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From the Sea and Beyond

April 2022

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The Incoming Unmanned Vessel Takeover

- China's Naval Expansion
- Naval High Frequency Communications
- Interview with Israel Shipyards Ltd

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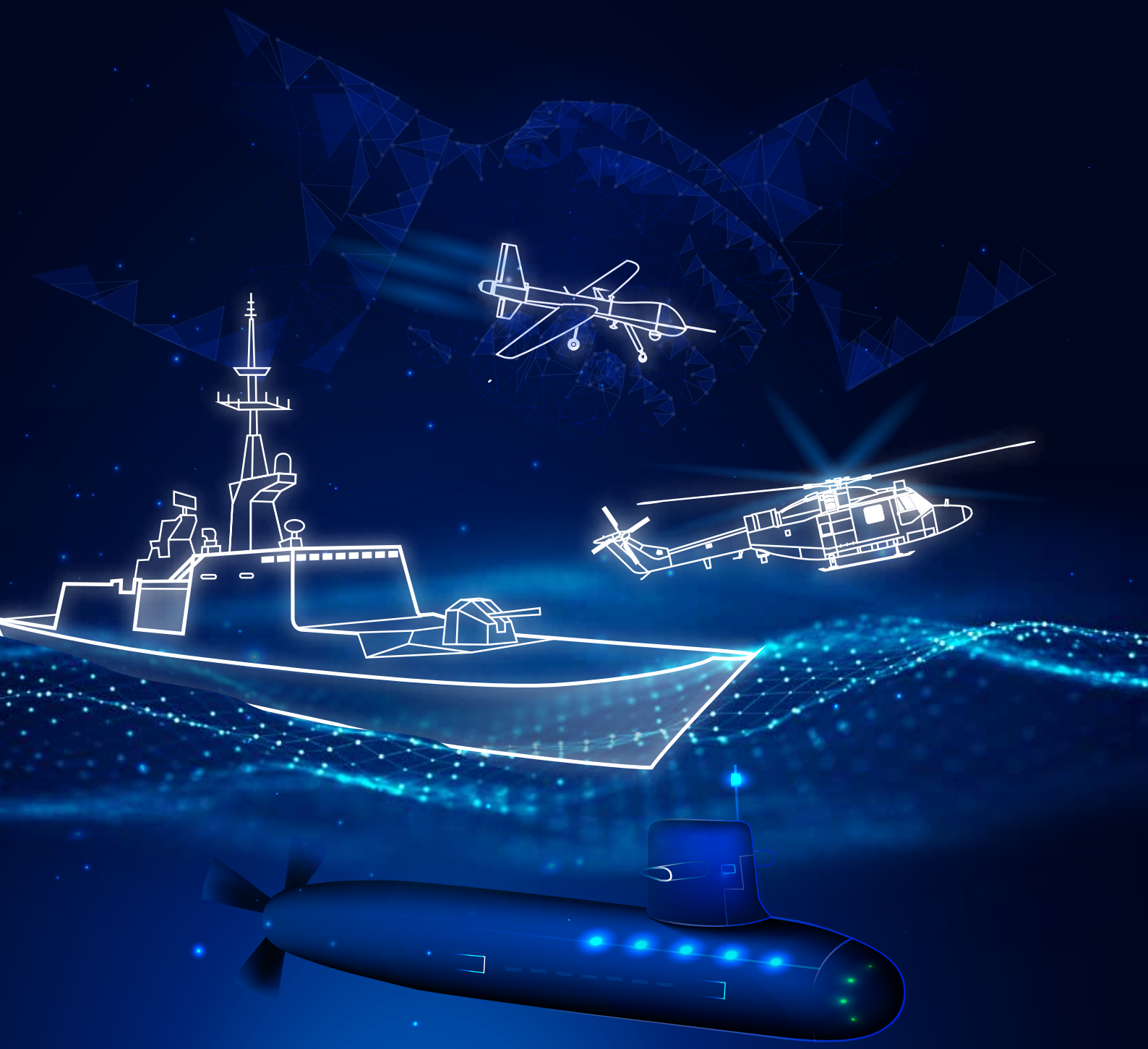
EURONAVAL

THE WORLD NAVAL DEFENCE EXHIBITION



28th edition

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A Darkening Security Environment


Photo: author

The 3,675 pages of the second part of the IPCC's (Intergovernmental Panel on Climate Change's) Sixth Assessment Report (AR6) released on 28 February 2022 provide numerous and substantial details on the impacts of climate change. Unsurprisingly, oceans are increasingly exposed to the detrimental effects of global temperature increase. The consequences, such as food insecurity and the resultant economic and societal effects will put stress on resources, supply chains, and global markets as a whole.

Meanwhile, the world faces a more immediate danger. On Thursday morning, February 24, the Russian Federation's President Vladimir Putin issued an Executive Order to invade Ukraine; a sovereign nation which had once been a friendly and allied country. The pretext he presented for his "special military operation" was to carry out what he calls the "demilitarisation and denazification" of Ukraine. Not only was this a cynical justification for his attempt to rewrite history. His sheer aggression also challenged Europe's established security order and put the reliability of the achievements that followed the end of the Cold War at risk.

It is therefore not only due to the expanding Chinese Middle Kingdom - which is increasingly tightening the reins of control over the free and liberal world – that it seems that the geopolitical skies are darkening. And it is not as if we were not faced with enough challenges anyway: pandemics, the environment, as well as cyber and energy security all loom large, as do migration, poverty, terrorism and food scarcity. One must also not forget the strife in Afghanistan, Libya, Middle East; to name just a few.

Given the vivid events in Eastern Europe, the issue of Maritime Defence Monitor that you now hold in your hands would like to give you some insights both into emerging naval security challenges and also developing technology. We include contributions focused on two global hotspots, China and the Gulf. And, turning to equipment, it is more than mere coincidence that we decided to illuminate developments in missile defence given President Putin's reckless threat to resort to nuclear means. Amongst other articles, we look at progress in the world of maritime communications and interview Israel Shipyards, an increasingly influential force in the market for smaller combatants.

Finally, we whisk you away in the Caribbean. But not for a cruise, as you might assume.

With hope that we can find a solution to today's challenging situation.

Yours Aye
Uwe

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Sidney Dean provides an American perspective on the new AUKUS Security Partnership, one of the most important maritime security developments of 2021. Page 14

Photo: US Navy

Slowly but surely, laser weapons are finding their way on naval vessels. Page 55

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EUROPE

ITALY: Work Commences on Italian Navy's U212NFS Submarines

(cw) On 11 January 2022, Fincantieri announced that production activities had commenced at their Muggiano shipyard near La Spezia on the first of two U212NFS (Near Future Submarines) destined for Italian Navy service. The project is an evolution of the earlier project for four Italian Type 212A TODARO class air Independent Propulsion (AIP) equipped submarines completed in conjunction with Germany's thyssenkrupp Marine Systems (TKMS) and will include a number of significant technological enhancements contributed by the Italian defence sector. It is envisaged that the two new boats will be delivered in 2027 and 2029, replacing the third batch of SAURO class boats on a like-for-like basis. The programme also includes options for an additional pair of U212NFS submarines that – if exercised – would allow replacement of the SAURO class to be completed.

MSD Editorial Commentary: Commencement of work on the next generation U212NFS submarines marks another important step in the Italian Navy's wholesale programme of fleet renewal. This process was initially given impetus under the 2014 Naval Law – that provided funding for the amphibious assault ship TRIESTE, logistic support vessel VULCANO, PAOLO THAON DI REVEL class offshore patrol vessels and CABRINI class high speed patrol boats – but is now moving forward to a new stage with further acquisitions. The end of 2021 saw the award of a circa €410M to a Fincantieri-led consortium to commence work on the second member of the VULCANO class whilst further procurement plans include two types of mine countermeasures vessel and a pair of large destroyers. Italy is also coordinator of the European Patrol Corvette (EPC) initiative being taken forward under the European Union's Permanent Structured Cooperation (PESCO) project.

In addition to the overall extent of the programmes underway, an interesting aspect of much of Italy's recent naval procurement has been the decision to place programme oversight in the hands of the Organisation for Joint Armament Cooperation (OCCAR). This included the majority of the Naval Law procurement, as well as the new submarine and logistic support vessel programmes. The decision is understood to reflect greater contractual flexibility available under agency management compared to purely national control, as well as the greater potential to open up projects to other partner countries under OCCAR arrangements.

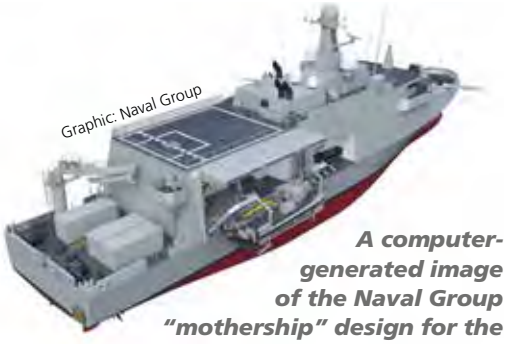
Finally, from an industrial perspective, the U212NFS project extends collaboration between Fincantieri and TKMS in the underwater domain whilst strengthening the Type 212 family's pole position in meeting European submarine requirements. Type 212 series boats are also under order for Germany and Norway following contracts for the Type 212CD variant in 2021, offering possibilities for efficiencies through potential shared logistical, technical and training arrangements.

Photo: Fincantieri

Fincantieri has commenced construction of the lead Type 212NFS submarine.

