors from talking to each other and to central hubs and command posts. There is also the prospect of using small instruments on unmanned systems that go where humans may not want to go. However, networked systems and unmanned systems are an interesting topic unto themselves for a future article. ■

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Protecting Vehicles from CBRN Threats

Dan Kaszeta

Most armies rely on mechanised and armoured forces for a wide variety of offensive and defensive roles. CBRN warfare, in particular chemical warfare, poses threats to heavy military forces.

Employment of persistent nerve and blister agents can adversely affect mobility and firepower. If the occupants of armoured vehicles can be killed or incapacitated by CBRN materials, then the dynamics of the modern battlefield could be rapidly altered. Mechanised infantry without the actual infantry is of little value, and a tank with a dead or injured crew wins no battles.

Historically, there have been a number of general approaches to mitigating the CBRN threat to vehicles. One way has been to physically harden the vehicles so that they are more resistant to chemicals. This is a particular concern in that many older types of vehicle paint absorb persistent chemical agents, like Mustard or the nerve agent VX. Then the paint slowly desorbs the agents, posing hazards long after the chemical attack. In addition, chemical agents that have deeply penetrated into paint make decontamination more difficult. For decades, the US military has had a systematic programme of applying CARC – chemical agent resistant coating to combat vehicles. Such coatings are now far more commonplace than in previous decades.

The oldest and easiest way to protect crew and passengers has always been to provide them with protective clothing and respirators, just as if they were infantry. Vehicle crew may require sensible modifications to equipment, for reasons of efficiency and safety. For example, many older CBRN protective suits did not adequately consider fire safety.

A Dead Crew Wins no Battles

Provision of centrally supplied air to vehicle protective masks, has long been a standard approach to protecting vehicle crews. Such “ventilated face-piece systems” have been in use for many decades. The US M14 mask dated from the 1950s, and its successor systems served throughout the cold

war. Analogous systems were in use in other countries, and usually had a central filter unit and air hoses to connect to each of the crew positions. These masks also had their own filters in the event the crew had to dismount. Newer masks are basically the same in principle, but much more improved in terms of comfort, filtration, and materials.

Most major protective manufacturers produce such variants of protective masks designed for the needs of combat vehicle crews. As one example of many, there is the M51 protective mask, produced by Avon and also marketed as the FM51. This mask is based on the US M50 Joint Service General Protective Mask, but modified for combat vehicle crew use, so that it can plug into the vehicle’s intercom system and ventilation system, and still be worn with the normal crewman’s helmet. The other major mask manufacturers, such as ILC Dover and Scott Safety, have made similar products.

The other approach is filtered overpressure, also referred to as “collective protection” as opposed to “individual protection.” In the case of vehicles, this means having a large air intake and filtration system. The filtration system provides enough clean, filtered air to the inside of the system. Such a system only works if the air pressure inside the vehicle is higher than outside, so that CBRN materials do not infiltrate through small gaps, seams, or cracks. This is why they are referred to as “overpressure” systems. The capacity of such systems is usually measured in volume of air over a period of time, with CFM (cubic feet per minute) being the US standard measurement and cubic metres per hour being commonly used in the rest of the world. Filtered overpressure systems do incur costs and maintenance, as filters are often consumed. The same system may have different types and grades of filters available, such as dust filters for non-CBRN environments, and training filters.

Filtered overpressure systems have become increasingly common in major armoured vehicle systems such as tanks, infantry fighting vehicles and armoured personnel carriers. Collective protection is not unheard of in self-propelled artillery and anti-aircraft systems. Softer vehicles are less often collectively pro-



Photo: Avon Protection, 2017

The FM51 is in use in many countries as a specialised combat vehicle protective mask.

tested, although the obstacles against doing so have more to do with weight and expense, rather than technical feasibility. Some civilian vehicles, generally specialty VIP protection armoured cars, have such systems.

Filtered overpressure has become sufficiently prevalent in the combat vehicle market that such features are now widely considered standard. A number of industrial standards apply in this area, the most prominent of which are NATO Triptych AC/225 and Allied Engineering Publication 54. Even in non-NATO countries, these standards are still viewed as significant marks of quality. Whether it provides filtered air through a hose for protective masks or provides filtered air at an overpressure for the whole interior of a combat vehicle, the basic technical principles have not changed in decades. Basically, these systems use a series of filters to filter out dust and particles (such as biological spores and radioactive fallout) and then use charcoal to scrub harmful gases and vapours. The most recent technical advances involve “regenerative filters” – filters that, as the name suggests, effectively renew themselves and are usable for a longer period of time than their older charcoal equivalents. For now, the charcoal is still cheaper and has the dominant position, but the overall total

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lifecycle savings that regenerative filtration promises may change the market.

A variety of companies produce goods in this market segment. Within the CBRN industry this market segment does not always get the



Photo: US Army

The M42 combat vehicle crew protective mask was in standard use from the early 1990s until very recently.

visibility it needs, as these products are components of a complex high visibility end item. While a full catalogue of products would be excessive in this magazine, it is interesting to view a few example products. It is also worth noting that many, if not most, of the companies in this sector make collective protection for other applications, such as buildings, deployable shelters, and ships. These other products are interesting in their own right, but are beyond the scope of this article.

Honeywell, the American multinational conglomerate, has a division called SP Defence. This particular branch of the company is quite an active producer of collective protection systems. Being based in France, this branch of Honeywell has reasonable market penetration in the non-US market. For example, one of their products is the 60 cubic metre per hour filter system for Panhard VBL armoured vehicles.

Dräger, a German company with a well known reputation in numerous segments of the CBRN industry, produces vehicle filtration systems. Their SBL 100 is a 100 cubic metre per hour system designed, logically, for German-produced armoured vehicle systems such as the PUMA armoured personnel carrier. Dräger's AFU 100 system is modular, which can be used singularly or in multiple units to provide protection to a wide variety of vehicles.

HDT Global, based in the US, has the distinction of producing a wide variety of collective protection components for major vehicle systems, both for the US market as well as export. A key product is the M93 system, which is a 100 CFM system that provides protection for the M1 family of tanks. The heart of this system is the M48 filter, which is also in widespread use on M2 Bradley Infantry Fighting Vehicles and various MRAP vehicle systems. They also make the M13 filter system, which is designed to supply air via hose to ventilated facepieces, particularly in vehicles which cannot be adapted to overpressure.

Several UK-based companies do work in this area. MDH is a division of Bioquell, an established name in the UK CBRN industry. Their signature military vehicle protection products are the Direct CBRN Unit and the Cyclonic CBRN Unit for filtered overpressure. They also produce filtration equipment for supplied-air ventilated facepiece systems. EMCELL produces a wide variety of filters for many applications, including filters for the CV90 combat vehicle, in use throughout the Nordic countries, The Netherlands and Switzerland. Parker Dominick Hunter provides the filtration system for the UK's TITAN and TROJAN vehicles.

Temet is a Finnish company also active in the collective protection market. Their primary business is for fixed facility operations, but some of their filters are also used in various military vehicle systems. NBC-Sys, part of the French conglomerate Nexter, has some capabilities in this market space. Their Air Treatment System (ATS) and VBCI systems are their standard products, the latter being named after the VBCI combat vehicle in which it is installed.

Several players outside the American and European space have offerings in this area. Israel's Beth-El is a well-established name in collective protection for civil defence purposes. They provide a wide array of filtered overpressure systems which have been adapted to many different military vehicles. They have a worldwide client base. Beth-El is also well suited for dealing with specialty civilian requirements. A Turkish firm, Makel, makes a NATO-standard 90 and 170 cubic metre per hour vehicle systems.

No Perfect Solution

It is important to understand that any approach to vehicle protection does not provide perfect defence against CBRN threats. Ventilated facepieces and/or overpressure systems are excellent defences, but they need to be used in order to have useful protective benefit. No army trains their tank crews to drive all day every day wearing masks. Likewise, tank crews

spend much of their operating life operating with hatches open, the driver's head exposed, and the torso of the tank commander and loader emerging out the top hatches of the tank. Masks and clothing only have benefit if worn. Mechanised infantry have the primary job of fighting dismounted and need to get in and out of their armoured personnel carrier. Overpressure systems provide protection only when the vehicle is sealed up. If so much as a single hatch is open, the system can't work properly as the air intakes physically cannot pump enough air into the vehicle to compensate for the air going out the open hatch. Furthermore, if vehicle crews or infantry troops dismount, get contamination on their boots and clothing, and bring the contamination back into the vehicle, then any protective ability is negated. As a former military CBRN officer, this author can attest that interior decontamination of tactical vehicles is far more complex and labour intensive than exterior decontamination.

Vehicle protection systems, therefore, need to be used intelligently. From a CBRN protection perspective it is easy to say "keep the tank buttoned up" and "don't get out of the troop carrier" – but these are not realistic operating modes in armoured and mechanised forces. Vehicle crews need a reasonable degree of situational awareness in order to protect themselves, much as infantry soldiers need to know when to put on protective masks and clothing. Vehicle protection systems, therefore, must work as part of a larger system of systems if their protective capabilities are to have any practical value. Three things need to happen. The first thing is to use detection and identification hardware. Improvements in chemical detection technology are such that there is no technical barrier to putting a reasonable chemical warfare detector onto every combat vehicle, in order to alert the crew. The US Army JCAD is an example, as it has a power and communications adapter that can fit it on most US vehicles. The second is to properly practice contamination avoidance. In practical terms, this means proliferating CBRN sensors around the battlefield and conducting proper CBRN reconnaissance, so that commanders know where the hazard areas are, in as close to real time as possible. As detectors become smaller and cheaper, this is more likely now than ever. Third and finally, this information needs to be spread around through CBRN warning and reporting systems, so that all manoeuvre elements know where the likely hazard areas are located. Without such an integrated approach, armoured and mechanised forces are still quite vulnerable to CBRN threats. ■

The Battle for Underwater Supremacy

Bindiya Thomas

Underwater warfare has come a long way since World War I. Technological advances in batteries, engines and periscopes led to submarines becoming faster, stealthier and more reliable.

The advent of unmanned vehicles has given rise to a new generation of underwater unmanned systems for maritime operations which will shape the future of the battlespace as border disputes, weapons proliferation, piracy and the need to

type (man-portable vehicle, lightweight vehicle, heavyweight vehicle and large vehicle), application (commercial exploration, defence, scientific research, and miscellaneous), propulsion (electric, internal combustion, mechanical, hybrid and others) and payload (sensors, lasers, cameras, radars) will drive the market.

The range of missions supported by unmanned systems is on the rise and will play an important role in military modernisation over the next decade.

Such modernisation is already underway. In November 2015, the Swedish Navy took delivery of the first of 10 SEAEYE FALCON UUVs from Saab. The SEAEYE FALCON will be deployed for seabed surveys, inspections, underwater operations and recovery of objects. Expected to be delivered as stand-alone systems, they will be integrated aboard patrol boats and auxiliary ships. In April 2016, the USS SENTRY mine countermeasures ship piloted a UUV fitted with explosives to destroy a mine as part of the International Mine Countermeasures Exercise (IMCMEX). Mapping the sea floor with the SQQ-32 (V4) mine hunting sonar, the SENTRY can classify objects as "mine-like" based on observed characteristics and neutralise them by deploying the SLQ-60 SEAFOX UUV, a remote-controlled mini-submarine drone. Using sonar, cameras and searchlights, SEAFOX allows the SENTRY to gain information about the ocean floor and to identify mines without deploying divers into a minefield.

Similarly, the UK and France announced last year that they would invest more than £17M to design a Maritime Mine Counter Measures (MMCM) demonstrator, which includes an unmanned surface vehicle with sonar and an unmanned underwater vehicle. The project, spearheaded by Thales, will provide equipment to defeat naval mines using remotely-operated, unmanned marine vehicles.

vehicles (AUVs) making them more efficient and reliable. Currently there are more than 250 configurations available of the Unmanned Underwater Vehicles platform. The US Navy identified nine capabilities (for FY 2011–2036) associated with UUVs – intelligence, surveillance, and reconnaissance; mine countermeasures; anti-submarine warfare; inspection and identification; oceanography; communication and navigation networking; payload delivery; information operations; and time-critical strike.

Though outdated, the US DoD noted in its 2004 UUV Roadmap (the 2011 updated version remains classified) that there are several capabilities and attributes that Unmanned Maritime Systems (UMS) must possess before their full potential can be realised: endurance; underwater C2 and de-confliction; survivability in an unforgiving environment; launch and recovery; communications technology for dynamic tasking, querying, and data dissemination. A decade later, those limitations are being addressed. In June 2016, General Motors, the US Office of Naval Research (ONR) and the US Naval Research Laboratory (NRL) announced a cooperative agreement to incorporate automotive hydrogen fuel cell systems into next-generation UUVs.



Photo: SAAB

The Swedish Navy's SEAEYE FALCON UUV from Saab will be deployed for seabed surveys, inspections, underwater operations and object recovery.

protect vital global communication assets grow. It comes as no surprise, therefore, that the global UUV market is projected to grow from US\$2.29Bn in 2015 to US\$4Bn by 2020.

Analyses of the market on the basis of type (remotely operated vehicle and autonomous underwater vehicle), ROV product type (small vehicle, high-capacity electric vehicle, work-class vehicle and heavy work-class vehicle), AUV product

Photo: Atlas Elektronik



ATLAS ELEKTRONIK's SEACAT is used to scan the seabed for objects of interest.

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Enhancing Capabilities

Technological advances have increased the capabilities of remotely piloted vehicles (ROVs) and autonomous underwater

Fuel cells convert high-energy hydrogen into electricity, resulting in vehicles with greater range and endurance than those powered by batteries. Under the ONR's Innovative Naval Prototype programme for Large Displacement UUVs, energy is a core technology in the navy's goals for vehicles,

Division (NSWCCD) technical lead in 2015. This technology can be used on many different types of vehicles.

In June 2016, the NSWCCD executed a successful underwater wireless energy transfer demonstration in a 6,000-gallon tank at its Bethesda, Maryland, facility.



Photos: Boeing

Boeing's ECHO VOYAGER can operate autonomously for months at a time.

targeting more than 60 days' endurance. Another remarkable feat is the Remote Environmental Monitoring Unit (or REMUS) MK 18 developed by the US Navy. The REMUS is an interoperable, programmable UUV that processes and transmits critical test data at the magnetic measurement facility and offers real-life seafloor mapping and buried target detection data to explosive ordnance disposal personnel and operators.