BELGIUM: Progress with the Belgo-Dutch RMCM Programme

(jh) At the end of November 2021, Naval Group laid the keel of Belgium's OOSTENDE, the first of the 12 Mine Countermeasure Vessels (MCMVs) ordered from the Belgium Naval & Robotics (BNR) consortium under the Belgo-Dutch rMCM programme. Kership, a joint venture between Naval Group and Piriou, is in charge of the actual production of the vessels and the ceremony took place at the latter's Concarneau yard in the presence of Admiral Michel Hofman and General Onno Eichelsheim, respectively the Belgian and Dutch Chiefs of Defence. The contract covers the delivery of 12 MCMV "motherships" (six for each Navy) that will deploy and control a range of unmanned and autonomous systems from outside the mined area. These drones are being produced by ECA Group, Naval Group's partner in the BNR consortium, at a facility in Belgium. It is planned to deliver OOSTENDE during 2024, with all twelve vessels in the programme expected to be operational by 2030.



Graphic: Naval Group

A computer-generated image of the Naval Group "mothership" design for the rMCM programme.

FRANCE: Keel-Laying Ceremony for the Lead Frigate De Défense Et D'intervention

(cw) In another of a large number of announcements by various companies marking the progress of new construction that were made in the run up to Christmas , Naval Group held a keel-laying ceremony

Photo: Naval Group

AMIRAL RONARC'H

for the *frégate de défense et d'intervention* AMIRAL RONARC'H on 16 December 2021. The first of a class of five being built for the French Navy, the c. 4,500 tonne ship has already been under fabrication at the group's Lorient facility for over two years and is expected to be delivered during 2024. Intended to be a smaller and more cost-effective successor to the previous FREMM multi-mission frigates, the new design has already gained success in the export markets with the selection of its BELH@RRA export variant to meet the Hellenic Navy's requirement for new frigates in September 2021 (see further Periscope, MSD 2021/5)

GERMANY: Further Equipment Selections for the U212CD Programme

(hum) At the same time as Italy has made a start with the production of its own Type 212-based submarine programme, the equivalent German-Norwegian U212CD project is also making progress with important equipment selections. In early 2022, sensor solutions provider Hensoldt announced it had received an order valued at over €50M to equip the U212CD submarines with a fully digital sensor suite. The contract encompasses a total of six optronic systems – one for each of the two German and four Norwegian submarines that currently form part of the programme – that comprise OMS 150 and OMS 300 optronic masts and an i360°OS panoramic surveillance system. The OMS 150 is designed to carry out search and surveillance functions with the OMS 300 being intended to undertake the "attack" role and the U212CD contract represents the first time that the combination has been ordered for the same boat. The Hensoldt award follows closely on from the December 2021 announcement that Norway's Kongsberg had been contracted to provide sonar and bottom navigation technology for the new submarines.

GERMANY: Final F125 Class Frigate Delivered

(cw) Long-delayed deliveries of Germany's quartet of F125 BADEN-WÜRTTEMBURG class frigates were concluded on 28 January 2022 when RHEINLAND-PFALZ was handed over to Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw) by thyssenkrupp Marine Systems on behalf of the ARGE 125 consortium. The contract for the four frigates' construction was first signed in 2007, with acceptances commencing in April 2019 after several programme difficulties had been overcome. Optimised

Photo: tkMS

The final F125 class frigate RHEINLAND-PFALZ has now been delivered.

for long-duration stabilisation missions in low and medium threat areas, much of the class's primary raison d'être seems to have been overtaken by the significant deterioration in the East/West security situation in the years after they were first conceived.

NORWAY: First Norwegian P-8A Maritime Patrol Aircaft Delivery

(jh) The Norwegian Defence Materiel Agency (NDMA) has accepted the first of five Boeing P-8A POSEIDON Maritime Patrol Aircraft (MPA) that will be operated by the Royal Norwegian Air Force. The aircraft, named VINGTOR, was delivered to the NDMA during a ceremony at the Museum of Flight in Seattle, Washington in November 2021, some four years after the NDMA entered into an agreement to purchase the type. Norway's four remaining aircraft are all in advanced stages of production at Boeing and are expected to be delivered during 2022. They will enter operational service with the Royal Norwegian Air Force's 333 Squadron based at Evenes Air

Photo: Boeing

A view of Norway's P-8A POSEIDON MPA VINGTOR taken at the time of its first flight.

Station within the next two years. Norwegian companies Nammo, Kongsberg Defence & Aerospace, Andoya Space and Berget all currently have agreements with Boeing as part of an industrial cooperation plan related to the POSEIDON fleet's acquisition.

VINGTOR is the 142nd POSEIDON to be delivered and Norway the fifth country to operate the P-8, following the United States, India (P-8I), Australia and the United Kingdom. In addition, first deliveries to New Zealand, South Korea and Germany will take place in 2022, 2023 and 2024 respectively.

POLAND: Decision on Project Miecznik

(hum): Babcock International's ARROWHEAD 140 has been awarded the design contract for Poland's MIECZNIK (Swordfish) frigate programme. The consortium responsible for the construction, headed by holding company Polska Grupa Zbrojeniowa (PGZ), announced on 4 March that "strategic cooperation agreements" had been signed with Babcock and the UK subsidiaries of Thales and MBDA. PGZ added that the signing of the contract "begins the phase of preparation for production under the programme to acquire three multi-purpose frigates for the Polish Navy".

According to Babcock, design and pre-production planning work will be completed before the end of 2022. The cooperation agreement with PGZ provides for the ships to be built in Poland, with "…significant participation of Polish suppliers and Babcock's global supply chain". Poland initially plans to construct only one frigate, on which work will commence in 2023. After the ship is commissioned in 2028, the vessel will be tested and the results incorporated into the second and third frigates. The entire MIECZNIK project is to be completed by 2034.

Readers will recall that, alongside Babcock, Kiel-based TKMS (and previously Spain's Navantia) had been shortlisted for the MIECZNIK procurement, which is likely to cost PLN 8Bn (circa US$ 2Bn). It will replace the two existing OLIVER HAZARD PERRY (FFG-7) class frigates GENERAL KAZIMIERZ PULASKI (ORP 272) and GENERAL TADEUSZ KOŚCIUSZKO (ORP 273). The ARROWHEAD 140 design – 138.7 metres long and displacing circa 5,700 tonnes – traces its origins to the Danish IVER HUITFELDT class and forms the basis of the Royal Navy's new Type 31 frigates. The Polish variant is, however, likely to be of a significantly different configuration than its Royal Navy counterparts.

RUSSIA: Russian Navy Tests another New Missile System

(red) Whilst events in the Black Sea region attract global attention, Russian naval forces elsewhere in the world continue a process of modernisation. Amongst recent developments, the Russian Ministry of Defence has announced that the newly-modernised Pacific Fleet-based Project 1155 (NATO: UDALOY) anti-submarine frigate MARSHAL SHAPOSHNIKOV has successfully carried out trials of the new OTVET (REPULSE) anti-

submarine missile in the Peter the Great Gulf off the Sea of Japan. The OTVET system consists of an anti-submarine guided missile launched from the 3S-14 universal launcher that is also used for the KALIBR and ONYX missiles. At its front, OTVET carries a small anti-submarine torpedo with a homing head. When approaching the target, the missile releases a torpedo into the water by parachute, which then independently continues to search for the submerged target by the use of a sonar. The maximum firing range of the surface-launched missile version is reported as being 40 km.

Photo: Dalzavod

Recently modernised by the Dalzavod ship repair facility, MARSHAL SHAPOSHNIKOV has been carrying out trials of the new OTVET (REPULSE) anti-submarine missile.

MARSHAL SHAPOSHNIKOV completed her modernisation at the Vladivostok Dalzavod ship repair facility early in 2021, receiving the 3S-14 VLS system alongside a new main gun and upgraded electronics as part of her refit. The yard is currently involved in the major overhaul of MARSHAL SHAPOSHNIKOV's Project 1155 sister ship ADMIRAL VINOGRADOV, which first entered service with the Soviet Pacific Fleet in 1989.

THE AMERICAS

UNITED STATES: Initial US Marine Corps F-35C Carrier Deployment

(cw) Another milestone in the integration of the Lightning II Joint Strike Fighter into US Navy service was passed at the start of January 2022 when the "Black Knights" of the US Marine Corps' Marine Fighter Attack Squadron (VMFA) 314 embarked in the aircraft carrier ABRAHAM LINCOLN (CVN-72) as part of Carrier Air Wing 9 to commence the Corps' first operational deployment of the F-35C variant. VMFA-314 was the first USMC squadron to transition to the F-35C, following on from previous Marine Fighter Attack Squadrons that have adopted the Short Take Off and Vertical Landing (STOVL) F-35B used by the navy's amphibious assault ships. The US Navy's "Argonauts" of Strike Fighter Squadron (VFA) 147 have already deployed with the F-35C, departing San Diego as part of the CARL VINSON (CVN-70) strike group in August 2021.

Photo: US Navy

A US Marine Corps' F-35C Lightning II strike fighter from VMFA-314 lands aboard ABRAHAM LINCOLN (CVN-72) in January 2022.

UNITED STATES: JOHN LEWIS (T-AO-205) CONDUCTS INITIAL TRIALS

(cw) The lead ship of a new class of US Navy replenishment oilers – JOHN LEWIS (T-AO-205) – has completed initial builder's trials from General Dynamics' NASSCO yard in San Diego. Launched in January 2021 and christened the following July, she is expected to be the first of some 20 vessels, a further five of which are either under construction or on order. Displacing around 50,000 tonnes in full load condition, the double-hulled design is constructed to commercial standards with a military overlay and will eventually replace the existing HENRY J. KAISER (T-AO-187) class, many of which are single-hulled. The new vessels will be increasingly important to US Navy operations given the likely pressure the new Distributed Maritime Operations concept will place on the fleet's logistic support assets.