One objective for magnetic testing in conjunction with the REMUS programme is to equip the UUV with "smart" technology to enhance the systems with decision-making abilities without the need for a pre-programmed path.

Underwater Refuelling and Energy Transfer

Over the next decade, the Pentagon plans to launch a global network to deploy unmanned underwater pods that will allow UUVs and robotic mini-subts to "recharge undetected and securely upload intelligence to Navy networks." At present UUVs are able to stay submerged for anywhere between 8 hours to a few days, depending on battery life.

"Underwater data and energy transfer are expected to multiply the effectiveness of Navy-operated UUVs and other unmanned platforms by providing a vehicle-agnostic method for autonomous underwater energy charging," said Alex Askari, Naval Surface Warfare Center, Carderock

These concepts of wireless underwater energy transfer, such as Forward Deployed Energy and Forward Deployed Energy and Communications Outpost (FDECO), were born in NSWCCD's Disruptive Technologies Lab. During the main demonstration in July 2016, the team was successful in transferring power wirelessly from an underwater docking station to a MARV UUV section, and ultimately to the UUV's battery, which was charged at 2 kW while submerged. The MARV is 16.5 feet long and slightly more than one foot in diameter. During underwater energy transfer, this programme was run using data that had been transferred wirelessly underwater using an underwater optical communications system, and allowed an enhanced estimation of the charge on the battery. Likewise, to meet the US Navy's goal of operating UUVs with 60 days' endurance, Bluefin Robotics is developing an underwater docking station that will rest on the ocean floor. According to the Boston Globe, "The refuelling station resembles a cage roughly 5 by 15 feet with a cone-shaped entrance. Once it is inside, the robot is recharged wirelessly through inductive coils — the same technology used for charging electric toothbrushes." The refuelling itself may rely on a bank of larger batteries if in a remote location, or a power cable from an external source, either on land or a surface buoy. Any data the robot has gathered, such as images of the sea bed or boat traffic, could be uploaded to the docking station and trans-

mitted to home base, which could wire new instructions to the robot.

The Institute for Systems and Computer Engineering, Technology and Science (INESC TEC) in Portugal is working on project ENDURE to develop an underwater docking station for autonomous underwater vehicles (AUVs). This project will develop a component capable of transferring power wirelessly to charge UUV batteries, also enabling data transfer via Wi-Fi and high docking precision of the AUV in the station.

The UK is also developing alternative battery solutions. Last year, OXIS Energy Ltd announced that it will collaborate with Steatite, MSubs Ltd and the National Oceanography Centre (NOC) to develop the next generation of lithium batteries for Marine Autonomous Systems. OXIS lithium sulphur (LiS) cells are ideally suited for subsea applications due to their mass density and safety. Li-S cells have five times the theoretical maximum specific energy of lithium-ion cells. The mass density of LiS cells is similar to that of water. As a result, bulky and expensive buoyancy foam is not required for the LiS battery as it is with lithium polymer batteries in use today. The combination of both these factors allows improvement in the performance of a neutral buoyancy battery system. OXIS Energy expects an improvement of at least 70% against the cells used in the best batteries on the market today. Li-S batteries will enable greater endurance at higher speeds for transit to survey sites which are often in remote locations, resulting in fewer launches and recoveries, allowing more sensing equipment to be installed, and will give end users the ability to collect more data.

Undersea Communications

Wireless underwater communication will be paramount for the function of UUVs in the future. However, AUVs have a limited ability to communicate with the outside world; the ability of UUVs to communicate while submerged is limited by physics, whereas the ability to communicate while surfaced is limited by design factors such as mast height, SATCOM system throughput rates, power availability, and the need to avoid detection. Some AUVs also have a limited ability to deal with obstacles they encounter. For example, in 2004, the path of an AUTOSUB-2 AUV was blocked by a deep ice keel that had drifted across the vehicle's mission route. After three unsuccessful attempts, the AUTOSUB found a way around the keel and continued toward its rendezvous with its mother ship.

ARL Penn State engineers have developed concepts for cutting systems that would enable AUVs to free themselves from nets, but these concepts have not been implemented. An improved capability to avoid obstacles is needed, especially for clandestine AUV missions vulnerable to mission failure, loss of cover, or vehicle exploitation by adversaries, but this technology is immature. Germany is tackling this limitation head-on. In 2014, the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw) in collaboration with various German companies announced plans to develop an underwater digital communication network. Key players include the Underwater Acoustics and Marine Geophysics Research Institute (FWG) of the Bundeswehr Technical Centre for Ships and Naval Weapons, Maritime Technology and Research (WTD71) and ATLAS ELEKTRONIK. The project will build on an undertaking developed by the European Defence Agency (EDA), beginning in 2010, in association with German, Italy, the Netherlands, Norway and Sweden.

The goal of Project RACUN (Robust Acoustic Communication in Underwater Networks) was to successfully develop an underwater ad-hoc robust acoustic network between several moving and stationary nodes. According to ATLAS ELEKTRONIK, in 2014, several network protocols were developed and tested at sea. In a practical demonstration, the technology proved it possible to set up and operate a large mobile digital network below the surface. With a total of 16 communication nodes, the two successfully developed methods were demonstrated at sea to observers from the various nations. For these trials, the research ship PLANET of WTD71 was used to deploy ATLAS ELEKTRONIK's autonomous underwater vehicle SEACAT. This robotic mini-submarine scanned the seabed with its sonars and reported the location of submerged objects of interest, such as wrecks, to the underwater network. Via a gateway buoy in the communication network, the data was received by acoustic means and forwarded to a shore station by radio.

Similarly, Portugal-based INESC TEC's Centre for Telecommunications and Multimedia (CTM) has begun working on project BLUECOM+ to develop a broadband internet solution at a low cost to use in remote areas of the ocean. According to the company, researchers will use standardised access technology, such as Wi-Fi and 4G. The project will include the specification, implementation and laboratory testing of the communications solution, to create a prototype that will provide broadband internet access in remote areas of the ocean, more than 100 km from the coast, as opposed to satellite communications.

The concept is based on the use of helium balloons anchored, for example, on buoys, boats or wind parks, forming a flying meshed broadband network operating in the frequencies of analogue TV, in order to guarantee long-range radio connections. In this context, communications should facilitate the dissemination of data collected by fixed and mobile platforms in a maritime environment – buoys and autonomous surface and underwater vehicles – besides providing access to internet services and applications to users at sea, similarly to what happens on shore.

Last year, the US Defence Advanced Research Projects Agency (DARPA) issued a Request for Information (RFI) to develop technology that will allow underwater vehicles to communicate with airborne and surface systems seamlessly. DARPA wants to create a networked undersea surveillance and weapons systems that can operate cable-free, calling it a "highly valued, long sought but elusive military capability".

According to the RFI, DARPA wants to broadcast high-bandwidth situation awareness data in real time from air and space

GYRO

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networks to undersea platforms. DARPA also wants to develop an undersea networking infrastructure to support wide area integrated operations with mobile and fixed platforms, sensors and systems

further. According to the Pentagon, Moscow is currently developing an unmanned underwater vehicle capable of carrying a megaton-class nuclear weapon capable of destroying US coastal cities. Designated

Sci-Fi Fuels Inspiration for Next-Gen Robots

Inspired by the agility of fish, scientists are revolutionising the design of next-generation underwater robots. Known commonly as biomimetic vehicles, this new generation of UUVs will be able to take on high-maneuvrability and mobility operations.

Scientists in Singapore announced last year the development of a new octopus-inspired robot which can “zip through water 10 times its body length within one second, in an ultra-efficient manner.”

According to the Singapore-MIT Alliance for Research and Technology (SMART), this ultra-fast propulsion and super-maneuvrability demonstrated in underwater vehicles is unprecedented. Inspired by the speed at which a cephalopod like the octopus flees from danger by inflating its mantle cavity with water to a bluff-body shape and then quickly expelling it to dart away, the researchers started building an octopus-inspired robot in November 2013. The end result was a polycarbonate, 3D printed, streamlined skeleton which had no moving parts and no energy storage device other than a thin elastic outer membrane. The 27-centimetre-long robot is inflated with water, which it powerfully shoots through an aperture at its base to power its propulsion. As the rocket contracts, it can achieve more than 2.6 times the thrust of a rigid rocket doing the same manoeuvre. The skeleton within the robot keeps the final shape streamlined, while fins at the tail help in stabilisation, said SMART.

In 2012, the EU funded the FILOSE (Robotic Fish Locomotion and SEnsing) project to better understand how fish sense their environment and how this can be applied to underwater robotics. The FILOSE fish resembles a rainbow trout not only in shape but also in its behaviour. The FILOSE fish's tail is actuated by a single servo motor located in its thorax. It creates an undulating wave that travels along the body and pushes the robot forward. Operators can modify the fish's tail to study changes in material properties and its relation to the efficiency and swimming pattern of the robot. FILOSE's head is watertight and contains sensors and electronics to control the UUV.

In 2013, a consortium of European researchers funded by the European Commission (EC) announced plans to develop a fully soft robotic octopus. The goal of project OCTOPUS is to apply anatomical, neuro-physiological and behavioural characteristics by developing a soft 8-arm



Photo: U.S. Navy

The US Navy's LDUUV is a new class of large-displacement unmanned undersea vehicles designed for intelligence, surveillance and mine countermeasures missions.

— such as submarines operating in concert with autonomous underwater vehicles — while networked with space and air military tactical and strategic networks. The agency also wants autonomous network-enabled sensor processing, such as distributed passive and active sonars and filtration of undersea sensor and platform data to tactical air and space networks.

Swarm of Drone Submarines Sets Sail

Autonomous submarines might be the answer for navies looking to cut costs. While they may not be able to completely replace crewed submarines, the advantages of using unmanned submarines to augment missions are undeniable, so much so that the US Navy plans to deploy a squadron of underwater drones by the end of this decade. The squadron will include the Large Displacement Unmanned Underwater Vehicle (LDUUV).

According to the US Navy, the LDUUV is a new class of large-displacement unmanned undersea vehicles that will provide increased endurance, range and payload capabilities. The system is being designed for intelligence, surveillance and mine countermeasures missions, and it is based on a modular, open architecture that will allow the navy to develop new mission sets for the craft. The LDUUV will be capable of being launched and recovered by multiple host platforms, including littoral combat ships, VIRGINIA class submarines and OHIO class guided-missile submarines.

Russia appears to have taken its unmanned submarine development one step

KANYON by the Pentagon, it is unclear what stage the project is currently at.

Similar advancements in underwater technology have been highlighted recently. Last year, Boeing filed a patent for an unmanned aerial vehicle that shapeshifts into a submarine once it impacts the ocean. According to the patent filed, the drone in its modified state may make use of equipment from its initial aerial state but still have a different configuration to provide added benefits.

More recently, in March 2016, Boeing introduced the ECHO VOYAGER, its latest unmanned undersea vehicle (UUV), which can operate autonomously for months at a time thanks to a hybrid rechargeable power system and modular payload bay. The 51-foot-long vehicle is not only autonomous while underway, but it can also be launched and recovered without the support ships that normally assist UUVs. ECHO VOYAGER is the latest innovation in Boeing's UUV family, joining the 32-foot ECHO SEEKER and the 18-foot ECHO RANGER.

Lockheed Martin also unveiled its version of the autonomous (yellow) submarine last year. MARLIN is an agile 10-foot, 2,000-pound, unmanned submarine equipped with sonar and sensors, including 3-D laser imaging. It offers a quick and safe way to conduct subsea surveys and inspections, according to the company. The MARLIN is also a Remote Multi-Mission Vehicle (RMMV) that provides the future primary mine reconnaissance capability as part of the US Navy's Littoral Combat Ship Mine Countermeasures Mission Package. It can “dramatically enhance” underwater operations for the oil and gas industry by providing faster, safer and more efficient inspections in place of divers or tethered vehicles.

robot, able to move in water, to elongate its arms, to reach and grasp, and achieve locomotion. The final OCTOPUS artefact will be built with no rigid structures and will show all the capabilities of an octopus. This can be used in exploration and monitoring tasks, for its capability to reach impracticable places, but also in maintenance or rescue tasks.

Researchers at the US Naval Research Laboratory (NRL) have also taken inspiration from marine life to design and develop novel underwater propulsion, control, and sensing solutions for near-shore and littoral zone missions.

Autonomous underwater vehicles (AUVs) have demonstrated many successful capabilities in inspection, surveillance, exploration, and object detection in deep seas, at high speeds, and over long distances. However, operations in littoral

zones requiring low-speed and high-maneuvrability present mobility and sensing challenges that have not been satisfactorily resolved, according to the US Navy.

Similarly, Boston Engineering has developed a tuna-sized device called the GHOSTSWIMMER Autonomous Undersea Vehicle (AUV) for the US Navy. The GHOSTSWIMMER is part of an experiment that explores the possible uses for biomimetic, unmanned underwater vehicles. At a length of 5 feet and a weight of 100 pounds, the GHOSTSWIMMER vehicle can operate in water depths ranging from 10 inches to 300 feet. Its biomimicry provides additional security during low-visibility intelligence, surveillance and reconnaissance (ISR) missions and friendly hull inspections, while remaining quieter than propeller-driven craft of the same size. The robot is capable of operat-

tum technologies which are expected to change underwater detection capabilities, with a 1,000-fold improvement in performance.

In 2014, researchers from Imperial College, London, developed a technology that could allow submarines to determine their exact location without resurfacing. At present, submarines' underwater navigation mostly relies on calculated estimates. Using sonar, radar or resurfacing to access satellite navigation makes them vulnerable. Current accelerometers have a tendency to drift and need recalibration, which can produce errors of up to 1 km when the submarine surfaces.