Photo: US Navy

JOHN LEWIS (T-AO-205) pictured running trials from General Dynamics' NASSCO shipyard in February 2022

UNITED STATES: AN/SPY-6 Series Radar Comes Closer to Entering Service

(cw) The United States Navy has recently achieved a major step forward in its efforts to upgrade the capabilities of its longstanding AEGIS combat system with the "light off" of the equipment installed in the lead Flight III ARLEIGH BURKE class destroyer JACK H. LUCAS III (DDG-125). This new BURKE class variant is the first to be equipped with Raytheon's modular AN/SPY-6 radar system, initially known as the Air and Missile Defence Radar (AMDR). Essentially a replacement for the veteran AN/SPY-1 series of radars found on previous US Navy surface combatants, the new SPY-6 series of active electronically scanned arrays represents a generational advance on these previous systems. The "light off" marks the beginning of combat system testing as shipbuilders Huntington Ingalls Industries ready the ship for propulsion tests and, eventually, sea trials.

MSD Editorial Commentary: Raytheon's AN/SPY-6 series of radars is of crucial importance to future US Navy air defence capabilities. Constructed from scalable "building blocks" comprising 2ft x 2ft x 2ft boxes known as Radar Modular Assembles, they can be stacked together to provide a solution adapted to the size and mission of the host ship. Each AN/SPY-6 variant uses the same hardware and software, easing overall maintenance requirements. An active phased array using individually-energised transmitting/receiving elements, AN/SPY-6 is claimed to provide significantly greater detection range, increased sensitivity and more accurate discrimination compared with legacy systems.

The AN/SPY-6 series is currently projected to equip seven separate classes of US Navy warship. The AN/SPY-6(V)1 variant fitted to JACK H. LUCAS encompasses four separate faces each equipped with 37 RMAs. It is intended to perform the most demanding defence missions against ballistic, cruise and other missiles, as well as against aircraft and surface ships. Other members of the family include AN/SPY-6(V)2 equipped with one rotating face with nine RMAs – largely intended for amphibious shipping – and AN/SPY-6(V3) with three fixed faces with nine RMAs – specified for series-built FORD class carriers and the new CONSTELLATION class frigates – that are also collectively referred to as the Enterprise Air Surveillance Radar (EASR). In addition, a four-faced AN/SPY-6(V)4 variant, with each face comprising 24 RMAS, has been proposed for retrofitting to Flight IIA BURKE class destroyers.

Photo: HUNTINGTON INGALLS INDUSTRIES

"Light off" of the AEGIS combat system aboard JACK H. LUCAS (DDG-125).

ASIA-PACIFIC

INDIA: Project 75 Submarine Milestones Achieved

(jh) VELA, the fourth P75 KALVARI class submarine completed for the Indian Navy, was formally commissioned on 25 November 2021. The vessel was built by the Indian shipyard Mazagon Dock Shipbuilders Limited (MDSL) on the basis of Naval Group's SCORPÈNE design and was the second of the class to be commissioned in the course of 2021.

Launched on 6 May 2019, VELA completed all major sea trials, including weapon and sensor tests, prior to delivery to the Indian Navy on 9 November 2021. She joins KALVARI, KHANDERI and KARANJ, which were commissioned in December 2017, September 2019 and March 2021 respectively. VELA has been completely built by MDL, taking advantage of technology transfer from Naval Group during the construction and trials of the first three boats.

Subsequently, on 1 February 2022, sea trials commenced for VAGIR, the fifth member of the class. Her delivery is expected before the end of the year. The programme is expected to be completed early in 2023, when the sixth and final SCORPÈNE – VAGSHEER – is expected to commission.

Photo: Naval Group

India's lead SCORPENE type submarine KALVARI pictured after launch. Four of the class have now been delivered with the recent commissioning of VELA.

AUSTRALIA: Launch of First ARAFURA Class OPV

(cw) The first ARAFURA Class offshore patrol vessel for the Royal Australian Navy was launched during an official ceremony held at the Osborne Naval Shipyard in South Australia on 16 December 2021. In accordance with longstanding navy tradition, the vessel was blessed and formally named by the ship's sponsor, Ms Nova Peris, in advance of being lowered into the water for the first time. The event marked another significant milestone in the Royal Australian Navy's new offshore patrol vessel project (SEA 1180 Phase 1), part of the Australian Government's wider Naval Shipbuilding Plan. ARAFURA is the first of two offshore patrol vessels being built to NVL's OPV80 design in Osborne, after which construction will transition to Henderson, Western Australia.

Photo: Australian Department of Defence

NUSHIP ARAFURA pictured shortly before launch

MSD Editorial Commentary: Intended to replace the existing ARMIDALE class patrol boats, a total of twelve of the much larger and more capable ARAFURA class are being acquired under the AU$3.6Bn Project SEA 1180 Phase 1. The actual design and construction of the new class is being carried out in accordance with a circa AU$2Bn contract signed with Lürssen Australia Pty Ltd in January 2018 under a programme that involves considerable local participation. Although the first pair of vessels is being completed at Osborne in South Australia to help maintain local shipbuilding skills in advance of assembly of the new HUNTER class frigates, the bulk of the class will be built in Henderson in Western Australia by a joint venture between the recently renamed German group and local Australian group company Cimvec. In addition to the ten vessels currently scheduled to be completed by the partnership, it has also been decided to explore a variant of the design for up to eight new mine countermeasures "mother ships" and hydrographic survey vessels set to be acquired under Project SEA 1905 Phase 1, thereby holding out the prospect of an extended production run.

The ARAFURA design represents a successful adaptation of the previous DARUSSALAM class OPV80 iteration supplied to Brunei by NVL, with key changes including the specification of the Saab 9LV command and control system similar to that found aboard other Royal Australian Navy warships. NVL's portfolio of OPVs and corvettes has also found success in Bulgaria, where fabrication of the first of two Multipurpose Modular Patrol Vessels (MMPVs) being completed by local partner MTG Dolphin commenced on 3 December 2021.

THE PHILIPPINES: Corvette Order Placed with Hyundai Heavy Industries

(cw) The Philippine Navy's fleet renewal programme received a further boost at the end of 2021 with the 28 December announcement that a contract has been signed with Hyundai Heavy Industries (HHI) for the acquisition of two new-build corvettes. The contract follows on from HHI's delivery of the two JOSE RIZAL class light frigates during 2020 and 2021, proving a strong vote of confidence in the South Korean group's expanding export business. Reported to cost around the equivalent of US$550M, the new corvettes form part of the 2018-2022 "Horizon 2" phase of Philippine Navy modernisation and, although likely somewhat smaller, will have sufficient commonality with the earlier HHI-built vessels. The corvette purchase is the second major acquisition programme secured by the Philippine Navy in recent months, following on from an order for up to nine SHALDAG Mk V fast patrol boats from Israel Shipyards Ltd earlier in 2021.

AFRICA & THE MIDDLE EAST

NIGERIA: New Tank Landing Ship Launched

(cw) In November 2021, Dutch shipbuilding group Damen announced that a new, 100-metre LST 100 type tank landing ship for the Nigerian Navy had been launched at the Albwardy Damen facility in Sharjah, UAE a few months previously. It had earlier been reported that this ship was subject to a keel laying ceremony in December 2019. The vessel has a helicopter/UAV deck and significant space for cargo, which can be loaded via the stern ramp, bow ramp or by a 25-tonne capacity crane. A military force of up to 250 personnel can be embarked in addition to the vessel's 32-strong crew. Previous official Nigerian Navy documents suggest a requirement for two such tank landing ships, so an additional vessel seems likely in due course.

Although news of the launch of the Nigerian Navy's LST 100 type vessel has been somewhat delayed, it is nevertheless a noteworthy development in representing a major stage in the completion of what us probably

Photo: Damen

Damen has launched a LST 100 tank landing ship for the Nigerian Navy.

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ISRAEL: Progress with Naval Modernisation

(cw) Progress continues to be made with Israeli Navy modernisation against a backdrop of recent naval tensions in the Eastern Mediterranean. Towards the end of February 2022, an announcement from Rafael Advanced Defense Systems confirmed the completion of a successful programme of live fire tests of C-DOME – the naval configuration of the well-known IRON DOME air defence system – that had been performed aboard the SA'AR 6 corvette MAGEN. C-DOME works in conjunction with a command and control system developed by fellow Israeli defence company mPrest's defence division and interfaces with the IAI ELTA ADIR (MF-STAR) radar used aboard the new vessels. Conclusion of these trials marks a major step in bringing the four new corvettes – the largest surface combatants in Israel's naval inventory – into operational service.

Photo: Rafael Advanced Defense Systems

The Israeli Navy has concluded a series of live fire tests of the C-DOME air defence system from the new corvette MAGEN.

Meanwhile, the previous month saw thyssenkrupp Marine Systems (TKMS) reveal that it had reached an agreement with the Israeli Ministry of Defence on the framework conditions for the purchase of three DAKAR class submarines, which are intended to replace the first batch of TKMS-built DOLPHIN class submarines towards the end of the current decade. The new boats are said to be of an entirely new design that have been specifically engineered to meet the Israeli Navy's operational requirements.

MSD Editorial Commentary: Although typically accorded a lower profile than the other branches of Israel's armed services, the Israeli Navy is currently in the course of a major programme of investment. This partly reflects the growing importance of protecting the country's offshore energy resources, as well as increased regional naval rivalry that has been reflected in significant Egyptian and Turkish fleet modernisation. The SA'AR 6 MAGEN class corvettes – built at German Naval Yards Kiel under a TKMS sub-contract but outfitted at Israel Shipyards Ltd (ISL) – form an important part of this programme that will also include the smaller ISL-designed RESHEF (SA'AR 72) corvettes. These are further described in our interview with ISL contained later in this edition.

The new DAKAR class submarines will likely play a different primary role in Israel's defence strategy, forming a key component of the nation's strategic deterrent forces. However, both they and the SA'AR 6 class vessels demonstrate the continued close cooperation between the Israeli Navy and the German shipbuilding sector, a relationship that has now endured for several decades.

the first large warship to be exported from the Gulf region. The United Arab Emirates is in the course of devoting considerable effort to expand its indigenous warship construction industry, as discussed in our article on Gulf Naval Procurement in this edition.

QATAR: Naval Deliveries Continue

(cw) Qatar's ambitious naval expansion programme saw another tangible development at the end of January 2022 with the delivery of the first Fincantieri-built offshore patrol vessel, MUSHERIB, from the Muggiano shipyard near La Spezia. One of a pair of vessels, she forms part of the massive naval acquisition contract for the Qatari Emiri Navy that was agreed with Fincantieri in June 2016 and which also includes four AL ZUBARAH class air defence "corvettes" as well as an amphibious transport dock. AL ZUBARAH was the first warship from this project to be completed when she was handed over at Muggiano at the end of October 2021.

Photo: Fincantieri

Oman has taken delivery of the offshore patrol vessel MUSHERIB. corvette MAGEN.

Although described as a patrol vessel, the c. 700-tonne MUSHERIB is a heavily-armed surface combatant with characteristics placing her somewhere between a large fast attack craft and a small corvette. Information released by Fincantieri states that she is 63 metres long, 9.2 metres wide and has a maximum speed of 30 knots. Accommodation is provided for up to 38 crew members.

WATCH BILL

Photo: GNYK

Mr Rino Brugge

New CEO at German Naval Yards Kiel

(jh) German Naval Yards Kiel (GNYK) has announced Mr Rino Brugge as its new CEO in succession to Jörg Herwig. Mr Brugge has already been part of GNYK's management since the middle of 2021. The graduate mechanical and industrial engineer, who comes from a shipbuilding family, has previously held leading positions in the international shipbuilding industry in Europe, Asia and the Middle East. Among other roles, he was previously CEO of the large state shipyard in Qatar and CEO of Damen Shipyards in Romania, the largest shipyard within the Damen group.

Changes at the Top of the German Navy

Photo: Bundeswehr

Vice-Admiral Jan Christian Kaack

(hum) The German Navy has a new *Marineinspekteur* (Chief of Naval Staff) with the appointment of Vice-Admiral Jan Christian Kaack on 11 March 2022. Born in 1962 and entering naval service in 1982, Vice-Admiral Kaack has held a number of important German and NATO command appointments in his 40-year long naval career, including command of the frigate BAYERN. Previously Commander-in-Chief of the Fleet and Support Forces and Deputy Inspector of the Navy, he assumed his new responsibilities on an acting basis in January 2022 following the resignation of the previous incumbent, Vice-Admiral Kay-Achim Schönbach. Vice-Admiral Kaack has already issued an Executive Order to the German Navy responding to the Ukrainian crisis: Not during our watch! He had 24 ships deployed in the North, the Mediterranean and the Baltic Sea. "We have brought out everything that floats. We can thus demonstrate presence in conjunction with with our NATO partners."

China's Naval Trajectory and Its Implications

James Bosbotinis

The development of the Chinese People's Liberation Army Navy (PLAN), alongside the wider rise of China, provides a defining feature of the evolving strategic environment, and one that will continue to be a significant shaping influence over the long-term.

The dramatic growth of the Chinese economy over the past four decades, driven by the policy of "opening up", has transformed China into the world's second-largest economy and the largest trading nation. Moreover, China is dependent on the global maritime trading system for its economic prosperity. As Toshi Yoshihara and James R. Holmes highlight in *Red Star over the Pacific*, 90 percent of China's imports and 85 percent of its exports, by value, are carried by sea, accompanied by expanding overseas interests, most vividly highlighted by the Belt and Road Initiative, including the Maritime Silk Road.

The evolving nature of the Chinese economy has significant strategic implications, including in terms of naval force development and strategy, illustrated by the declaration in China's 2015 defence white paper, *China's Military Strategy*, that the PLAN would shift 'its focus from "offshore waters defence" to the combination of "offshore waters defence" with "open seas protection"'. Moreover, in his 12 April 2018 speech at a PLAN Fleet Review, President Xi Jinping emphasised the importance of building a strong, world-class navy, stating that "On the journey of the new era, in the struggle to achieve the great rejuvenation of the Chinese nation, the task of building a powerful People's Navy has never been so urgent as it is today". This is reflective of a wider ambition to develop "world-class armed forces" by 2035. What are the implications for the PLAN of this ambition? How is Chinese maritime strategy evolving and what are the implications for naval force composition? Further, what are the implications of the shifting China-US naval balance of power for the wider relationship, regional and international security?

Photo: Crown Copyright

China's PLAN is growing its capacity to conduct global operations as part of a greater emphasis on "open seas protection". Here the Type 054A frigates HUANGGANG & YANGZHOU are seen transiting the English Channel.

China's Evolving Maritime Strategy

In November 2012, then-President Hu Jintao, in his report to the 18th National Congress of the Chinese Communist Party, stated that, alongside developing wider marine resources and the maritime economy, China should be built into "a maritime power". Whilst in the context of military modernisation, President Hu stated that "We should attach great importance to maritime, space and cyberspace security". The importance of seapower, broadly defined, and its implications for Chinese strategy were explained in *China's Military Strategy*: "The seas and oceans bear on the enduring peace, lasting stability and sustainable development of China. The traditional mentality that land outweighs sea must be abandoned, and great importance has to be attached to managing the seas and oceans and protecting maritime rights and interests". Thus, in order to "safeguard its national sovereignty and maritime rights and interests", China should "develop a modern maritime military force structure commensurate with its national security and development interests", be capable of protecting "the security of strategic SLOCs [sea lines of communication] and overseas interests", and provide the necessary "strategic support for building itself into a maritime power". The importance of ensuring the security of China's "maritime rights and interests" was reiterated in the 2019 defence white paper, *China's National Defense in the New Era*, which also stated that "In line with the strategic requirements of near seas defense and far seas protection, the PLAN is speeding up the transition of its tasks from defense on the near seas to protection missions on the far seas".

The authoritative textbook, *Science of Military Strategy*, an edited volume published by the National Defence University, Beijing, intended for senior People's Liberation Army officers, and most recently revised in 2020,

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Photo: US Navy

The US Navy aircraft carriers CARL VINSON (CVN-70) and ABRAHAM LINCOLN (CVN-72) pictured operating in the Pacific. China's maritime strategy envisages the acquisition of similar capabilities to project power across the far seas.

provides valuable insight into contemporary Chinese maritime thinking. The naval case is set out in the following terms: "Building a powerful modern navy is an important symbol of building a world-class military, a strategic support for building a maritime power, and an important part of realising the Chinese dream of the great rejuvenation of the Chinese nation". The connection between the need to develop China's maritime, and particularly naval forces and wider strategy is described thus: "the country is actively advancing the 'One Belt and One Road' initiative, and China's strategic interests are accelerating the expansion of the oceans and even the world, effectively safeguarding the sovereignty, security and development interests of the country's maritime direction, actively expanding the depth of maritime defense, and combating the country's maritime forces, especially the navy". Whilst the Belt and Road Initiative was founded on a principally economic rationale, as a 2019 report on *The Belt and Road Initiative: Progress, Contributions and Prospects* observes, "Without a peaceful and stable environment, it would be impossible to pursue the Belt and Road Initiative". *The Science of Military Strategy* states with regard to the development of the Chinese Navy that "the construction and development of the navy should accelerate the overall transformation and realise the historic transition from an offshore defensive navy to a long-sea defensive navy". In this context, the role of the PLAN would be to "ensure the security of the national maritime strategic channel, push the strategic defense frontier from the offshore to the open sea involving the country's survival and development interests, continuously improve the defense capabilities of the far sea, and effectively respond to security threats from the sea". Moreover, naval capability development is shifting focus from "building a mechanised navy to building an informatised and intelligent navy". In terms of naval force structure, the *Science of Military Strategy* highlights the shift in emphasis from forces configured for operations in support of "off-shore defence", that is, in the South and East China, Yellow and Bohai Seas, to "a new type of force structure centred on aircraft carrier formations and nuclear submarines".

Photo: US Navy

PLAN sailors being inspected onboard a modern frigate. China's navy is expanding both in numbers and quality.

Naval Priorities

In the ten years since the commissioning of China's first aircraft carrier LIAONING (the former Soviet VARYAG, sister ship of the Russian Navy's ADMIRAL KUZNETSOV) in September 2012, the PLAN has seen a dramatic expansion in both numbers and quality. In turn, this has resulted in a marked improvement in its ability to conduct "far seas" operations. Notable warships that have entered into service during this timescale include:

- The Type 052D LUYANG III class destroyer: approximately 25 have been commissioned thus far.
- The Type 055 RENHAI class large destroyer: classified by the United States as a cruiser; eight have been launched to date and four are currently in service.
- The Type 075 YUSHEN class amphibious assault ship: Two of these circa 40,000-tonne vessels, HAINAN, and GUANGXI, have been commissioned to date and a third ship has been launched. A Type 076 design, possibly incorporating an electromagnetic catapult launch system, may follow on from these ships.
- The Type 071 YUZHAO class amphibious transport docks: Six of these ships have been completed from 2012 onwards, joining two earlier members of the class for a total of eight.