To combat this, British researchers are building a portable quantum accelerometer 1,000 times more accurate than current technology, by engineering smaller and better-controlled lasers. Essentially, this is Google Maps for submarines and other UUVs. Operators will be able to track exact movements in real-time with an error range of 1 metre. For robots inside buildings, this technology could yield sub-millimetre accuracy. It has the long-term potential to be applied to aircraft, cars and mobile phones. It might also be used for indoor navigation such as in multi-storey car parks, shopping malls, airports and tunnels. The current global market for GPS systems is US\$27Bn (£17.5Bn), according to the National Strategy for Quantum Technologies roadmap. New quantum technologies are expected to have a profound impact on many of the world's biggest markets – for example, significantly enhancing the £305.6Bn global semiconductor industry and the US\$2.5Tr world oil and gas industry. In daily life they could enable faster 5G or 6G communications for mobile devices. DARPA is also working on developing underwater navigation technology. In May 2016, BAE Systems was selected to develop an undersea navigation system aimed at enhancing the US Navy's ability to provide precise global positioning throughout the ocean basins. The contract will support a programme called the Positioning System for Deep Ocean Navigation (POSYDON), aiming to allow undersea vehicles to accurately navigate while remaining below the surface.

As reliance on Unmanned Underwater Vehicles (UUVs) for maritime missions continues to grow around the world, so do their uses and capabilities. Emerging trends suggest future UUVs will be capable of wireless energy transfer, mimicking fish and cephalopods, and will have greater endurance, speed and range. ■

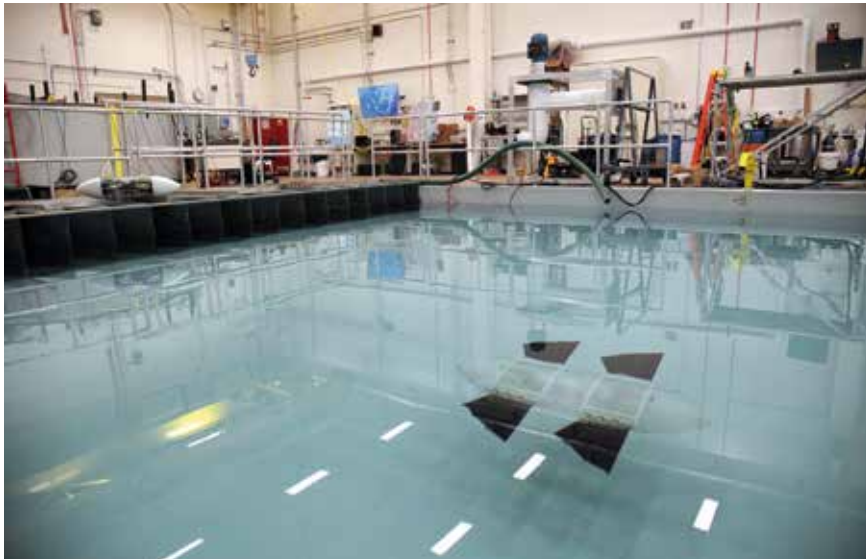


Photo: US NRL

The near-shore AUV WANDA uses four side-mounted fins for propulsion and control.

ing autonomously for extended periods of time, but it can also be controlled by laptop with a 500-foot tether. The tether is long enough to transmit information while inspecting a ship's hull, but if operating independently the robot will have to periodically be brought to the surface to download its data.

Online maps and GPS have become an integral part of life for land dwellers. However, underwater GPS and navigation technology are seriously limited underwater, not unlike communication and Wi-Fi technology. These limitations are being challenged by the next generation of products driven by emerging quan-

Quantum Technology to Find the Way

Online maps and GPS have become an integral part of life for land dwellers. However, underwater GPS and navigation technology are seriously limited underwater, not unlike communication and Wi-Fi technology. These limitations are being challenged by the next generation of products driven by emerging quan-

"Inspired by the pectoral fins of the reef fish, bird wrasse, NRL researchers have developed an actively controlled curvature robotic fin that provides scaled down AUVs a novel low-speed propulsion system," said Jason Geder, aerospace engineer at the Laboratories for Computational Physics and Fluid Dynamics at NRL. The artificial pectoral fin has been integrated into a man-portable, unmanned vehicle named the Wrasse-inspired Agile Near-shore Deformable-fin Automaton, or WANDA. Four side-mounted fins, two forward and two aft, provide propulsion and control. A set of custom control algo-

Attack Submarine Weapons and Sensors

Sidney E. Dean

Traditionally, the primary weapons of attack submarines have been heavy torpedoes. These continue to feature strongly in both the anti-surface warfare (ASuW) and anti-submarine warfare (ASW) roles.

Torpedoes

Lockheed Martin's Mk-48 heavyweight torpedo was introduced into the US Navy (USN) in 1972 and remains the primary ASuW and ASW weapon for USN attack submarines. It is optimised to attack major surface combatants as well as difficult to acquire (low acoustic profile, deep diving) submarines including ballistic missile boats. The currently deployed Mk-48 ADCAP (ADvanced CAPabilities) weighs 1,600 kg and is fired – like most but not all heavy torpedoes – from a standard 21-inch tube. The US Navy reports a speed in excess of 28 kn, a range of more than five miles, and an operational depth of more than 366

metres. The Mk-48 can be wire-guided or deployed in fire-and-forget mode. A digital proximity fuse determines the optimal time for detonation. The 295 kg warhead is designed to detonate beneath the target's keel in order to break its back.

The weapon has been continually upgraded to enhance performance and to keep pace with adversarial countermeasures. The Mod 6 introduced in 2009 can remotely receive software updates while at sea. The latest iteration, the Mod 7 Common Broadband Advanced Sonar System (CBASS) jointly developed with the Royal Australian Navy, is optimised for both blue water and littoral operations and has advanced counter-countermeasure capabilities.

Similar or equivalent heavy torpedoes are produced in other nations, often with range and speed superior to the official capabilities of the Mk 48 although independent experts maintain that the USN significantly downplays the Mk-48's performance, which they estimate to attain 55 kn attack speed and an operational depth between 800 and 1,300 metres. The DM2A4 introduced in 1976 for the German Navy by Atlas Elektronik has a 50 kn sprint speed and a range of 27 nautical miles (NM). Leonardo's new generation BLACK SHARK Advanced (BSA) torpedo developed for the Italian Navy demonstrates similar performance. Classified as a stealth torpedo (the skewed propellers generate very little sound), the BSA can be launched in push-out or swim-out mode at any operational depth achieved by the submarine (in this case, at least 700 metres). It can acquire and track targets in either acoustic or wake-tracking mode. The Advanced Sonar Transmitting and Receiving Architecture (ASTRA) active and passive acoustic sensor head enables the simultaneous tracking of several potential targets.

The UK's Royal Navy utilises the SPEARFISH heavy torpedo being produced by BAE since 1988. A wire command link permits constant exchange of situational awareness updates during an attack run. Operational range is 30 miles. The torpedo runs very quietly at low speeds, permitting a stealthy approach phase utilising passive sensors, followed by a high-speed 61 kn attack sprint using active sonar. According to BAE, high power transmissions and sophisticated signal processing enable SPEARFISH to accurately discriminate targets from background noise, and ensure high resistance to acoustic countermeasures and/or evasive manoeuvres. SPEARFISH will automatically calculate a second attack run if it misses the target on the first approach. BAE is currently working on a major SPEARFISH upgrade set to enter service in 2020. Improvements will include a new insensitive munitions warhead, a higher-bandwidth fibre optic network cable link between the submarine and the torpedo, and safety improvements to the fuel system. Software and database updates for the sonar and guidance systems can be implemented wirelessly "through the skin", ensuring that the latest threat characteristics can be transferred immediately without the need to open the weapon.

Photo: US Navy



Sailors assigned to the submarine tender USS FRANK CABLE's (AS 40) weapons department stabilise a MK48 torpedo during a weapons on-load. FRANK CABLE is one of two forward-deployed submarine tenders in the US 7th Fleet area of operations and conducts maintenance and support of deployed US naval force submarines and surface vessels in the Indo-Asia-Pacific region.

Author

Sidney E. Dean is President of Transatlantic Euro-American Multimedia LLC., and a regular contributor to ESD.

ties. Key elements of the upgrade include a broadband analogue sonar receiver and an improved digital guidance and control system. The increased sonar bandwidth improves targeting and tracking capabilities against high-performance submarine and surface targets with low acoustic signatures.



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Photo: Leonardo

The BLACK SHARK torpedoes are produced by Whitehead Alenia Sistemi Subacquei (WASS), now part of Leonardo. They are fibre-optic wire-guided, but can work in self-guidance mode during the final phase of the mission.



Photo: BAE Systems

The SPEARFISH torpedo is deployed on the Royal Navy's TRAFALGAR and ASTUTE Class attack submarines.

Russia's new FUZIK-2 or FUTLYAR homing torpedo has a reported range of 30 NM and a top speed between 50 and 60 kn. Russia also boasts the world's fastest torpedo, the supercavitating SHKVAL-2 which can achieve 200 kn speed. Details remain classified but it is thought that the SHKVAL-2 employs vectored thrust, and thereby achieves superior manoeuvrability over the original SHKVAL. Range appears limited to less than nine NM. The 21 inch weapon is fired from conventional torpedo tubes, and is thought to be deployed on the KILO class and YASEN class. Russia also aspires to the world's longest range torpedo. In 2015 Moscow leaked information about the developmental "Status 6" or KANYON class nuclear payload torpedo (or more accurately, submarine-launched drone) with an alleged range of 6,000 miles and an operational depth of 1,000 metres. The 1.6 metre diameter, 24 metre long weapon could be deployed on the new KHABAROVSK class, which is thought to have six centrally mounted 39 inch torpedo tubes.

Anti-Ship and Land-Attack Missiles

In addition to torpedoes, attack submarines can carry a variety of missiles to combat surface vessels, land targets, and even aircraft. Depending on the submarine class, missiles can be carried in dedicated cells embedded in the topside hull, or be carried in launch canisters and deployed via torpedo tube.

All attack submarine classes of the US Navy are outfitted with Vertical Launch System (VLS) cells carrying TOMAHAWK Land Attack Missiles (TLAM). A torpedo-tube launched variant of the 21 inch diameter cruise missile was sold to the UK in 2008. Depending on variant, TLAM range lies at 700 or 900 NM with a speed of 475 kn. Guidance options include GPS, INS, TERCOM (Terrain Contour Matching) and Digitised Scene Mapping Area Correlator (DSMAC). The TOMAHAWK is currently produced in the Block IV TLAM-E configuration, which adds the capability to reprogramme the missile while in-flight via two-way satellite communications to strike any

of 15 pre-programmed alternate targets or redirect the missile to any Global Positioning System (GPS) target coordinates. The TLAM-C and -E variants carry a penetrating 455 kg high-explosive unitary warhead; the TLAM-D carries submunitions. The US Navy is currently developing a Maritime Strike TOMAHAWK as a long-range ASuW weapon; this weapon should achieve IOC with the surface fleet in 2021, with follow-on deployment with the submarine fleet. Again, these capabilities are mirrored by other major navies, Russia's in particular. The supersonic anti-ship cruise missile P-800 ONIKS can deploy on the YASEN and OSCAR class submarines. Maximum range is 320 NM. The fire and forget missile can be programmed to conduct the entire flight in sea-skimming mode or use a "high-lo" option with initial approach at 10,000 to 14,000 metres. The midcourse INS guidance system is replaced with active and passive radar for the attack run. The radar is hardened against electronic countermeasures. The 250 kg semi-armour-piercing warhead is equipped with a delaying fuse to ensure detonation inside the target hull.

The 3M54 KALIBR introduced in 2012 is more versatile. It can deploy on AKULA, KILO, LADA and YASEN attack submarines, and will replace the P-700 cruise missiles on the ANTEY class when those submarines enter their refit phase. The KALIBR is smaller than the P-700, enabling each vessel to carry a larger arsenal. The submarine launched KALIBR variants are the 3M54K ASuW missile and the 3M14K land attack missile. The 3M54K has a 200 kg warhead, 240-350 NM range, high-subsonic cruise and Mach 2.9 terminal speed. Both are launched via torpedo tube. Approach to target is performed in sea-skimming mode at 4-5 metres above wave height. The 3M14K has a 450 kg warhead, 1,350 NM range and a subsonic terminal speed.

MBDA's SM39 is the submarine launched version of the French-designed EXOCET anti-ship missile. While range is limited to 27 NM, the EXOCET displays great accuracy and kill-power. The weapon is launched via torpedo tube while encased in a self-propelled, guided launch capsule. Before surfacing, the capsule swims away from the launching submarine to avoid revealing the vessel's location. Immediately upon surfacing, the capsule launches the missile which approaches the target in as little as one metre above wave height; this ensures the weapon cannot be detected before it is within 6,000 metres of the target, leaving little reaction time. An active radio frequency guidance system places the missile on target, with impact usually near the water



Photos: MBDA

EXOCET SM 39 being loaded onto a SCORPENE submarine. EXOCET SM39 is launched from a submarine's torpedo tubes enclosed in a VSM (Véhicule Sous Marin).



EXOCET SM39 firing. Housed in a robust, water-tight, propelled and guided underwater vehicle, the aerial missile is ejected as soon as it breaks the surface, to ensure a very low engagement altitude.

line to maximise damage; the delayed fuse ensures detonation inside the hull. France intends to replace the surface and submarine launched EXOCET circa 2030 with the supersonic PERSEUS stealth cruise missile to be jointly developed with the UK. As conceived, the PERSEUS will carry up to three

warheads, and will be able to attack multiple targets. Synthetic aperture radar and laser radar (LIDAR) will provide advanced targeting capabilities; a satellite data link will enable in-flight retargeting. The Republic of Korea is planning a new weapon for the JANGBOGO III class at-

tack submarines scheduled to enter service in 2025. The CHONYRONG submarine launched cruise missile will be carried in VLS cells and have a range of 800 NM. Attributes and performance are expected to approximate the American TLAM. The Korean Herald reported in 2016 that the JANBOGO III would also be able to deploy the HYUNMOO-2B ballistic missile with a range of 270 NM and a 1,000 kg payload. Plans to carry this missile have not been confirmed by the RoK government.

Photo: US Navy



USS Florida launches a TOMAHAWK cruise missile during "Giant Shadow" in the waters off the coast of the Bahamas. "Giant Shadow" is a Naval Sea Systems Command (NAVSEA) experiment to test the Navy's future guided-missile submarines. FLORIDA is one of four OHIO class ballistic missile submarines (SSBN) being converted to guided missile submarines (SSGN). Giant Shadow is the first experiment in a series before converting the four SSBNs to SSGNs. The SSGNs will have the capability to launch up to 154 TOMAHAWK missiles.

Air Defence

German firms Diehl Defence and Thyssen-Krupp Marine Systems (TKMS) are jointly developing the Interactive Defence and Attack System for Submarines (IDAS). Conceived as a defensive weapon against ASW helicopters, the wire-guided IDAS missile is launched underwater through the torpedo tube. After launch the missile may operate autonomously, or a human operator may retain control. Images are relayed to the operator through the fibre-optic cable to ensure proper target identification. The rocket motor fires underwater and reaches full power before breaching the surface. Underwater it distances itself from the submarine to avoid revealing its position, and then orients itself toward the target coordinates acquired by the submarine sensors. Once airborne it refines its targeting through optical sensors. Effective range is

expected to fall between five and ten NM. In addition to helicopters, IDAS can attack small to medium surface targets and shore targets.

Sonar / Acoustic Sensors

Submarine sensors are utilised for navigation, for tactical situational awareness including locating and engaging hostile vessels and mines, and for conducting ISR (Intelligence, Surveillance and Reconnaissance) missions. They can be divided into acoustic (including sonar), optical and electromagnetic systems.

Acoustic sensors are divided into active and passive systems. Active sonar emits an acoustic pulse which rebounds when it strikes a solid surface; the returning signal or "echo" is received by the sonar's transducer array and transferred to a signal processor for evaluation. Active sonar can determine the object's contours (aiding classification); it can also determine its distance, direction and speed by measuring the time elapsed between pulse and echo. However, active sonar also reveals the presence of the searching submarine. Passive arrays send no signal, but merely monitor for sound from surface ships and submarines; such acoustic signals can include sound produced by ship's engines, rotor wash, explosions, collisions or even heavy objects being dropped onto a deck. Passive acoustic monitoring alone cannot determine the distance to an object. However, triangulation between several sonars or sensors can allow even passive systems to calculate distance to a target.

Submarines carry several sonar systems simultaneously, with each being optimised for different tasks. These include bow and flank mounted sonars as well as towed sonar arrays which can be deployed as needed to augment the on-board systems; towed arrays have the advantage of less interference from sound generated by the host submarine.

The first ten units of the US Navy's VIRGINIA class attack submarines introduced in 2004 featured a spherical bow sonar array enclosed in a dome-shaped cover. Similar arrays – the MTK 500 SKAT – are found on several Russian attack submarines including the new YASEN class. However, as of USS NORTH DAKOTA (the eleventh VIRGINIA class vessel) the USN switched to the horseshoe-shaped Large Aperture Bow (LAB). The LAB contains a medium-frequency active array and a passive array with improved performance over the previous transducers. The new transducers, adopted from the SEAWOLF class attack submarines, are designed to last the life of



Photo: Northrop Grumman

Light Weight Wide Aperture Array (LWWAA) is the only available, passive, fibre-optic hull mounted sensor array in the market and is critical to the operation of the US Navy's VIRGINIA Class fleet.

the submarine. And while the dome surrounding the spherical array was filled with air, requiring a complex system to maintain constant pressure, the dome surrounding the LAB is filled with water. Taken together, the transition to the LAB increases performance while reducing maintenance effort and expense.

On both flanks the VIRGINIA class is equipped with a fibre optic Light Weight Wide Aperture Array (LWWAA) consisting of three flat panels. High frequency active sonars are located at the chin and on the sail, serving for navigation, mine detection and ASW. A conformal high-frequency active sonar array on both sides of the sail provides sonar coverage of the waters above and behind the submarine, eliminating sensor blind spots. In addition to the hull mounted systems, the VIRGINIA class carries two towed passive arrays: the TB-34 to search for adversary submarines in cluttered littoral environments; and the TB-29 to detect, localise and pursue submarines in all environments. Technological advances are constantly incorporated as new submarines are built, and retroactively applied to older vessels after proving themselves. The newest VIRGINIA class submarine, USS SOUTH DAKOTA, will feature new large vertical sonar arrays on each flank. These passive arrays are expected to improve the submarine's ability to detect other vessels well before being detected itself.

Traditionally, acoustic sensors have utilised ceramic hydrophones which require electronics and signal processing to be located near the sensor. Northrop Grumman has developed fibre optic sensors as an alternative. They are in service as part of the LWWAA on the VIRGINIA class. Acoustic pressure striking the sensor



Photo: Northrop Grumman

Fitting the LWWAA hardware for Block IV of the US Navy VIRGINIA Class submarines.

causes a malleable sensing spool (called a mandrel) to expand or contract, temporarily changing the flow of laser light through the optical fibre. That change is measured and transmitted to the signal processor located deep within the submarine. The fibre-optic system offers several advantages. The hydrophones are simpler, containing fewer parts than piezoceramic transducer systems – less than ten passive components and splices per channel, compared with hundreds per channel for ceramic arrays, according to Northrop Grumman. Data loss during transmission to the signal processor is reduced. Since they lack electronic components, they are also immune to electromagnetic interference.

Optical and Electromagnetic Sensors

Modern periscopes are equipped with high-definition cameras which can automatically switch to infrared or low-light mode as needed. A prime example is the Series 20 Attack Periscope produced by Safran. Despite the designation, it can also be used for ISR and navigation. It has multiple features including a gyro stabilised direct optical channel with 4 magnifications, a high-definition colour camera, an infrared camera, a low-light camera with anti-blooming, as well as enhanced image processing capabilities and video recording features. The periscope can be integrated with GPS and Electronic Warfare/Electronic Support Measures (EW/ESM) antennae.

The next evolution in optical sensors is the photonic (alternately: optronic) mast. In contrast to the periscope, which is raised and lowered through the hull and therefore constitutes a weak point in the submarine's physical integrity, a photonic mast is stationary outside the hull. The VIRGINIA class was the first class to replace periscopes completely with photonic masts. The two KOLLMORGEN (now L-3 KEO/Calzoni) AN/BVS-1 masts feature high resolution electro-optical colour, black-and-white, and infrared cameras, low-light television and a laser rangefinder. The sensors are connected via optical fibre to three work stations (including the captain's) in the command centre on the second deck. The workstations feature LCD screens which display the sensor images, and joysticks and keyboards to control the sensors. Streaming images are recorded on tape and CD for documentation and analysis. The British ASTUTE class which entered service in 2010 is also equipped with photonics masts, produced by Thales.

Electronic Warfare (EW) is now a major element of submarine operations. Electromagnetic sensors constitute a major element of a submarine's ability to conduct Intelligence, Surveillance and Reconnaissance missions. Sail or mast mounted EW systems – such as the US Navy's AN/BLQ-10 ESM system – can intercept and analyse radar and communications signals. Finally, radar also belongs to the submarines' electromagnetic capabilities. Mast mounted radar is used when surfaced, for navigation and safety as well as for tactical situational awareness.

System Integration

Even the most powerful sonars and sensors are of limited value by themselves. The input from a submarine's various component sensors must be aggregated in order to create a useful operational assessment. This is the role of command and control systems such as the Integrated Sensor Underwater System (ISUS) developed by Atlas Elektronik. The ISUS 100 Combat System for Submarines networks acoustic and non-acoustic sensors to create a unitary tactical picture. The system is modular, and can incorporate a variety of Atlas Elektronik sonars as well as periscopes, photonic masts, ESM and navigation radar, and even off-board sensor data supplied via data link. The aggregated data can flow through the target management system to the weapons control stations, creating an uninterrupted "sensor to shooter" chain for all onboard weapons including torpedoes, missiles and countermeasures. ■

Masthead

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Is the EU Defence Industry at a Crossroads?

Giulia Tilenni

Establishing an EU defence industry is considered to be a crucial step to advance European defence cooperation. Although a European Defence Industrial Policy has been in place since 2007, an effective EU defence industrial base does not exist yet. Could recent developments such as Brexit and the EU Defence Fund serve as enablers for establishing a real EU defence industry?

Establishing an EU defence industry and the related EU defence market could solve some basic, yet decisive EU dynamic inefficiencies, thus mitigating their negative impact on EU defence industry's strength and competitiveness. For instance, EU countries spend €380-400Bn per year on defence, but only 4% to 5% of EU forces are combat ready. Duplications and over-capacities alone cause a waste of €24.8Bn each year. According to the EU Parliament, an effective pooling and sharing could reduce these losses by 30%.

reasons, such as the will to maintain a certain degree of strategic autonomy and to preserve the national economy; the defence industries employ 1.4 million skilled workers and produce €100Bn turnover per year.

So far, the EU Commission's efforts to affirm cooperation as the best remedy to markets fragmentation and materials inefficiency and duplications have not proven effective. In particular, the European Defence Technological and Industrial Base (EDTIB) legal framework, also known as

ber states to push forward towards an integrated EU defence industry.

How to Build a European Defence Technological and Industrial Base (EDTIB)

The idea of establishing the EDTIB goes back to 2007-2009, when the so-called Defence Package was approved. This package included an EU Commission Communication ("Strategy for a stronger and more competitive European Defence Indus-



Photo: EDA

The European Defence Agency's (EDA) Ministerial Steering Board met on 5 May 2018 in Sofia under the chairmanship of HR/VP Federica Mogherini. Defence Ministers encouraged EDA to further develop initiatives in areas such as military mobility and main battle tank capability.

As analysed in ESD 04/2017, the mix of different national industrial policies and the lack of permanent political willingness restrain EU defence cooperation. EU members tend to prefer national procurement for political and economic

Defence Package, was approved in 2007, but remained mainly on paper.

Attempts to create an effective Common Security and Defence Policy make sense only if they include European defence industrial integration, and vice-versa. The complexity of today's security threats and the need to compensate for last decade's declining defence budgets are amongst the main reasons for pursuing a higher degree of industrial cooperation. Thus, the EU Commission is working on identifying new tools that could encourage EU mem-

try") and two Directives (2009/43/EC and 2009/81/EC).

The Communication identified EDTIB weaknesses, which, not surprisingly, are almost the same ten years later: intergovernmental approach, preference for national procurement and off-the-shelf purchases from the US, inefficient R&D investments, and lack of standards' harmonisation. Thanks to the Defence Package approval, the EU institutions filled the existing legislative gap in this domain (one of the several EDTIB's problems) and worked on lifting existing legal

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The Capability Development Plan of EDA

obstacles and introducing new procedures that could to ease and speed up intra-EU defence transfers and procurement.

Directive 2009/43/EC regulates intra-EU transfer of defence-related products, and introduces a licencing and certification system. For what concerns licenses, this Directive introduces the general licence to complement the two existing ones (global and individual licences). When a supplier is awarded a general licence, its materiel should be allowed to circulate within the EU without any other form of authorisation. Furthermore, this directive introduces the possibility to certify the liability of defence companies. Competent national authorities can issue a 5-years valid certificate that demonstrates a company respects specific obligations included in the directive. An EU database called CERTIDER contains the list of certified firms and awarded general licences.

Directive 2009/81/EC introduces defence and security tailored procurement procedures. In an attempt of enhancing transparency and fair competition, this directive pushes member states to prefer public bids and negotiated procedures rather than awarding contracts under restricted procedures – that remain admitted under specific conditions and in certain cases only. In order to incentive cross-country procurement, states could publish specific announces on the TED platform in order to receive proposals from other EU relevant suppliers.

Both directives had the common aim of limiting the use of article 346 TFUE, which allows member states to take the measures they deem necessary to protect their national security interests when it comes to military materials' production and trade. In fact, this article has been frequently used beyond its scope to justify national procurement choices.

So far, EU directives seem far from achieving expected results. The number of awarded general licences and certificates remain limited, as well as the number of cross-country procurement procedures. This resulted in amplifying the EU defence market fragmentation. Actually, as six countries (France, Germany, Great Britain, Italy, Spain and Sweden) control 86% of the market, they can shape up the market's dynamics regardless of the regulatory framework. Thus, smaller countries, such as Baltic States, which have been able to develop some remarkable niche capabilities, remain unable to offer their products to bigger countries and, consequently, struggle to find their place in the European defence market.

The European Defence Agency

The Defence Package has not been the only attempt of creating the basis for an EU defence industry. Established in 2004, the European Defence Agency (EDA) was cre-

ated to support Member States in improving their joint defence capabilities. Since the entering into force of the Lisbon treaty in 2007, EDA is also in charge of stimulating joint Research and Technology (R&T) and strengthening the European defence industry. The EDA EDTIB strategy was approved in the same year, establishing that EDA would have worked on programmes compliant with member states' requirements and would have pursued its objectives by identifying priorities, consolidate demand, increase investments and competition, and ensure security of suppliers.

However, as the EDA is an intergovernmental agency depending on the EU Council, its active contribution to EU defence cooperation has been heavily dependent on EU members' willingness to involve the agency in their joint defence programmes. Despite EDA has been running several projects since its foundation, its role in the EU defence cooperation has remained marginal.

Developing EU Strategic Thinking in the Defence Domain

As we heard in Brussels during a dedicated seminar, the quest of coherent strategy and synergy among the stakeholders is the most interesting aspect of ongoing discussions on defence cooperation. In the past, a number of legal and political measures aimed at advancing defence cooperation have been taken within the EU institutions, but they suffered of at least two main weaknesses – the well-known lack of enduring political willingness and the lack of a coherent strategy. Before 2016, EU member states have focused on the actions that could benefit of the highest degree of political agreement, rather than advancing their defence cooperation. The bottom-up approach has been preferred to the top down-one, thus creating further fragmentation and downsizing EU defence policies' and joint defence programmes' impact.

Conversely, the pathway that started in 2016 sees the Commission at the core of a joint effort involving states (via the Council), EU people representatives (via the EU Parliament), EDA and EU defence industries. Although its output is still uncertain, this embryonic form of strategic thinking could be a game changer for EU defence cooperation.

For the reasons expressed in the first paragraph, it is not surprising that market and industrial considerations are part of this developing strategy. The European defence fund will be at the core of this new attempt to establish a cohesive EU defence industry.

Towards a European Defence Fund

The European Defence Fund is part of the broader European Defence Action Plan adopted in 2016, aimed at identifying concrete proposals to advance defence cooperation. The other proposals concern SME support (to reinforce their role in EU defence cooperation), and the establishment of an open and competitive EU defence market. The European Defence Fund, which will be included in the Multiannual Financial Framework (MFF) 2021-2027, is expected to persuade member states to spending more and better on joint defence programmes. In order to achieve this goal, the fund has been divided in two strands, also known as windows, focussed on collaborative research programmes (research window) and materiel development/acquisition (capability window).