Moreover, in December 2019, the PLAN commissioned its first indigenous designed and built carrier, SHANDONG (a modified variant of the LIANONING).

China is also investing in the construction of auxiliaries, including the Type 901 fleet replenishment ship, which will primarily support carrier operations (two are in service with more likely to be built). It has also continued to develop its force of smaller surface combatants, in particular the Type 054A

JIANGKAI II class frigate (30 in service, with more under construction) and the Type 056 JIANGDAO class corvette (22 Type 056 and 50 Type 056As are in service, completing production of the type). In February 2022, Chinese media reported that around 20 Type 056 corvettes may be transferred from the PLAN to the China Coast Guard. The ships to be transferred will reportedly be the original Type 56 variant, not the newer Type 56A with improved multi-mission capabilities. The rapid development of China's surface combatant force and shift away from a focus on coastal defence to blue-water capabilities, and with it, the opportunity to strengthen at low cost, the China Coast Guard, likely underpins the decision to transfer the ships.

China's submarine forces have also seen significant improvements, in particular with the commissioning of six Type 094 JIN class nuclear-powered ballistic missile submarines (SSBNs), four Type 093A SHANG class nuclear-powered attack submarines (SSNs), and the diesel-electric Type 039A/B YUAN class boats (the US Department of Defense's 2021 annual report on *Military and Security Developments Involving the People's Republic of China* states 17 of a planned total of 25 YUAN class boats have entered service). An unmanned underwater vehicle, the HSU001, was publicly revealed at the National Day Parade marking the 70th anniversary of the founding of the People's Republic of China on 1 October 2019; its role was not disclosed. The HSU001 reflects China's wider investment and interest in undersea warfare, and an area that is likely to see significant progress through the course of the 2020s, in particular as the next-generation Type 095 SSN and Type 096 SSBN begin entering service.

As the 2019 defence white paper, *China's National Defense in the New Era*, highlights, the priorities for naval modernisation are: "improving its capabilities for strategic deterrence and counterattack, maritime manoeuvre operations, maritime joint operations, comprehensive defense, and integrated support". The implications for force composition are, as the *Science of Military Strategy* explains: 'the development of aircraft carriers, large destroyers, strategic nuclear submarines, large ocean-going supply ships, long-range carrier-based aircraft, etc. will become an important trend in the construction of naval equipment'. These priorities are reflected in Chinese naval procurement, as discussed above, and as seen in current construction. Perhaps the most significant expression of China's naval ambition is the building of the new Type 003 aircraft carrier, currently underway at the Jiangnan Shipyard, Shanghai.

Photo: Conrad Waters

The PLAN has commissioned eight Type 071 amphibious transport docks – this is CHANGBAI SHAN – as part of its strategy of naval expansion.

Photo: Conrad Waters

China's PLAN is expanding support assets to extend its global reach. This is the Type 903 replenishment ship CHAOHU; larger Type 901 combat support ships have also been acquired.

Photo: US Navy

The Type 054A frigate YUEYANG. Since 2008, China has used frigates of this class as part of task groups maintaining a regular naval deployment in the Indian Ocean.

Photo: US Navy

The PLAN warships QINGDAO and LINYI exercising with a US Navy cruiser in the Pacific in 2013. Over the past decade, the PLAN has undergone a transformative period of improvement, becoming the US Navy's major rival.

The Type 003 will provide a step change in capability; it will be China's first catapult-equipped carrier (employing an electromagnetic catapult system), providing a much-enhanced capability compared to the ski-jump-equipped LIAONING and SHANDONG. The ship will also be the largest aircraft carrier built outside of the United States, displacing in excess of 80,000 tonnes, and comparable in size to the US Navy's FORD (CVN-78) class. It will be conventionally-powered. The Type 003 will be capable of embarking an air-group comparable in numbers to that of a US carrier, with the air-group likely comprising initially a mix principally of J-15B and J- 35 fighters, the KJ-600 airborne early warning and control aircraft, helicopters, and unmanned air systems (such as the CH-7 or HK-5000G). The Type 003 is likely to be launched in 2022 and enter service in 2024. The *Science of Military Strategy* highlights the growing importance of Unmanned Air Systems (UAS), in particular due to their "high performance, miniaturisation, stealth, and strong attack capabilities", with long-range, wide area reconnaissance, and long-range precision strike seen as key roles. The *Science of Military Strategy* adds that the deployment of carrier-based UAS "will bring revolutionary changes" to naval operations.

It is likely that China will build further large aircraft carriers, either of the Type 003 and/or a follow-on nuclear-powered design. It has not been publicly disclosed how many carriers China intends to build, but given China's global interests, dependence on the maritime trading system and the importance of the Maritime Silk Road, an eventual force of at least six ships is likely, in order to enable a regular carrier presence in both the Western Pacific, the Indian Ocean and potentially beyond. The development of China's carrier force, alongside its amphibious forces, centred on the Type 075 amphibious assault ship, together with the Type 052D and especially the Type 055 multi-role surface combatants (both classes are equipped with vertical launch systems for anti-air, anti-surface, anti-submarine and land-attack missiles, advanced radar, and other sensors), as well as the Type 095 SSN, will provide Beijing with a credible maritime force capable of protecting and projecting Chinese interests globally. Since 2008, China has maintained a regular naval deployment to the Indian Ocean for counter-piracy operations off Somalia, conducted non-combatant evacuation operations in 2011 and 2015 from Libya and Yemen respectively, and opened its first overseas base in Djibouti in 2017. It will likely continue to expand its overseas presence, including establishing new bases; the United States has stated China attempted to establish a base in the UAE, and is looking at Cambodia and Equatorial Guinea as options.

The Evolving China-US Naval Balance and its Implications

As China-US competition evolves and intensifies, the naval balance of power will become of increasing significance. In contrast to the US-Soviet rivalry of the Cold War, which was concentrated on the East-West divide in Europe, the focus for China-US competition is inevitably on maritime East Asia. The PLAN is now the world's largest navy and expected to attain qualitative parity with the US Navy by the early 2030s, and given United States' interests in the region, including the presence of allies such as Australia, Japan and South Korea, maintaining a favourable balance of power will be a priority. In this respect, it is likely that agreements such as the recently announced AUKUS will be developed as part of US-led efforts to ensure the balance of power in the Indo-Pacific remains tilted to its advantage. For China, ensuring sea control in its near seas – the South and East China, Yellow and Bohai Seas – is critical, as well as the security of its overseas interests and maritime communications. The development of the AUKUS security partnership is likely to prompt further Chinese investment in enhancing, particularly, its anti-submarine warfare capabilities.

In this respect, China and the US face a common challenge: ensuring that the naval balance in East Asia does not shift in favour of the other, whilst also protecting their respective global interests. For the US, the role of allies, both in East Asia (especially Japan) and Europe, will be central to balancing the competing requirements of maintaining presence in Europe (particularly due to the growing Russian threat), the Middle East, and East Asia. For China, continuing to develop overseas basing arrangements and its navy will be central to securing its global maritime trading interests.

China's naval development, centred on the creation of carrier task groups, potent amphibious forces, supported by a growing auxiliary fleet, will enable China to project maritime power globally. The 2021 report on *Military and Security Developments Involving the People's Republic of China* estimates that the PLAN, currently comprising 355 'battle force' ships, will grow to 460 ships by 2030. Ultimately, whilst the planned overall size of the PLAN has not been publicly disclosed, it is likely that it will be a substantial force, designed both for operations in East Asia and globally. China, currently the world's second largest economy, and likely to surpass the US by the late 2020s/early 2030s, with extensive global interests, and dependent on the maritime trading system for its prosperity, will develop a navy commensurate with that status. As one of two superpowers alongside the US, the size and capability of the PLAN will be of a significant factor in the evolving strategic system, with the US-China naval balance of power a central feature of the bipolar relationship. ■

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The AUKUS Security Partnership: An American Perspective

Sidney E. Dean

The announcement of the new AUKUS Security Partnership was one of the most important maritime security developments of 2021. Following on from the viewpoint from Australian shores provided by Peter Layton in our last edition, MDM asked Sidney E. Dean, Mittler's regional correspondent in North America, to provide an American perspective on the new partnership.

Canberra, London and Washington formally announced the new Australia – United Kingdom – United States enhanced security partnership agreement on 15 September 2021. Generally referred to as AUKUS, the three longstanding allies' new agreement is a major strategic development. It must be viewed first and foremost in the greater context of regional tensions between the People's Republic of China (PRC) and its neighbours, and particularly between the PRC and the United States.

The Joint Leaders Statement on AUKUS issued on 15 September, 2021, emphasised the goal of updating and enhancing the three nations' ability to jointly meet "the challenges of the 21st Century." The partners commit to significantly deepen cooperation. Elements of this initiative include enhanced information and technology sharing, as well as deeper integration of security and defence-related science, technology, industrial bases, and supply chains. The agreement's core focus is the development of enhanced military capability of the partners. The most prominent initiative commits the parties to support Australia's acquisition of nuclear-powered, conventionally armed attack submarines at the earliest possible date. "The development of Australia's nuclear-powered submarines would be a joint endeavour between the three nations, with a focus on interoperability, commonality, and mutual benefit," reads the Joint Leaders Statement.

Additional goals of AUKUS include deepening cooperation regarding cyber capabilities, artificial intelligence, quantum technologies, and additional undersea capabilities. While the attack submarine has received the most public interest, the significance of the remaining competencies should not be underestimated.