In order to verify fund's compliance with EU political objectives in the light of their inclusion in the MFF, the Commission has agreed on funding some pilot projects for each of the two windows.

The so-called Preparatory Action on Defence Research (PADR), run by EDA, has been funding a number of research projects in the 2017-2019 timeframe to demonstrate the added value joint EU research could bring to EU defence. Three projects have been granted €25M funding for 2017, and calls for proposals are under submission for 2018 projects (€40M). Funds for 2019 – to be approved – could reach up to €25M.

The European Defence Industrial Development Programme (EDIDP)

In June 2016, the EU Commission proposed to the EU Council and Parliament the approval of a regulation establishing the European Defence Industrial Development Programme.

EDIDP should run in 2019 and 2020, with an expected €500M budget, and could serve as basis for future capability window's developments. Thus, the programme could support EU defence industry's competitiveness and innovative capacity according to the other EU defence provisions. In particular, the programme focuses on supporting defence products' and technologies' development phase (usually the riskiest, thus the more expensive), consequently reducing the gap between research and development, and incentives SMEs participation in joint projects. Interinstitutional negotiations are ongoing, and approval is expected by mid-2018.

Future Perspectives

For the near future, EU institutions are expected to work to enhance EU strategic autonomy. This implies, among others, building and maintaining a strong political responsibility to pursue cooperation, and establishing a certain degree of autonomy from foreign assets to ensure security of supplies. EU institutions and member states have already agreed on the next steps for advancing their cooperation, namely the identification of priorities/operational requirements to be later translated in tailored joint programmes. In fact, as EU funding will be limited, eligible projects should be compliant with member states' requirements, with a special focus on solving capability shortfalls.



Photo: EU

Federica Mogherini is the Head of the European Defence Agency, in her role as High Representative of the Union for Foreign Affairs & Security.

2018 will be crucial to create the premises for the next decade's EU defence cooperation, in an attempt of reinforcing the remarkable progresses obtained under the Juncker Commission and Mogherini's mandate as High Representative. Despite CSDP will remain an intergovernmental policy due to its strategic nature for national security, the EU Commission will gain a preeminent role in its implementation. In addition to being at the core of EU defence fund's governance, the EU Commission will use its role of guardian of the Treaties to supervise the full implementation of CSDP legal pro-

visions. For instance, in January 2018 the EU Commission has opened infringement procedures against five members not compliant with Defence Package directives.

A European Defence Fund in the Next MFF

The European defence fund is expected to have a crucial role in the EU defence cooperative framework. For the first time since the creation of the EU, some MFF fund will be entirely dedicated to defence cooperative projects. The EU Commission is expected to propose a €13Bn defence fund (about €2Bn more than expected), to be ideally shared between research (€4.1Bn) and capability (€8.9 billion). Additional funds would be dedicated to military mobility (€6.5Bn), European Peace Facility (€10.5Bn) and space (€16Bn).

While describing EU Commissions' proposals to include defence-tailored funds in the next MFF, Mr. Delseaux, the EU Commissions' DG GROW Deputy Director-General, stressed that the EU Commission is extensively working on defining defence EU fund's legal framework, which will probably be published in June 2018. However, some of the EU Commission's indications have already been attached to the European defence fund proposals. Despite ideally being split into research and capability windows, they will probably converge into one R&D fund. The degree of EU contributions for each project will depend on its technological readiness level, with a preference for research programmes (which could be 100% funded). When feasible, the EU Commission will encourage SMEs' participation in EU joint projects to encourage cross-country and cross-industry cooperation, and to advance EU research on disruptive technologies. The EU Commission will be in charge of the fund's governance, thus selecting potential recipients according to priorities established by the Coordinated Annual Review on Defence and other strategic documents. Consequently, PESCO projects would have the priority when eligible. This will be the case for the EU military mobility project, part of the PESCO framework, which will be developed in collaboration with NATO (actually, American troops operating in Europe will be the primary beneficiary, as analysed in ESD 2/2018).

According to Mrs. Mogherini, the European Peace Facility "would allow to be much more efficient in planning and deploying our military missions, but also to support our partners in dealing with our shared security challenges." EU defence fund for space will

Photo: ESA



The €10Bn GALILEO project is the global navigation satellite system that is being created by the European Union (EU) through the European Space Agency (ESA), headquartered in Paris.

likely benefit the GovSatcom (Governmental Satellite Communications) project started in 2013 and expected to prepare the next satcom generation by 2025.

Enhancing EDA's Role

EDA's effective contribution to defence cooperation is perceived as an important part of EU Global Strategy's implementation. To this end, EU institutions envisage a full (or, at least, a better) use of EDA. With the Agency's Long Term Review, approved between 2016 and 2017, EU member states have officially recognised that EDA has to become the EU funded defence activities' central operator and the intergovernmental coordinator for defence capability planning, prioritisation and development. As EDA's chief executive Jorge Domecq underlined, the agency's agenda is undergoing an intensive revision in order to be compliant with this renewed role. The agency is already in charge of managing and implementing PADR projects. From 2018 EDA will be in charge of updating Capability Development Plan (CDP) priorities through a new set of actions (June 2018), and of establishing a new strategic research agenda (September 2018). Future key strategic activities will include the recognition of the skills needed to expand EU autonomy from foreign suppliers and the identification of the disruptive technologies available on the market, including dual-use or potentially dual-use capabilities, with a special attention to SMEs.

Assessing the Brexit Impact

Despite Great Britain not being at the forefront of EU defence efforts, British industries play an important role in the European defence market, and are participating in a number of cooperative projects within the EU framework (for example GALILEO). Moreover, the UK has been deeply involved in the creation of a more cohesive EU defence market, being one of the states more compliant with Defence package directives. Thus, the impact Brexit could have on pursuing the creation of an EU defence market will probably be higher than the one on military cooperation in which London's participation has always been limited, especially considering overall British defence capabilities. Brexit's impact on the EU defence market will heavily depend on future EU-UK economic relations still under discussion. In general terms, EU negotiators are not expected to consider defence as an exclusion to general internal market rules applied to third countries, regardless of the kind of agreement the two parties will reach on defence cooperation.

The new organisation decided for the GALILEO programme (British access to industrial developments will be blocked, but London may access the signal in case of successful agreement), it is likely that Great Britain will no longer participate in joint projects' decision-making or in military operations' planning. Companies or the military will remain able to join, but only in a second stage.

Moreover, Great Britain will no longer be an EDA member, and its participation in EDA projects will be subject to the signature of an administrative arrangement approved by the EU Council; this is already the case for Norway, Serbia and Ukraine.

Final Considerations

Today's efforts for creating stronger EU defence seem based on good premises, probably the best ever seen so far. The fact that all relevant stakeholders (EU Council, Commission and Parliament, EDA, and defence industries) are actively collaborating to enhance a form of joint strategic thinking is highly encouraging, and the rapidity of the decision-making process stresses the political willingness to pursue the pathway towards defence integration started two years ago. This virtuous circle and the approval of the EU defence fund could have a positive impact on the EU defence industry, and could serve as pushing factor for reducing existing market fragmentation and better adapt joint programmes with operational requirements, thus allowing for an optimisation of scarce financial resources. Despite the remarkable political advancements, EU defence integration is still in an embryonic phase. 2019 will represent a new test for stakeholder commitment, as Brexit and political changes in EU institutions (European Parliament elections and designation of a new EU Commission) will be of utmost importance for future defence cooperation. ■

On Target! Fire!

Hirtenberger Mortar Experience 2018

Waldemar Geiger

In April 2018, Austrian mortar systems company Hirtenberger Defence Systems invited more than 100 representatives of armed forces and business partners from 21 countries to present its latest developments in the mortar field and to exchange opinions and information. The event was supported by SafranVectronix, Junghans Defence and the Austrian Army.

The heterogeneous pattern of requirements from different armed forces already became apparent during the introductory briefing when delegates were asked about their preferences for the optimisation of the effect of different mortar systems (60 mm Commando, 60 mm, 81 mm, 120 mm). Every nation, even almost every branch of the forces has dedicated expectations as to which areas of already matured weapon systems should be made subject to continuing development.

On the second day, Hirtenberger, SafranVectronix, a manufacturer of target acquisition equipment, and the fuse specialist Junghans Defence jointly presented a series of

However, in order to respond to requirements of modern forces the intention is to make the weapon system as a whole safer, faster and more effective, including the additional implementation of digital technologies.

Grid Aiming Mode (GRAM)

GRAM, in the Germanic mythology the name of Siegmund's sword which he used to slay the dragon Fafnir, constitutes Hirtenberger's response to a requirement for weapon systems with a sensor-to-shooter capability. The combination of a positioning sensor package mounted on the mortar barrel and

According to the company the costs for this "universal retrofit" equal those of a 60 mm bi-pod mortar, thus offering a cost-effective measure for the effective and efficient upgrade of old mortar systems, affordable even for forces with a low budget.

Apart from the sensor-to-shooter capability GRAM encompasses:

- The possibility of using commando mortars for indirect fire missions;
- Increased target precision in combination with better effect at the target;
- Easy integration of existing mortars with VBS 3-based simulators;
- Use of the mortars in training facilities like the German GÜZ combat training centre.

ARC-FIRE Fire Control System

ARC-FIRE has been developed in dedicated accordance with the philosophy that, above all, fire control software is to offer easy handling at moderate procurement costs, easy integration and a universal deployment capability - open architecture is the buzzword. According to the programme manager, almost all existing fire control systems suffer from the same weakness, namely how armed forces manage their software as they manage their hardware. As a result, such systems have to be supported for several years, but must not be changed. Software, however, takes advantage from its programming language, which brings along several challenges. As the programming languages prominent in the late 80s and early 90s are no longer taught today, there is a lack of personnel able to maintain and develop these systems which, in turn, makes their costs increase significantly. With ARC-FIRE Hirtenberger wants to follow another avenue: based on the C# language the software provides more intuitive handling, easier operation and faster integration with regard to computers, target acquisition devices, weapons, communication and battle management systems. Every person that

Photos: Hirtenberger Defence Systems



A 60mm commando mortar with the GRAM has an indirect fire capability and can provide faster and more precise fire support than conventional commando mortars.

briefings on increased mortar deployment on the modern battlefield, as well as a live firing demonstration, in the scope of which delegates were offered the opportunity to operate the mortar themselves.

The characteristic features of the mortar as a "simple" and cost-effective area effect weapon are still the focus of considerations.

a modern ballistic computer provides a digitisation upgrade option for mortars already in service, including those of other manufacturers, and to integrate them with the battle management system of choice. This variant is already available for 60 mm mortars; 81 and 120 mm are to follow soon.



The SRIPP is a 60mm training bomb. With a trajectory of max. 80m (height) and 200m (range) the SRIPP can be used for training outside of live firing training areas.

can handle a smartphone is able to safely handle ARC-FIRE after a few minutes of instructions. The application can run on all conventional computers, laptops and PDAs and only requires a bandwidth of 2-3 Kb/s. The same software provides the fire control of mortars, tube and rocket artillery of all conventional systems, giving a significantly smaller logistical footprint than that of existing systems with proprietary solutions.

ConFrag

The ConFrag technology (Controlled Fragmentation) provides for the dedicated configuration of the ammunition effect with regard to splinter size, shape, number, speed and distribution in the target area. According to a study of the Dutch TNO Institute this increases the effect of the high explosive (HE) ammunition by up to 100%. In the scope of Hirtenberger's blast test campaigns CONFRAG-optimised 60, 81 and 120mm calibre ammunition was tested and the increased performance was confirmed. The price for this new kind of ammunition is only about 20% higher than that of conventional HE-ammunition. Fire missions that require 15 bombs of conventional HE-ammunition can be accomplished with eight or nine ConFrag-bombs. It is up to the user whether he either wants to save ammunition or use the same amount of ammunition for increased effect at the target. The qualification of the 60 and 81 mm ConFrag has been completed; qualification of the 120 mm variant is still expected in 2018. Besides, Hirtenberger is working on implementing this technology for 40 mm grenades. More details on this will be released soon.

Powerful, Compact and Precise: Target Acquisition Devices from SafranVectronix

The Swiss target acquisition experts presented their current portfolio of portable and compact target acquisition devices.

The PLRF25C, the VECTOR family, the MOSKITO TI and the JIM COMPACT are all target optics in the 500 to 2,000 g category. They can all be operated in conjunction with the indigenous STERNA gyro (ca. 2.5 kg) to provide CAT 1 target coordinates, which are required for the deployment of precision weapons. They respond to current military requirements for target acquisition devices providing increased performance, precision and video-streaming capabilities.

Particularly impressive was the performance spectrum of the MOSKITO TI (dynamic magnetic compass, uncooled thermal imager, CMOS sensor for low light conditions, laser pointer and laser range finder as well as a photo/video stream function) and the JIM COMPACT (cooled thermal imager, same functions like the MOSKITO TI), which provide an impressive sensor package for dismounted observers.

New Fuses from the Black Forest

Even the most precise target coordinates and the best mortar system are useless if the round does not detonate in the target area. Representatives from Junghans Defence (a joint venture of Diehl Defence and Thales) explained the complex functions of mechanical fuses with two independent

mechanical safeties. The new DM 111 S (impact fuse with and without delay) and DM 183 (impact and time fuse) comply with STANAG 4187 security requirements in that they feature an airflow primed "wind wheel" safety as a second independent mechanical safety function in addition to an acceleration launch force safety mechanism. The "wind wheel" safety replaces the safety pin known from predecessors DM 111 and DM 93. Handling faults like early or forgotten removal of the security pin can thus be avoided. Moreover the new fuses can be used for mortars with automatic loaders. Both fuses have been qualified by the company and are to complement the old family of fuses, rather than replace it. The DM 183 has already entered service with the German Bundeswehr.

FLAME was introduced as another product, an electro-mechanical proximity fuse which is still under development, and the qualification of which is expected early in 2019. Like the other fuses it will comply with STANAG 4187. All fuses are suitable for use with all current standard NATO mortar calibres.

Summary

Western armed forces expect new challenges from modern combat requirements; in particular, this applies to networking capabilities, range and speed. The products and technologies presented are suitable to contribute to successfully responding to these challenges. As a result, the Hirtenberger Experience Days 2018 were once again a successful event for the profound exchange of information and ideas. ■



Hirtenberger showed their complete portfolio of mortar systems in the calibre range from 60 to 120mm during the live-firing event.