Photo: Australian Department of Defence

US Marines training onboard the Royal Australian Navy's CANBERRA during Exercise Talisman Sabre 2021. Although the AUKUS partnership's most prominent initiative relates to nuclear-powered submarines, the significance of the agreement's wider security impact should not be underestimated.

The AUKUS Agreement

From a technology standpoint, Australia is the primary beneficiary. For the first time since the 1950s, the United States and the United Kingdom will share atomic propulsion technology with a third partner, making Australia just the seventh nation in the world capable of deploying nuclear submarines. The current plan calls for the Royal Australian Navy (RAN) to replace its six COLLINS class diesel-electric attack submarines with a minimum of eight nuclear-powered boats. In addition to the submarines, AUKUS will also provide Canberra with long-range missiles including hypersonic missiles, sea-launched TOMAHAWK cruise missiles (for HOBART class destroyers), air-launched anti-ship missiles, and unmanned underwater vehicles. Further technology transfers are intended.

Joint research and development as well as information sharing in such vital fields as cyber warfare, artificial intelligence, and quantum computing are further capabilities Australia is eager to pursue under the AUKUS framework. Canberra also hopes to further develop its defence and technology manufacturing base through the agreement.

Implementation of the agreement lies with two trilateral joint steering groups, one for Advanced Capabilities and one for Australia's Nuclear-Powered Submarine programme. The initial bureaucratic focus at this point is to design an architecture governing how the partners will work more proactively on defence and on developing harmonised perspectives and

Photo: US Navy

Australian, American and South Korean sailors pictured aboard the lead Australian HOBART Class destroyers. Under AUKUS, the RAN will receive TOMAHAWK cruise missiles for the HOBART class.

positions regarding the Indian Ocean/Pacific Ocean (Indo-Pac) region. This will require frequent and regular virtual and physical interaction between defence and diplomatic staffs (as well as other relevant personnel providing economic and scientific input) from all three countries. The allies have given themselves 18 months (counting from September 2021) to conduct this preparatory phase to establish the framework for implementing the agreement.

Enhanced Australian-UK-US Interoperability and Partnership

Technology transfer aside, enhanced interoperability is another key aspect of the agreement. While Australia's deeper integration into the American strategic system forms the core focus of AUKUS, the United Kingdom also continues to increase its focus on the Indo-Pacific region. The US welcomes this development because "we want to extend this overall engagement with Europe about Asia," said Kurt Campbell, Asia-Pacific Coordinator on the US National Security Council. Campbell classified AUKUS as a remarkable new phase of allied partnership. In particular, he predicted "almost a melding of our services" between the naval forces of the three allies. "We will have more British sailors serving on our naval vessels, Australians and the like on more of our forward-deployed assets in Australia. This leads to a deeper interconnection and, almost a melding in the new respects of our services and working together on common purpose that we couldn't have dreamed about five or 10 years ago," Campbell said during a November 2021 event at the Washington DC based US Institute of Peace.

This builds on an established framework of defence technology transfers and, more recently, a rotational presence of American forces in northern Australia. While modest in numbers, this decade-long presence permits US fast reaction units – primarily US Marine Corps (USMC) units – to preposition for quick deployment in the greater Southeast Asian region. American naval vessels and strategic bombers also practice staging out of Australia. Washington has signalled a desire to double to size of the USMC rotations to potentially 5,000 Marines at any time. Simultaneously, berthing facilities for visiting US Navy vessels are being expanded, as are pre-positioned stockpiles of US military equipment. As early as 2018 the US and Australia announced plans to jointly develop a naval base on Manus Island in northern Papua-New Guinea. Taken together, these developments will facilitate any future deployment of larger US formations from Australia in case of a future conflict with China.

Upgrading Australian Submarine Capabilities

AUKUS will directly enhance Australian military capabilities, especially in the context of a major-power confrontation. The most prominent aspect of AUKUS is the provision of nuclear powered attack submarines.

The actual design of the new Australian submarine is yet to be determined. In November 2021 Vice Admiral Jonathan Mead, Head of Australia's nuclear submarine task force, told the Australian Senate that the Defence Department intends to select a mature design based on an active production line. This would effectively limit options to either the US Navy's VIRGINIA (SSN-774) class or the Royal Navy's ASTUTE class. Advantages of the VIRGINIA class would include a larger payload and access to the more extensive US Navy logistics and support system. The British submarine, being smaller and requiring a smaller crew, would likely be cheaper, and easier to integrate into the RAN. THE ASTUTE class also uses an older reactor design. "It's fairly straightforward and doesn't get into really sensitive nuclear engineering stuff," said Heritage Foundation's naval technology expert Brent Sadler. A retired US Navy engineering officer, Sadler postulated in November that the ASTUTE class may be

Photo: Australian Department of Defence

Enhanced interoperability across all domains is a major aim of AUKUS. Here Royal Australian Air Force aircraft fly alongside a United States Air Force B-52H STRATOFORTRESS aircraft.

Photo: Australian Department of Defence

A United States Marine Corps MV-22 OSPREY performs deck landing training, onboard Australia's CANBERRA in the Timor Sea. Washington has signalled a desire to double to size of the USMC rotations to Australian base facilities.

the leading contender, and that this may have been the primary reason for inclusion of the UK in the partnership.

While the details of the new Australian attack submarines are to be determined, the advantages of nuclear propulsion are well known. Nuclear submarines are considered the most survivable weapon in any future conflict with the PRC. The vessels can dive deeper than conventional submarines, and sustain greater speeds. They purify their own water and air, which permits them to remain submerged until food needs to be replenished (typically every three months). This ability to remain undetected is especially vital when submarines are tasked with shadowing high-value opposing forces such as aircraft carriers or strategic submarines, or remaining on station for prolonged periods. Specifically, the boats could operate undetected in the South China Sea; by contrast, aircraft and surface ships will have to contend with the Chinese anti-access/area-denial belt formed by a chain of small, militarised islands and reefs along that sea's eastern and southern rim.

Another advantage is payload, which, however, can vary widely among submarine types. US Navy VIRGINIA class boats can carry, depending on configuration, between 12 and 40 TOMAHAWK silo-launched cruise missiles as well as 25 tube-launched torpedoes. The ASTUTE class, by contrast, has an arsenal of 38 weapons (TOMAHAWKs and torpedoes combined) all of which are fired through the torpedo tubes. By comparison, the RAN's current COLLINS class carries only 22 weapons (a mix of torpedoes and HARPOON anti-ship missiles).

Technology Transfer and Collaboration

The nuclear-powered submarine aside, the technology-cooperation and -transfer envisaged under AUKUS seems destined to transform Australia's warfighting power to qualitatively match China's technological progress and support seamless interoperability with the United States across the multi-domain spectrum. In many ways AUKUS builds upon and expands previous collaborative initiatives. In 2020 the United States and Australia agreed to jointly develop an air-breathing hypersonic cruise missile, a programme which is currently in progress. In March 2021 Australian Prime Minister Morrison announced a programme to develop an indigenous guided missile programme in collaboration with the United States. "Whether it's an artificial intelligence and machine learning, cyber, other undersea warfare capabilities and quantum [computing], are all very important capabilities for Australia to develop high-level capacities in, and we cannot do this on our own," Canberra's US Ambassador, Arthur Sinodinos, said on 16 November 2021.

One day after the three nations' leaders revealed AUKUS, the US defence secretary and his Australian counterpart presented a new agreement between the US National Reconnaissance Office (NRO) intelligence service and Australia's defence department. The agreement would cover a "broad range of satellite activities," said Australian Defence Minister, Peter Dutton, on 16 September, 2021.

Overall military and civilian space cooperation is also intensifying and evolving. A joint space launch facility in southern Australia is under consideration. "There may be future architectures for some mission area [where] we get together as allies and say, you know, we'll concentrate on this piece here in the United States, and maybe the UK agrees to concentrate on this piece, and Australia concentrates on this piece. And together we bring an integrated by design architecture forward," said Lt. General John Shaw, Deputy Head of the US Space Command, during a November 2021 aeronautics conference. During the same event Lt. General Nina Armagno, US Space Force Staff Direc-

Photo: US Navy

The US Navy's VIRGINIA (SSN-774) class is one potential contender for the Royal Australian Navy's revised future submarine programme.

tor, discussed ongoing cooperative development efforts. "Today, we're talking about getting together from concept, from design and working together on future capabilities and projects," she said. These efforts build on a Memorandum of Understanding signed in 2014 with ten nations including the UK and Australia, to collaborate on "burgeoning science and technology" to enhance "responsive space capabilities," she said. Partnership with Australia is of special value for the US' space situational awareness programme, as the Pentagon has few options for radar and space surveillance facilities in the southern hemisphere.

Strategic Partner in the Indo-Pac Region

For the past decade the United States has identified China as the premier strategic competitor, even before Russia. AUKUS represents a major step forward in developing a potent geopolitical and military counterweight to the PRC's coercive regional policies. The rapid quantitative and qualitative growth of China's armed forces, coupled with the US armed forces' global commitments, make the United States dependent on regional and/or global allies for any effective peacetime or wartime strategy vis-a-vis Beijing. "Fundamentally, it leads to what we believe is going to be the most essential feature of an effective strategy in the Indo-Pacific, and that's deeper cooperation with allies and partners," Kurt Campbell said in November 2021. "These tasks ahead in the Indo-Pacific we cannot take on alone. We must get on in partnership. "While the AUKUS parties stress their desire for cooperative relations with the PRC, all simultaneously make no secret that the agreement is a response to China's coercive regional policies.