Russian Arms Exports

Eugene Kogan

The article provides in-depth analysis of Russian arms sales and deals with factual data, not forecasting or wishful thinking based upon hopes and dreams.

There is no doubt that the new US sanctions imposed on Rosoboronexport and its customers worldwide known as the Countering America's Adversaries Through Sanctions Act (CAATSA) adopted by US Congress on 28 July 2017 and signed by President Donald Trump on 2 August 2017 are likely to have effect on Russian arms sales in 2018 and beyond. Still, it can be said that so far Rosoboronexport maintained second place behind the US in arms exports around the globe and generates steady income from arms sales. Thus, it is premature to speculate about declining Russian arms sales in the years ahead since Russians are ingenious when it comes to finding new customers and maintaining friendly relations with old customers. Russian arms exports go by and large to three geographical areas: Asia-Pacific, Middle East and North Africa (MENA) and South America, while Russia retained its role as a major arms exporter to members of the Commonwealth of Independent States (CIS). China and India are still Russian customers but exports to both countries have declined considerably over the last five years.

Rosoboronexport is a subsidiary of Rostec State Corporation which consists of about 700 companies, enterprises and research institutes. Anatoly Isaykin, CEO of Rosoboronexport between November 2007 and December 2016, successfully guided the company throughout his term, found new customers around the globe and increased revenues from arms sales from US\$7.43Bn in 2009 to US\$13Bn in 2016. In December 2016 Isaykin retired and Alexander Mikheev became CEO of Rosoboronexport. Until his recent appointment Mikheev was CEO of Russian Helicopters, another subsidiary of Rostec, on which activities the author will touch upon be-

low. Before his appointment Mikheev was employed at Rosoboronexport for some time. Thus, we can see a changing of the guard accompanied by policy of continuity. Mikheev is well-versed in the work of Rosoboronexport and has a team of professionals who are eager to expand the reach of Russia's arms sales and, if possible, increase revenues.

The Impact of Sanctions

On the one hand, Sergei Chemezov, CEO of Rostec Corporation, said in January 2017 that "Despite the 'difficult geopolitical realities' caused by international sanc-

Kladov, Director for International Cooperation and Regional Policy at Rostec, "combat aircraft and helicopters accounted for 40% of the overall sales. Besides combat aircraft and helicopters, air-defence systems, ground forces hardware and naval equipment constitute major Russian arms sales' categories." The impact of Western sanctions on Russian arms sales in 2015 and 2016 is unknown. However, the preliminary results of the Russian arms sales mentioned below in 2017 show that the Western sanctions have so far had no impact on sales. Vladimir Kozhin, Assistant to President Vladimir Putin for Technical-Military Cooperation, said in an interview with Rossiya 24 TV channel on 12 March 2018 sanctions are "a serious challenge and a serious problem, but we know how to deal with it. The experience of last year shows that Russia has been successfully working despite the sanctions."



Photo: Vitaly Kuzmin

The Russian S-400 air defence missile system as has been sold to Turkey

tions against Russia following its annexation of Crimea in 2014, global arms sales have increased threefold, ending 2016 at US\$14.5Bn." On the other hand, President Vladimir Putin said in March 2017: "Russia exported arms exceeded US\$15Bn in 2016 compared with US\$14.5Bn in 2015", with 85% of sales accounted by Rosoboronexport. Thus, we can assume that the correct number is somewhere between US\$14.5Bn and US\$15Bn. In 2016, Russia sold arms to 52 countries, including CIS member states. According to Viktor

In addition, Western sanctions helped to improve the quality of Russian designs and developments, increase the pace of development of Russian military components and make the production of the entire life cycle of Russian weapon systems independent of Western inputs.

According to Kozhin, "result shows that Russia sold arms worth US\$15Bn and/or slightly more in 2017. Russia succeeded to attract new customers such as Bahrain, Niger, Qatar, Turkey, the United Arab Emirates and Saudi Arabia, to name but a few.

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Photo: Dsg2006



Rosoboronexport headquarters in Moscow

Russia also kept the second place behind the United States as a major arms exporter in 2017." A major breakthrough was a sales contract of the S-400 air-defence system signed between Russia and Turkey in September 2017. The contract has a total value of about US\$2.5Bn; the S-400 will be delivered in 2019.

It appears that Russia aims high and intends to maintain the level of US\$15Bn in 2018 as well but US sanctions imposed on Russian customers worldwide will make

fighters, helicopters and air-defence systems is no longer inferior and pricewise comparable to the quality of arms manufactured in Western countries.

Moreover, Russia does not prohibit secondary arms sales; Russian weapons can be easily resold for profit. There are no strings attached to Russian arms sales, such as improvements of human rights, prohibition of arms sales to dictatorial regimes or arms sales to opposing conflict parties as is the case with Armenia and Azerbaijan. Until re-

35Ms over the next years and has received the first four helicopters in August 2017 at a cost of US\$153M including training, spare parts, ground support equipment and ammunition.

For Russia, arms exports are just business like any other business and Rosoboronexport's management looks for every opportunity to increase profits. For instance, back in August 2013 the US imposed an arms embargo on Egypt's military junta which created a window of opportunity for Russia which President Putin sized right away. Since then Russia has sold arms worth US\$3.5Bn to Egypt. Russia also uses debt relief as a lever on the African continent, often offering the debt relief in return for arms sales, to increase its influence in the region.

Payment in Commodities

It is worth noting that Rosoboronexport treats every customer differently. When it comes to customers considered important for Rosoboronexport, like Indonesia, Russia is ready to invest in setting up an MRO facility in the country as part of Su-35 offset obligations. Russia's investment in the MRO facility will be worth 35% of the overall contract and will include transfer of technology (ToT) and expertise. Indonesia will pay about 50% of the contract sum by delivering commodities like palm oil and rubber to Russia, while the rest of the sum will be paid in cash. It is not the first time that Russia has sold combat aircraft to Indonesia. For instance, Indonesia's procurement of Su-27SKs and Su-30MKs back in 2003 was partly paid in commodities including coffee, palm oil, cement, rubber, and bauxite. Indonesia's procurement of Mi-35 helicopters in 2003 was also paid in rubber. A similar policy is pursued with regard to old customers such as Laos. TASS News Agency reported in March 2018 that Russia and Laos signed an agreement to set up a new facility to support military platforms such as APCs, MBTs and helicopters for the Lao People's Armed Forces (LPAF). Russia's effort is focused on providing support to enable localised MRO.

The Indo-Russian Aircraft

The Indo-Russian Fifth Generation Fighter Aircraft (FGFA) programme has been problematic ever since its inception in 2007. In April 2018 it was finally reported that Ajit Doval, India's National Security Advisor and Sanjay Mitra, India's Minister of Defence, asked the Russians to proceed alone with developing FGFA. They

Photo: Vitaly Kuzmin



The Russian Mi-35M attack helicopter as sold to Pakistan

it harder to meet this target. Still, Russia's purposefulness and consistent arms export policy under various conditions as presented further below cannot be ignored. At the same time, the quality of Russian weapon systems such as combat

cently, the Russian government abstained from selling arms to India's arch-enemy Pakistan but in August 2015 the situation changed when Russia, for the first time, sold Mi-35M attack helicopters to Pakistan. Pakistan plans to procure a total of 20 Mi-

said that "India might rejoin the project later on or buy the fighter outright when it has entered service with the Russian Aerospace Forces." As for the potential sale of five S-400 air-defence systems to India for between US\$5Bn to US\$5.5Bn all technical aspects of the deal have reportedly been agreed upon, but the price tag is still under negotiation which is why it is still too early for Russia to celebrate the deal. For many years India has been a major Russian customer and Russia took it for granted that it will stay that way. However, over the last decade Russian sales to India have declined from 79% between 2008 and 2012 to 62% between 2013 and 2017, partly because the Indian government diversified its arms imports and manufacture arms domestically and partly because of India's dissatisfaction with the quality of Russian arms. Rosoboronexport officials have vehemently denied the last point and claim that Western competitors emphasize the poor quality of Russian weapons. The reality is, however, that Russia is no longer the dominant force on the Indian arms market, although Russia would like it to be different; at least three countries - France, Israel and the United States - are stiff competitors on the Indian market.

Transfer of Technology

Rosoboronexport's individual approach to customer needs is justified not only because of US pressure but also because each and every customer requires special attention and customer demands have to be met accordingly. Kladov said back in 2017 that, "Russian strategy at the moment is to grow, to open up, and to expand its offer from just selling defence equipment to the provision of full life-cycle support", not just after-sales support. Nevertheless, Rosoboronexport officials are suspicious of Turkey because they fear that Turkey will share Russian technology with other NATO members, which is why ToT was not on the Russian table in the case of the sale of the S-400 to Turkey, despite Turkish demands. Thus one can say that, unlike Indonesia and Laos, Turkey is not yet considered a trustworthy customer in Russia's eyes.

In addition to Rosoboronexport, Russian Helicopters, another subsidiary of Rostec, is important for the current analysis since the export of combat helicopters is a profitable business. Andrei Boginski, CEO of Russian Helicopters said in June 2017 that "Russian Helicopters fulfilled its contract obligations fully and did not have financial problems. This resulted in

the stabilisation of our order backlog to about 400 helicopters by the end of 2016. This fills the company's order backlog for the next two years. In 2016, the company delivered 189 helicopters to customers." In 2017 Russian Helicopters delivered 220 helicopters. Boginski added in June 2017 that contracts for the delivery of 32 helicopters worth RUR18.2Bn have been signed since January 2017. Compared to 2015, Russian Helicopters delivered 23 fewer helicopters in 2016 and 31 more in 2017. Revenues fell from RUR177Bn in 2015 to RUR165.8Bn in 2016. There is

ronexport officials consider such regulations is not known to the author. Another possibility offered by Russia to Turkey, for example, was that Russia provided loans to cover 55% of the costs and pledged to provide the S-400 ahead of schedule. In addition, a special service centre can be an attractive offer, such as Russia set up in Kuala Lumpur, Malaysia, in the mid-1990s, with 70% financing from Malaysia and 30% from Russia. This joint venture is operated by the Malaysian Aerospace Technology Systems Corporation (ATSC). When it comes to ToT, much depends



Photo: Oleg Belyakov

The Russian multi-role SU-30MK bought by Indonesia. Indonesia partly paid with coffee, palm oil, cement, rubber and bauxite.

indeed a serious decline in demand for military helicopters since global markets are saturated and customers worldwide are interested in domestic manufacturing. As a result, Russian Helicopters is forced to focus on manufacturing civil helicopters, introducing and marketing new products and improving customer service.

The managers of Rosoboronexport and Russian Helicopters know that they cannot rest on their laurels, as their competitors in general and the USA in particular are trying to stop Russian arms sales. One also recognises that every customer is king and the requirements of the king must be adequately fulfilled. Whether CAATSA will have a real impact on arms exports in 2018 and beyond cannot yet be said. Much depends on Russia's efforts to reduce the economic damage to its customers. Therefore, the case of Indonesia - the barter including the establishment of an MRO facility in the country - is an example of what Russia offers its customers. Russia can also offer a special discount to customers like Armenia. Whether Rosobo-

on how Russia perceives the customer, whether he has purchased weapons from Russia and whether the customer is in a position to manufacture weapon systems independently and thus could become a potential competitor for Russia in the future. China is such a case and as a result Russian arms sales to China have declined in the last decade.

The case of Indonesia mentioned above shows how much Russia has done to retain Indonesia as a customer. Selling arms to both sides of a conflict is, to say the least, a profitable business, and Russia is not shy of doing such business. Whether the first sale of the Mi-35M attack helicopter to Pakistan helped to cool relations between India and Russia is difficult to say, but this possibility cannot be dismissed. Finally, the above-mentioned case of Russian Helicopters clearly underlines the current trend to shift production to the commercial market while continuing the development of new combat helicopters, primarily for the domestic market and later for export.

Thales' Big Cybersecurity Bet

Esteban Villarejo

The French Company invests €1Bn to strengthen this key area of business.

What do the Williams Formula 1 team, the French Ministry of Defence and Terminal 4 at JFK Airport have in common? For one reason or another, all are potential targets of cyber attacks and all are customers of the technology company, Thales. The French multinational has invested €1Bn over the last three years in the development of four key digital technologies: Connectivity, large data volumes, artificial intelligence and cyber security. As part of a "Media Day" Thales presented the new technologies of a group of media, including ESD.

"The more digital and interconnected our lives are, the greater the impact that a great failure can produce. We are immersed in an authentic digital revolution and we must protect ourselves", Patrice Caine, Chairman and CEO of Thales, explained during a seminar on "Cybersecurity: decisive moments for citizens" at the Thales learning centre in Velizy (Paris).

gether with partner Sopra Steria, Thales will compete in the first phase of the Artemis programme, a Big Data platform for the French Ministry of Defence."

It is Thales' goal to make cybersecurity a key factor of its five major business units: defence, aeronautics, space, security and transport. "This business unit reports about €500M per year of revenue with a growth forecast of 10% by 2018. We have 130 customers worldwide and employ 5,000 cybersecurity engineers", said Marc Darmon, Executive Vice-President, Secure Communications and Information Systems of Thales.

Cybersecurity Operations Centres

Currently, the company operates five Cybersecurity Operations Centres (CSOC), in Canada, France, Hong Kong, The Netherlands, and the UK. "They detect threats in real time, analyse events and provide a basis for effective incident response and mitigation, while monitoring the infrastructure's compliance with cybersecurity standards and regulations", Darmon told ESD.

One of those CSOCs was established in the

normally come. "It's a mere record of the origin of IPs from computers. It helps us to assess the probability of dealing with cyber attacks," explained one of the CSOC cyber-defence operators.

Protecting the Military

What kind of cybersecurity can be provided to the military? Battle space digitisation began in the late 1990s. Hyperconnectivity has been a technological revolution for defence systems, making it possible to gather, share, process and store huge volumes of data.

Recent advances in Artificial Intelligence could give these systems the capability to perform a whole range of data-driven functions crucial to the success of future military missions. As the age of total connectivity dawns, ensuring that systems are "cybersecure by design" is therefore a strategic need rather than a necessary evil.