US Defense Secretary Lloyd Austin made the focus on China clear during the 16 September, 2021 press conference with his Australian counterpart. "We spoke in detail about China's destabilising activities and Beijing's efforts to coerce and intimidate other countries, contrary to established rules and norms. While we seek a constructive, results-oriented relationship with the PRC … we will remain clear-eyed in our view of Beijing's efforts to undermine the established international order." The US Chief of Naval Operations, Admiral Mike Gilday classified AUKUS as a "brilliant stroke with respect to our posture in the Pacific, particularly vis-a-vis China," while the Head of the United States Indo-Pacific Command, Admiral John Aquilino, stated that AUKUS was motivated by Australian concerns regarding China.

Photo: Crown Copyright

The British ASTUTE class design – AMBUSH is seen here – might be a relative easy and cost-effective design to integrate into Royal Australian Navy service.

Ambassador Sinodinos echoed such assessments during a 9 November 2021 Hudson Institute virtual forum on AUKUS. He underscored Canberra's commitment to a rules-based international order, citing an obligation for Australia and other democracies to "preserve [and] protect the sovereignty of all states in the region." He directly referenced the need to demonstrate to China that it could not "throw [its] weight around" in disputes with smaller nations. AUKUS will enable Australia to project power further from its own shores, provide new ways to shape the security environment, and (in conjunction with allies) help the nation to deter Chinese aggression. Australian Defence Minister Dutton went a step further in a 13 November 2021 interview with The Australian newspaper, in which he implied a willingness to support the United States in a war against China. It would be "inconceivable that we wouldn't support the US in an action if the US chose to take that action," Dutton said, referring to a potential US intervention to defend Taiwan from a Chinese attack.

The combination of enhanced capabilities and a closer position within the US strategic orbit will also boost Australian security vis-a-vis the PRC. AUKUS underscores Washington's role as guarantor of Australian security, which can only encourage Canberra to continue its own regional efforts to support democracy and the rule of law.

Photo: Australian Department of Defence

The Australian frigate WARRAMUNGA rendezvous with the United States Navy aircraft carrier CARL VINSON (CVN-70) during a Regional Presence Deployment.

Photo: Australian Department of Defence

The Australian frigate ANZAC pictured conducting office of the watch manoeuvres with Indonesian Navy vessels. AUKUS underscores Washington's role as guarantor of Australian security, which can only encourage Canberra's own regional efforts to support democracy and the rule of law.

Moving Forward

As it stands, the AUKUS programme's implementation is still at a very early stage. Many specifics have yet to be determined. Both trilateral joint steering groups met for the first time in December 2021 in the Pentagon to outline the next steps in the implementation process.

According to a US government press release, the Advanced Capabilities steering group identified opportunities for collaboration on a range of critical capabilities and technologies, and committed to significantly deepen cooperation and enhance interoperability. In particular, participants committed to finalising a programme of work in relation to advanced capabilities by early 2022.

The second steering group, meeting on Australia's Nuclear-Powered Submarine programme, agreed on detailed elements of the 18 month review which will ultimately determine the actions necessary to establish a viable pathway to establishing Canberra's submarine procurement programme. Challenges which have already been identified include current capacity limitations in the Australian shipbuilding industry and the lack of a nuclear engineering work force.

Legal and bureaucratic hurdles must also be overcome. The transfer of sensitive US nuclear technology to a foreign nation will require the approval of the United States Congress. The Biden administration formally submitted the requisite "Agreement among Australia, the United Kingdom, and the United States for the Exchange of Naval Nuclear Propulsion Information" on 1 December 2021 for Congressional consideration. The document was formally signed on 22 November, 2021. The agreement must also be approved by the Australian parliament.

Once ratified by all parties, the agreement will remain in force until December 31, 2023, after which it will "automatically extend for four additional periods of six months each." Any party may terminate its participation in the agreement with six months written notice, but may be required by the other parties to return or destroy any transferred data.

One caveat regarding AUKUS is the long lead-time for actually constructing and fielding new submarines. Even taking over either the ASTUTE or VIRGINIA class design without changes would likely require at least a decade between keel laying and commissioning of the first boat, with additional years before full operational capability. Given the perceived urgency of the China threat, introducing the new submarine class in the mid-2030s might well be too late. An interim solution advocated by Australian and American naval experts would be the lease or purchase of older US Navy LOS ANGELES (SSN-688) class submarines or British TRAFALGAR class boats to fill the capabilities gap. "The peril is not far off," former Australian Prime Minister Tony Abbott stated in October 2021 in reference to the possibility of war with China. "Australia needs bigger, better submarines now, not two decades from now," he stated. Such a solution would also permit the RAN to develop fully-trained nuclear-qualified crews. One possible solution – implied by statements by US and Australian officials – would be mixed manning, with US or British personnel joining Australian crews, and some Australian personnel serving aboard allied vessels.

Fortunately, AUKUS extends far beyond the nuclear submarine project. Other technology transfers could be implemented much more quickly to enhance RAN and Royal Australian Air Force capabilities. While details are still being studied, many strategic experts suggest equipping Australia with advanced fixed and mobile undersea sensors to monitor chokepoints and larger ocean areas; medium and large unmanned underwater vessels capable of conducting reconnaissance and surveillance missions as well as deploying mines and torpedoes; and additional long-endurance UAVs for armed maritime patrols. Such systems are either in production or nearing service, and could be quickly deployed as force multipliers. ■

Status Report: Naval Programmes in the Persian Gulf

Conrad Waters

Ongoing instability in the Persian Gulf has meant that the region has remained a hotspot for security spending. Whilst naval programmes have tended to be accorded a lower priority than many other defence requirements, the market has proved to be a lucrative one for European and US-based shipyards. However, the emergence of new market entrants and a slow but steady focus on expanding local industrial capabilities looks set to shift this dynamic over the medium term. This brief review looks at naval procurement outside of the essentially closed market of Iran. It focuses on the trio of leading regional naval powers: the Royal Saudi Naval Forces, the United Arab Emirates Navy and the rapidly expanding Qatar Emiri Naval Forces.

Saudi Arabia

Although Saudi Arabia has by the far the largest security budget in the broader Middle Eastern region, the requirements of the Royal Saudi Naval Forces have typically ranked behind those of the other branches of the military in determining spending priorities. Naval force structure has also been further complicated by the country's geography and the need to protect fairly long – and separated – coastlines along both the Red Sea and the Persian Gulf. This has resulted in the need to maintain two distinct fleets: the Western Fleet based in Jeddah and the Eastern Fleet focused on Al-Jubail. In general terms, the Western Fleet has historically sourced its major warships from France's Naval Group, whilst the Persian Gulf-based Eastern Fleet has relied heavily on American built-equipment.

In spite of their relatively low priority for the country's defence resources, the Royal Saudi Naval Forces are still anticipated to dominate naval procurement in the Persian Gulf over the next two decades. Total investment of circa US$10Bn is anticipated on warship construction alone – around 40% of the regional total – according to estimates produced by respected consultancy AMI International. If anything, this could be an understatement. [1] Moreover, with significant sums expended on recapitalising the Western Fleet shortly after the turn of the Millennium, it is the somewhat elderly force currently maintained in the Gulf that will likely be the prime beneficiary of this spending.

The modernisation of the Eastern Fleet – sometimes referred to as the Saudi Naval Expansion Programme II (SNEP II) – reportedly has two major components. One is the acquisition of four Lockheed Martin-designed Multi-Mission Surface Combatants (MMSCs), upgraded derivatives of the FREEDOM (LCS-1) littoral combat ship variant. Finalised by the previous American Trump administration, the deal is being managed under the United States' Foreign Military Sales programme. Substantial awards for design support and long lead items in the course of 2018 were followed by the conclusion of a US$2Bn construction contract in December 2019. Of this, US$1.3Bn was destined to Fincantieri Marinette Marine, the vessels' actual builders. Steel-cutting for the first vessel – to be named SAUD – actually took place two months earlier in October 2019. Work on the second unit commenced early in 2021. Deliveries are anticipated to take place from mid-2023 onwards.

Photo: US Navy

Saudi Arabia's Multi Mission Surface Combatants are being built by Fincantieri Marinette Marine alongside FREEDOM (LCS-1) variant littoral combat ships – pictured here – from which design they have been adapted.

Photo: Navantia

The lead Saudi Arabian AL-JUBAIL class corvette pictured on initial sea trials in 2021.

Described by Lockheed Martin as "… a lethal and highly manoeuvrable multi-mission surface combatant capable of littoral and open ocean operation…", the MMSC essentially swaps out some of the modularity associated with the FREEDOM class's 118 metre hull to provide a more potent core armament. Fundamental to this is the installation of an eight cell Mk 41 Vertical Launch System (VLS) for quad-packed Evolved Sea Sparrow Missiles (ESSM). Other armament includes a 57mm gun, SeaRAM, over the horizon surface-to-surface missiles and an embarked MH-60R helicopter. The MMSC also utilises the COMBATSS-21 combat management system, which benefits from the AEGIS combat system's software library. The propulsion system is the same as that used in the FREEDOM class, providing a range of 5,000 nautical miles and a maximum speed in excess of 30 knots.

The quartet of MMSCs will be supplemented by five AVANTE 2200 corvettes ordered from Spanish shipbuilder Navantia under a €1.8Bn (c. US$2.1Bn) contract announced in July 2018 after three years of negotiations. With a length of 104 metres, these are slightly enlarged variants of the four GUAIQUERÍ class offshore patrol vessels previously sold to Venezuela and are equipped to the design's more capable "combatant" standard. Much of the electronic outfit – including the CATIZ combat management system – originates from Navantia. However, there is some commonality, for example with respect to specification of the Mk 41 VLS – with the MMSCs. The ships are equipped with an all-diesel propulsion system, providing a top speed in the order of 27 knots.