The new French Military Programming Law subjected critical national infrastructure providers to stronger cybersecurity measures to protect their IT systems from any type of cyber threat: "The key is to detect cyber attacks before they occur and to offer counter solutions."

In the case of France and Thales, the French Defence Procurement Agency (DGA) plays a key role in supporting constructive relationships between major industry players, smaller businesses and start-ups.

Another key "cyber area" of Thales is airport systems which protect air traffic management or boarding pass checking at airports in Lyon, Oman, Bahrain and JFK's Terminal 4 in New York.

To fight cyber threats effectively and enable airport staff to make the right decisions in real time, Thales helps operators to deploy comprehensive smart airport solutions which meet the strictest standards of safety and security.

Thales offers an Airport Operation Control Centre platform that supports all the processes and procedures needed to manage airport security and airport operations smoothly and efficiently. Thales' command and control centre enhances situational awareness for the entire airport by collecting information from all the different subsystems so that security personnel are able to respond more quickly and more effectively to emergency situations. ■



Photo: Thales

Marc Darmon, Executive Vice-President, Secure Communications and Information Systems, during his speech at the Thales Media Day in Paris

Thales announced the upcoming opening of a "Cyber Hub", or centre of excellence, in Dubai to expand the cyber branch in the Middle East; it also announced a contract with the Williams F1 team to protect all their communications in a highly competitive environment susceptible to industrial espionage. Thales also announced a key defence project, "a major programme to help structure the future of the French Armed Forces; to-

nearby city of Élan court, which provides 24/7 surveillance and security management for the IT systems and networks of a number of French and international customers, three of which are large contractors to the French MoD.

One of the screens in the conference room showed a world map with countries such as China or Russia coloured red. They are "critical zones" from which cyber attacks

Solutions for a Persistent Global Threat



Interview with Frank St. John, Executive Vice President, Lockheed Martin Missiles and Fire Control

ESD: How would you describe the current global security environment?

FSJ: The global security environment is dynamic, and the US and its Allies have robust security needs. Our customers are facing a variety of threats around the globe that are stretching resources but at the same time contributing to many lessons learned about training, tactics, and technologies. As we look at Europe and other regions, we see a growing need for defense forces to have multi-domain capabilities that can address threats in the air, at sea, on the ground, and even in the cyber environment within a very fast response time. At Lockheed Martin, we focus on our customers and support their needs as circumstances change, while also exploring advanced concepts to address new requirements. We have an important responsibility to stay ahead of emerging threats that have the potential to negatively impact our nation and its allies.

ESD: How has this dynamic environment affected your operations?

FSJ: Lockheed Martin continues to see a growing domestic and international demand to meet new security challenges. Over the past six months we have received additional contracts for our THAAD and PAC-3 family of Hit-to-Kill (HTK) interceptors to support the US and allied forces' critical munitions supply. As a result, we are increasing production of THAAD interceptors. Our ATACMS missiles and GMLRS rockets received funding to support increased production for the US Army and Foreign Military Sales. We are also seeing strong demand for the F-35, C-130J and its variants, rotary wing aircraft, Littoral Combat Ship, and air-to-ground missile systems. Our Missiles and Fire Control business area is making significant investments in our facilities, equipment and workforce to ensure that we have the necessary infrastructure to continue meeting the requirements of our customers.

ESD: Lockheed Martin is the largest global security leader in the world. What is the key to your success?

FSJ: One of our core strengths comes from the innovative spirit that permeates our organization. Our talented employees are dedicated to excellence in everything they do, and they deliver on that promise. We also develop long-term strategic partnerships to advance our technical capabilities and help countries around the globe reach their national goals. We are successful because we work very hard to demonstrate that we are a capable and reliable partner with nations that make an investment in their security and their industries. We recently announced our joint venture with MBDA Deutschland to deliver the TLVS Integrated Air and Missile Defense system. That joint venture is rooted in a decade-plus partnership where we collectively developed the MEADS technology which is now providing the foundation for TLVS. Our longstanding teaming agreement with Roketsan in Turkey and partnership with Safran in France on the SOM-J program has developed a highly lethal, low-cost air-to-ground cruise missile for the F-35. Our SOM-J can provide all F-35 customers with a fully qualified and integrated solution for internal bay missile operations. We're also partnered with Dassault to support the integration of our SNIPER® Advanced Targeting Pod (ATP) for the Qatar Emiri Air Force's fleet of RAFALE aircraft. The RAFALE will be the 10th platform to fly with SNIPER. Thanks to partnerships like these, our targeting pod capability continues to expand, support mixed fleet modernization efforts, and improve the lethality, accuracy and overall capability of the US and Allied forces.

ESD: What is on the horizon?

FSJ: Lockheed Martin has many solutions to meet the needs of our customers today and in future defining moments. We are continuously working innovations – from missile, sensor and geo-spatial technologies to directed energy, autonomy, rapid prototyping, advanced algorithms, and hypersonics, among others. Systems like the T-50A and its associated ground-based training system for the next-generation fast jet training program in the US, a very capable offering for the US Navy's future frigate, next generation satellites and other systems promise to be solutions that will be in production for decades to come. As part of our leading-edge research and

development, we're incorporating advanced prototyping, testing and production technologies in a range of programs and across the technology, development, and production phase to increase agility and performance while decrease costs.

Our Lower Tier Air and Missile Defense Sensor (LTAMDS) solution will compete to replace the current PATRIOT radar and serve as the US Army's future Integrated AMD (IAMD) Sensor. The Lockheed Martin solution will provide 360-degree coverage and allow the PAC-3 MSE interceptor to defeat threats at the limits of its kinematic envelope. We believe our LTAMDS solution will enable the US Army's AMD battlefield dominance for the next 40 years.

In the Short Range Air Defense (SHORAD) space, the US Army is working to field an initial capability for defense of the Maneuver force by 2020. We are developing a small Maneuver SHORAD Interceptor (MSI) for this requirement. Also in the SHORAD space, we received an award from the U.S. Army to further mature our Miniature Hit-to-Kill interceptor for their Indirect Fire Protection Capability (IFPC).

Our franchise low observable cruise missile programs, the Joint Air-to-Surface Standoff Missile (JASSM) and the Long Range Anti-Ship Missile (LRASM), have achieved important milestones in their operational and development programs and will continue to be an important part of our Tactical Missiles portfolio, along with other, new missiles now in development.

ESD: Any other thoughts about your business?

FSJ: Having spent my entire career working on solutions to meet current and future threats that our customers face, I consider it a great honor to be leading Lockheed Martin's Missiles and Fire Control business area. We go to work every day with the awareness that soldiers' and citizens' lives depend on our products, and we are honored to be part of the worldwide team of Lockheed Martin employees and industry partners, in many nations, who support military service members in their critical missions. That is the highest calling of the military technology industry and drives us to keep pushing the boundaries of the capabilities we provide.

The interview was conducted by Stephen Barnard

New Chief Technology Officer at Airbus

(ck) Airbus has appointed Grazia Vittadini (48) as its Chief Technology Officer (CTO). In her new capacity, Vittadini will report



Photo: Airbus

to Airbus CEO Tom Enders and joined the company's Executive Committee as of 1 May 2018. Previously Vittadini served as Executive Vice President of Engineering with-

in Airbus Defence and Space. She succeeds Paul Eremenko, who left the company at the end of 2017. An engineer by education, with a Master's degree in Aeronautical Engineering from the University Politecnico di Milano, Vittadini joined Airbus in 2002 and quickly climbed the management ranks. Among others, she served as Chief Engineer on the Wing High Lift Devices for the A380 in Bremen as well as Head of Airframe Design and Technical Authority for all Airbus aircraft.

Maintenance Contracts for Airbus Helicopter H225M

(ck) Both the Brazilian Armed Forces and the Mexican Air Force have contracted Airbus Helicopters to provide its HCARE SMART BY THE HOUR programmes for a total contract value of more than €125M. The contract with the Brazilian Armed Forces

Photo: Airbus Helicopters



covers all 50 H225Ms currently on order, of which 30 have already been delivered to the Brazilian Army, Navy and Air force. The aircraft belong to the H-XBR programme, signed in 2008 with the Ministry of Defence to provide 50 H225M for the three Armed Forces. The contract with Mexico includes support for the 11 H225M aircraft in operation with the Mexican Air Force. With the HCARE service Airbus Helicopters offers customer service solutions covering material management, helicopter maintenance, technical support, training and

flight operations, and connected services. The HCARE Material Management programme offers spare parts management, Repair & Overhaul services, and a team of technicians ready to provide services 24/7, 365 days a year.

New CEO at ATLAS ELEKTRONIK

(ck) Michael Ozegowski (52) has been appointed Chief Executive Officer of ATLAS ELEKTRONIK GmbH with effect of May



Photo: Atlas Elektronik

1st, 2018. He succeeds Dr. Jens Bodo Koch who will become CEO of the Heckler & Koch Group. Michael Ozegowski began his professional career in 1999 and has held

various management positions, such as Head of Product Management for submarine sonars and systems and Head of Central Procurement. Since 2013 he has been Managing Director of the Submarine Systems business field.

New CEO at DIEHL

(ck) Diehl Group has appointed Dr. Karl Tragl (55) as CEO as of 1 May 2018. Tragl graduated in physics from Friedrich-



Photo: Diehl

Alexander University in Erlangen-Nürnberg and completed his doctorate at the German Aerospace Institute in Oberpfaffenhofen. He started his

career at Siemens and later joined Siemens Management Consulting where he was in charge of the company's global frequency-inverter business. He then joined the engineering company Bosch Rexroth and eventually took overall charge as CEO. Most recently, he served as Group CEO of Alcoa in the US. Tragl combines his entrepreneurial experience in various industrial sectors with his knowledge of modern production systems in the fields of Industry 4.0, automation engineering and 3D printing.

DSM Increases DYNEEMA Production Capacity

(ck) Royal DSM, a company active in health, nutrition and materials, will increase its pro-

duction capacity for the DYNEEMA fibre. Dyneema is DSM's brand for Ultra High Molecular Weight PolyEthylene (UHMWPE) fibre, UD and fabric. Dyneema combines maximum strength with minimum weight: it is 15 times stronger than quality steel and 40% stronger than aramid fibre. Dyneema UD is a composite unidirectional laminate that offers excellent energy absorption and enhanced protection and is available as a hard and soft ballistic material. The company says that strong demand for the fibre is prompting this increase and it is investing to install additional new fibre technology at its plants in Heerlen, the Netherlands, and Greenville, NC, in the US. Production capacity will increase by more than 20%. Law enforcement organisations such as the New York Police Department (NYPD), the US Department of Homeland Security, the US Immigration and Customs Enforcement, the Los Angeles Police Department and others rely on DYNEEMA.

ISTAR for the European MALE RPAS Programme

(df) Elettronica, Hensoldt, Indra and Thales have joined forces for the MALE (Medium Altitude, Long Endurance) drone programme of France, Germany, Italy and Spain – designated European MALE RPAS (Remotely Piloted Aircraft System) – with an ISTAR (Intelligence, Surveillance, Target Acquisition and Reconnaissance) function. The four companies signed a memorandum of agreement, in compliance with legal and regulatory requirements, confirming their common goal to offer a coherent ISTAR functional chain for the MALE RPAS, comprising all elements from sensors and computing through data processing to communications. The team is open to co-operation with other companies. "Thales, Hensoldt, Elettronica and Indra have big ambitions based on a shared vision of the digital transformation of their industries and customers," said Patrice Caine, Chairman and CEO of Thales. "Thales will be using its expertise in Defence Mission Systems, mastering four key digital technologies of Connectivity, Big Data, AI, and Cybersecurity." Ignacio Mataix, Executive Director at Indra, added: "We are building industrial cooperation in Europe and preparing for a future in which Defence investments will be mainly performed at the European level. This alliance will pave the way for future large programmes currently being defined in Europe." The European MALE RPAS programme is managed by OCCAR. A Definition Study contract was signed on 26 August 2016 with the Eu-

European aircraft manufacturers Airbus Defence and Space, Dassault and Leonardo. The development phase is expected to be launched in 2019.

Finland Wants 64 Fighter Jets

(ck) Finland has invited tenders for 64 multi-purpose combat aircraft to replace its obsolete fleet of F/A-18 HORNET jets which is due to be phased out in 2025. The contract is expected to have a total value of €7-10Bn. Possible candidates are Saab's GRIPEN, Dassault's RAFALE, Boeing's SUPER HORNET, Lockheed Martin's F-35 and the EUROFIGHTER TYPHOON, a joint project of Airbus, BAE Systems and Leonardo. Defence Minister Jussi Niinistö said the performance of the jets was the main criterion, and Finland would talk to all aircraft manufacturers. US President Donald Trump suggested last year that Finland had already opted for SUPER HORNETs, an allegation Finland denied. Helsinki invites manufacturers to submit price offers for the new jets by early 2019 and plans to take the final decision in 2021. Finland shares a 1,340 km long border with Russia and has a difficult history with its Russian neighbour. Finland has compulsory military service for all men and is one of six members of the European Union who have not also joined NATO.

Security-Hardened IT Systems

(ck) HENSOLDT is expanding its defence and security expertise to develop secure IT systems, and has partnered with the cyber specialist, Secure Elements GmbH, in founding a joint venture in Germany by the name of HENSOLDT Cyber GmbH. This joint venture will develop security-hardened basic IT systems, which are impervious to hacker attacks and integrated hardware weaknesses. The highly secure solutions are designed to protect IT systems against unauthorised access even at the operating levels of a computer. This approach avoids the shortcomings of conventional cyber protection, which only begins at higher application levels and can therefore be easily circumvented. HENSOLDT Cyber GmbH is already working on the development of secure operating systems and trustworthy basic hardware, the architecture of which has been designed for maximum security and is to be used, initially, to make HENSOLDT products more secure.

HENSOLDT Expands to France

(ck) HENSOLDT has acquired Airbus DS Electronics and Border Security SAS, a France-based company which offers highly secure data link solutions and a range of IFF



Photo: Hensoldt

(identification friend or foe) products. The new HENSOLDT France SAS, based in Plaisir near Paris, generates revenues of approximately €20M per year with a workforce of 60 people. It is led by Philippe Guibourg, President of HENSOLDT France SAS. This acquisition allows HENSOLDT to establish a footprint in France and to expand its line of products in the domains of IFF (interrogators, cryptographic computers, test equipment) and high rate data link solutions, dedicated to missiles or to airborne mission systems (mission aircraft, helicopters, UAVs).

100th Multi-Mission Radar Sold

(ck) IAI-ELTA has marked the 100th ELM-2084 Multi-Mission Radar (MMR) family acquisition with an exhibition held at ELTA facilities in Ashdod, Israel, including the participation of senior MoD and military



Photo: IAI

officials, military attachés, and current users worldwide. The MMR radar has been acquired by many countries and has been a game-changer in the world of air surveillance and air defence. Sales have passed the US\$1.9Bn mark. Initially developed for Israeli Defence Forces requirements, and improved for the IRON DOME interception system a decade ago, the MMR family has evolved to offer capabilities for air surveillance, air defence, C-RAM, Hostile Artillery Weapon Location and Friendly Fire Ranging. MMR is a main sensor of IRON DOME, DAVID'S SLING and IAI's land-based BARAK weapon systems. BARAK is a short- to long-range point and area defence missile system, which has been proven operationally in concert with the MMR radar with several customers to date. The radar has achieved more than 1,500 operational intercepts in battle since 2011.

Light Attack Jet Cooperation

(ck) Aero Vodochody Aerospace (AERO), a Czech manufacturer of military light jets, and Israel Aerospace Industries (IAI) have signed a partnership agreement relating to technical and marketing cooperation for the L-159 light combat aircraft. The L-159 is a robust platform which has been successfully operated in NATO operations, Red Air exercises and combat missions. It is a light multi-role combat aircraft designed for a variety of air-to-air, air-to-ground and reconnaissance missions. The partners have agreed to integrate new avionics into the



Photo: IAI

L-159 platform and jointly to market the aircraft, which will be equipped with IAI-ELTA's radar for all-weather, day and night operations. It can also be equipped with IAI's combat-proven Real Time Tactical Data Link, offering a high level of situational awareness presentation, and it can carry various NATO-fielded weapons including air-to-air and air-to-ground missiles and laser guided bombs. The L-159 can also be tailored to customer-specific requirements and adapted to the needs of basic training as well as combat missions, including air-to-ground, patrol and reconnaissance missions. AERO and IAI have agreed also to collaborate on enhancing pilot training by integrating IAI's virtual training solutions as part of the L-39NG training system. The L-39NG is a platform which meets most pilot training needs, which is beneficial to customers who choose to use only one platform for pilot training.

IAI Moves From France to Germany

(ck) Israel Aerospace Industries (IAI) has opened a new office to support its European business. The location for the new office in Berlin was chosen due to Germany's central role in Europe, and it replaces IAI's former office in Paris, France. IAI regards Germany as a key European market and as a platform for co-development of defence and aeronautics technologies. European nations have been busy struggling with terror and uncontrolled immigration over the past decade; this new reality of Europe has given

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444

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Photo: IAI

rise to new defence and home front security needs. IAI addresses these needs with technologies such as aerial defence, anti-missile, special mission aircraft, unmanned aerial systems, intelligence and cyber systems, drone disruption, land robotics, platform protection, and marine systems: collaboration with European companies is a feature of IAI's presence in Europe.

In 2009 IAI delivered HERON 1 systems to the German Air Force, which are used to this day in collaboration with Airbus. IAI believes that collaborating with European companies will enable it to respond better to current and future customer requirements.

New Managing Director for MASA Group

(ck) In April 2018 Marc de Fritsch joined MASA Group as the company's Managing Director. Fritsch assumed this role following



Photo: MASA Group

a career with the French Army, from which he retired as Brigadier. David Chouraqui will remain the company's CEO and President. Among Fritsch's priorities is increasing the market share of all three of MASA's products, MASA SWORD, MASA SYNERGY and Direct AI. MASA's flagship product, SWORD, is a constructive simulation software for training staff and has been successful with armed forces around the world. Its most loyal customer, the French Army, has used SWORD for many years. The relationship with the French Army is destined to grow under the direction of Fritsch, whose Army career spanned more than 30 years, starting as a helicopter pilot. He spent several years working at the Ministry of Defence, and in 2009 he became

head of the Army Corps 4th Helicopter Regiment of the Special Forces. Fritsch continued with roles in strategic affairs at the MoD before becoming Director of Bilateral Cooperation – South, where he led the international military relations network with African, Middle Eastern, Asian and Latin American armies. He is charged with ensuring that support for MASA and SWORD continues to grow as more defence forces apply the product to their training needs.

Naval Group, GSL to Develop Submarine Simulators

(ck) The French organisation Naval Group will collaborate with Goa Shipyard Limited (GSL) to design and produce shore-based simulators for the SCORPÈNE Submarine project and for other advanced simulator requirements of the Indian Navy. As training is a key aspect of operations of naval assets, simulators are a practical and cost-effective way of meeting the operational re-



Photo: Naval Group

quirements of crews, especially in the most extreme situations. Naval Group supplies a tactical simulator, an exact reproduction of the control room of the SCORPÈNE submarine, and a diving safety simulator driven by a moving platform. In line with the "Make In India" initiative, these simulators will have significant indigenous content. The two companies will also develop simulators for the submarine's Combat Management System (CMS)). The two companies cooperated earlier on advanced simulators for the Integrated Platform Management System (IPMS) and Submarine Escape Training Tower (SETT): with this renewed collaboration with Naval Group, GSL will be able to offer complete simulator suites, including 3D simulators for different future platforms, including submarines, to the Indian Navy.

Naval Group to Support Malaysian Navy E-Learning

(ck) Naval Group will implement a comprehensive E-learning system for the Royal Malaysian Navy (RMN), in order to train



Photo: Naval Group

Malaysian naval force personnel all over the country.

For this purpose, Naval Group will cooperate with Defense Conseil International (DCI), the reference operator of the French Ministry of Defence in the transfer of French armed forces skills to friendly countries. Over a three-year period DCI will transfer French Navy expertise to the RMN. DCI will help setting up the hardware and software system within the Malaysian Naval Education Training Centre and will provide specialised courses and contents. With this E-learning system, the RMN will be able to train cohorts of trainees with state-of-the-art technology.

3W-International Signs Distribution Agreement for Turkey

(ck) 3W-International GmbH, a designer and manufacturer for more than 35 years of 2-stroke engines for the Unmanned Aerial System (UAS) industry, has developed and patented the newest generation of Heavy Fuel (HF) engines. 3W-International engines are suited for projects that focus on low fuel consumption and high TBOs. At Xponential 2018 in Denver, 3W-International signed a distribution agreement with IHATEK Ltd., under which contract IHATEK will mar-

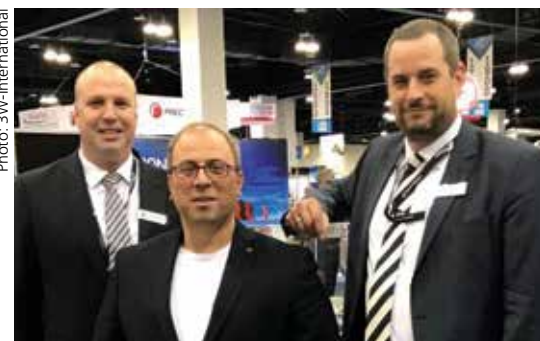


Photo: 3W-International

ket and distribute the products of 3W-International in Turkey. IHATEK Ltd. will also distribute SkyPower engines. The German engine supplier will actively support IHATEK on site. The development of service structures in Turkey is planned for the second half of 2018.

Maintenance Contracts for MTU

(ck) MTU Maintenance Canada and Lockheed Martin have signed two contracts covering the maintenance, repair and overhaul (MRO) of CF6-50C2 engines as well as accessory repair for the engines. Combined, the contracts have a value of around US\$135Mio. These contracts support Lockheed Martin in their maintenance programme for KC-10 EXTENDER refuelling tanker aircraft programme on behalf of the US Air Force (USAF). MTU Maintenance Canada is MTU's centre of excellence for



Photo: MTU

military MRO in North America; it has about 400 employees at its 130,000 square foot facility at Vancouver airport, with full test cell capacity services to serve military and commercial customers in V2500, CF6 and CFM56 engine programmes. MTU Maintenance Canada also specialises in accessories repair, providing LRU management for various engine types, such as GE90.

New Director of International Trade at Naval Group

(ck) With effect from 2 April 2018, François Dupont has been appointed Director of the



Photo: Naval Group

International Trade department at Naval Group. He will oversee all the areas in which Naval Group has prospective customers, and he will define, execute and lead all sales

activities with export clients and partners and French government entities involved. He reports to Alain Guillou, Executive Vice President. The International Trade Department (DCI) is responsible for order taking and sales follow-up through to the signature of the contracts and their amendments for export trade in the Group's vessels, services, underwater weapons, systems and naval equipment. International development represents a major challenge for Naval Group, whose international sales should represent

50% of its revenues by 2020, compared to one third, currently. François Dupont joined Naval Group at the age of 54 as Director of the International Trade department after having dedicated 28 years of his career to the export market. A graduate of Columbia University, he spent 18 years with Thales, as manager of the Thales subsidiaries in Malaysia and then in India. Since 2011, he headed export trade at the Thales sonar subsidiary.

NATO-Industry Cyber Partnerships

(ck) The NATO Communications and Information (NCI) Agency has signed new industry partnership agreements with CY4GATE, Thales, and Vodafone. These partnerships are the latest in a series of agreements between NATO and leading industry partners. The agreements allow the participants to share critical information on national security cyber threats, improving both parties' ability to detect, prevent and respond quickly to cyber threats.

NCIA is responsible for operating and defending NATO's networks. As rapid information sharing is one of the most effective defences in cyberspace, collaboration between the public and private sectors is one of the fastest and cheapest ways to increase cyber resilience, improve incident handling and mitigate vulnerability to attack. These three agreements are part of an effort to strengthen NATO's cyber defence through the NATO Industry Cyber Partnership (NICP), which aims at information-sharing on cyber threats, allowing participants to enhance situational awareness and better protect their networks. In practice, the agreements will facilitate rapid bilateral exchange of non-classified technical information related to cyber threats.

New MBDA Plant in Spain

(Esteban Villarejo) MBDA will set up a factory in Spain in order to benefit from new military programmes that the Spanish Ministry of Defence will launch in the coming months. At the moment, MBDA has a commercial office in Madrid. "Spain is a country with industrial potential in the world of missile manufacturing, so it has been decided to invest and strengthen our presence here, with hiring of personnel and the opening of an industrial plant", said Antoine Bouvier, CEO of MBDA. Daniel García Guelbenzu, General Manager of MBDA Spain said that the Spanish MoD is considering reactivating the so-called "Missile Master Plan", currently on standby. Spain, a long-standing customer of Raytheon's Evolved SEASPARROW Missile (ESSM), has signed a €9.5M R&D contract

with MBDA to determine whether the Common Anti-Air Modular Missile Extended Range (CAMM-ER) and the SEA CEPTOR system are suitable for equipping the future Spanish F-110 naval frigates. In 2017 MBDA announced that it would produce in Spain a new short-range air defence system designed to meet the needs of the Spanish MoD to upgrade its MISTRAL launchers from the M1 version to M3. The METEOR is another missile used by the Spanish Air Force for its EUROFIGHTER fighter aircraft. MBDA is the only European company able to provide missiles and missile systems for each branch of the armed forces, whether in the air, at sea or on land. MBDA is a joint venture of the three major European defence companies Airbus (37.5%), BAE Systems (37.5%) and Leonardo (25%).

SKYSHIELD for Asia

(ck) An Asian nation has commissioned Rheinmetall to supply its SKYSHIELD advanced air defence system. The order, booked in April 2018 has a value over €100M. The systems are already in production and shipment will take place within the next three years. In addition to reconnaissance sensors, 35mm fire units and the associated command and control equipment,



Photo: Rheinmetall

the order includes a comprehensive logistics and service package. Rheinmetall is responsible for the complete training of operating and maintenance personnel as well as technical assistance and support during fire drills in the customer country. Local companies will participate in the project, including the construction of buildings and vehicle procurement. Rheinmetall attaches great economic importance to this order; follow-up orders are already contemplated.

Maintenance Check Flights in Switzerland

(ck) RUAG Aviation test pilots have completed training of Swiss pilots and other interested parties in the first-ever helicopter Maintenance Check Flights (MCF) in Switzerland. The theory-based courses are

offered by RUAG to prepare flight crews and technical personnel for the introduction of MCF regulations by the European Aviation Safety Agency (EASA), expected in 2019. Instruction took place at the RUAG Aviation Helicopter Competency Centre in Alpnach, Switzerland, on 24 April 2018. Several courses are scheduled throughout 2018. RUAG instructors and their helicopter training courses are supported by the Swiss aviation authorities. In order to test functions which can only be checked during actual flight, Maintenance Check Flights are required by aircraft original equipment manufacturers (OEM) and Continuing Airworthiness Management Organisations (CAMO) throughout the aircraft's service life. As of 2019 EASA will introduce regulations for MCF to confirm safety guidelines and define pilot requirements of the testing process for helicopters. Maintenance Check Flights are routine for maintenance organisations like RUAG, although for most pilots, MCF only take place periodically.

Qioptiq New £3.7m STAS Facility

(sb) Qioptiq, an Excelitas Technologies® company and global technology leader in delivering innovative optical and photonic solutions,

has opened its new £3.7m STAS facility in North Wales. The facility will support the £83M UK MOD STAS (Surveillance and Target Acquisition Support) contract, which was awarded to Qioptiq in March 2017. The STAS award allows Qioptiq's St. Asaph site to provide support for surveillance and targeting equipment to the UK Armed Forces over the next six years. Work under the new STAS contract will merge 20 individual support contracts into one, saving the MOD £47M over the next six years.

CEO of the MOD's Defence Equipment and Support organisation, Tony Douglas said, "Crucially, the STAS contract will deliver improved support to Her Majesty's Armed Forces." Peter White, MD at Qioptiq said, "For this opportunity we needed to take a more collaborative approach, which has helped secure a major contract from UK MOD to support equipment vital to the safety of our soldiers in front line operations." The Welsh Government played an important role in supporting the growth and expansion of Qioptiq in St. Asaph, North Wales by investing in the new purpose-designed facility, which opened next to the current Qioptiq plant in the St Asaph Business Park. Economy Secretary Ken Skates commented,



Photo: Qioptiq



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Preview

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