Construction of the lead ship, named AL-JUBAIL, commenced in January 2019. She was launched in July 2020 and commenced sea trials in September 2021 prior to her anticipated delivery in the first quarter of 2022. All the other members of the class are now in the water following the launch of the fifth and final ship, UNAYZAH, on 4 December 2021. Statements when the contract was first announced suggested that the entire programme would be completed by the end of 2022. However, progress appears to have been impacted by the pandemic. Current plans envisage UNAYZAH's delivery in Spain during August 2023 prior to the completion of final outfitting in Saudi Arabia in early 2024. Interestingly, recent Navantia press releases state that maintenance of the ships' systems will be conducted at the Western Fleet's Jeddah naval base. Whilst this might indicate that at least some of the class will be assigned to Red Sea operations, lack of infrastructure for such large vessels at the Al-Jubail base might be an alternative explanation.

Although Saudi Arabia has historically relied entirely on overseas construction to meet its naval needs, Saudi Arabian Military Industries has benefitted from technological transfers agreed under the Navantia programme as part of efforts to "onshore" at least half of military spending under the Saudi Vision 2030 strategic framework. Another example of this approach has been the April 2018 agreement with France's CMN that encompasses the purchase of 39 of the company's 32 metre HSI32 fast interceptors for Royal Saudi Naval Forces' service. Eighteen of these craft will be assembled by Zamil Offshore Services at its shipyard in Dammam. In October 2020, the facility launched its lead, locally-made HSI32, the first Saudi Arabian naval vessel to be completed "in country". Whilst a comparatively modest start, the event was

another notable step in the gradual process of indigenisation that is likely to have a major long term impact on the country's future naval procurement. [2]

United Arab Emirates

The United Arab Emirates (UAE) is somewhat further along the path towards naval indigenisation. This process gained traction with transfer of technology arrangements agreed as a part of major procurement contracts concluded with French and Italian yards early in the Millennium and has subsequently seen a growing amount of naval construction allocated to domestic industry. Locally-based Abu Dhabi Ship Building (ADSB) is becoming increasingly central to this indigenisation process.

It is France's naval sector that has been the United Arab Emirates Navy's main overseas supplier in recent years. This position was established in late 2003 with the conclusion of negotiations to acquire six BAYNUNAH class corvettes from a consortium that combined France's CMN with ADSB. Described at the time as the Gulf region's most ambitious naval programme, the project went through a number of design iterations – and consequent delivery delays – but eventually saw all six vessels delivered between 2011 and 2017. Notably, five of these ships were completed by ADSB, providing the infrastructure and technological base for further major warship construction. Roughly contemporaneous with these deliveries were those of the sole ABU DHABI class corvette and pair of FALAJ 2 patrol vessels ordered from Fincantieri. Although all these three ships were built in Italy, the contracts contained further transfer of technology provisions, including options for additional vessels to be built in the UAE.

Photo: Fincantieri

The United Arab Emirates' FALAJ 2 patrol vessels – SALAHAH is seen here - were built in Italy by Fincantieri but the following FALAJ 3 class will be constructed locally.

The foundations laid by these programmes are reflected in the current major construction contracts that are now underway. The most advanced of these is that for GOWIND type corvettes ordered from France's Naval Group in 2019. Two of these are being built at the group's facility at Lorient, from where the lead vessel – BANI YAS – was floated out in December 2021. Displacing in the region of 2,800 tonnes, these 102-metre vessels will be the largest in the UAE Navy. A broad range of weaponry will be largely compatible with that previously used to equip the BAYNUNAH class, all controlled by a Naval Group SETIS combat management system. Statements when the deal was initially under negotiation envisaged construction "…in partnership with ADSB…" but the company's exact role in the contract is unclear. However, the deal includes two optional vessels that could be built in the Emirates. If this materialises, they would mark a further step forward for the local naval industry.

In the meantime, ADSB is focused on the new FALAJ 3 programme for four, heavily-armed offshore patrol vessels. The contract – valued at close to US$1Bn – was announced in May 2021 and is described as the largest ever order received by the company. To date, few technical details have been provided on the new 60 metre ships. However, in an interesting development, it has emerged that Singapore's ST Engineering will provide technical assistance with the basic, detailed and production design services for the vessels, which will be based on the Republic of Singapore Navy's FEARLESS class. ST Engineering has previously built patrol vessels for

Photo: Bruno Huriet

The United Arab Emirates' lead GOWIND type corvette BANI YAS is pictured here being fitted out at Naval Group's Lorient facility.

Photo: Fincantieri

Qatar's third air defence corvette AL KHOR was launched in September 2021.

Oman based on the FEARLESS design and this new award suggests that the European and American groups that have previously dominated the region can no longer take their market position for granted.

It is also worth noting that ADSB has gained expertise in building a wide range of smaller warships, including the 24 GHANNATHA fast troop transports developed in conjunction with Swede Ship Marine, as well as landing craft and small patrol boats. The company has gained some success exporting these vessels to other countries in the Gulf region in another indication of the complex and competitive nature of the local market for naval construction.

Qatar

It is possible that the rapid expansion of the Qatar Emiri Naval Forces has been the most significant development in Persian Gulf naval procurement in recent years. Previously something of an "also ran" amongst regional fleets, the navy is being transformed as a result of a major procurement programme valued at circa €4Bn (circa US$4.5Bn) that was concluded with Fincantieri in 2016. Probably owing as much to the tensions with fellow members of the Gulf Cooperation Council as to any fear of threats from outside the Arab world, actual realisation of the project inevitably represents a major challenge for a country with fewer than half a million citizens (excluding expatriates).

The seven ship programme has three major components: four air defence corvettes, two offshore patrol vessels and an amphibious transport dock. Completion of the AL ZUBARAH class corvettes is most advanced, with the lead ship being formally handed over at a ceremony at Fincantieri's Muggiano facility near La Spezia in October 2021. The three other members of the class are all in the course of construction, with the third – named AL KHOR – being launched at the end of the previous month. The circa 107 metre long vessel will be capable of achieving speeds of up to 28 knots from a CODAD power plant. A powerful multi-mission armament includes ASTER area defence missiles controlled by an active phased array radar, whilst provision is made for a hangar and flight deck large enough to house a medium-sized helicopter.

Good progress has also been made with the MUSHERIB class patrol vessels following the launch of the second member of the class in June 2021 and delivery of the first in January 2022.. With an overall length of some 64 metres and a top speed of around 30 knots, the ships have a heavy gun and missile armament that aligns them more closely to a fast attack craft type than their official designation. June 2021 also saw work commence on the final ship in the contract, a circa 9,000 tonne LHD based on the Algerian KALAAT BÉNI ABBÈS. Like the air defence corvettes, the vessel will be armed with ASTER surface-to-air missiles, adding an extra dimension to her amphibious capabilities.

Construction of the new ships has been accompanied by a major effort to provide the appropriate logistical and training infrastructure needed to support such a major expansion. This has included investment in a new Qatar Emiri Naval Forces Base as part of the larger 26.5km² New Port Project at Umm Al Houl. The new base is ultimately to encompass around 200 separate buildings, a helicopter airfield and accommodation for 4,000 personnel. Two specialised training vessels are also being acquired from Turkey's Anadolu Shipyard to help meet the new training burden. The lead ship – Al DOHA – was delivered in August 2021 and her sister will follow during 2022. Qatar is also scheduled to receive a variety of landing craft from the Turkish company. Turkey's naval sector is another emerging player in the region's naval procurement market, with the country's ARES Shipyard a major supplier of patrol craft for the Qatari Coast Guard.

Other Regional Navies

The region's other navies present a somewhat eclectic mix so far as procurement is concerned. At the entrance to the Gulf, Oman possesses an effective and modern fleet that has undergone a major period of renewal over the last decade. The United Kingdom – its traditional supplier – provided the three large BAE Systems-built KHAREEF class corvettes as part of this programme but the completion of four

smaller AL-OFOUQ class patrol vessels by ST Engineering showed the growing influence of alternative suppliers. Other recent acquisitions have included a pair of Al MUBSHIR class high speed transports from Austal, as well as ARES Shipyard-supplied HERCULES fast patrol craft for the Royal Oman Police Coast Guard. Given the relative youth of much of the Royal Oman Navy's current fleet line up, further major acquisitions seem unlikely in the immediate future.

The smaller regional fleets – those of Bahrain, Kuwait and Iraq – generally have modest procurement ambitions that will likely focus on the acquisition of minor patrol and logistic assets, accompanied by the occasional larger purchase. A possible representation of typical future acquisition patterns was provided in early 2021, when Bahrain commissioned a flotilla of eight new vessels encompassing two new craft and six units acquired second-hand from overseas. The new ships were two 35 metre patrol vessels supplied by US builder Swiftships under the Foreign Military Sales programme, with five surplus US Navy Mk V patrol boats also of American origin. The final vessel was the former British Royal Navy offshore patrol vessel CLYDE, which has been renamed AL-ZUBARA by its new owners. Bahrain was previously reported to be looking to supplement its FFG-7 type frigate SABHA with a second member of the class but it is not clear that the deal will ultimately be concluded. The Foreign Military Sales route is likely to be a popular one for the United States' other smaller regional maritime partners. For example, the US Naval Sea Systems Command floated a request for information for a new logistic support auxiliary for Kuwait under this programme in the first half of 2021.

Photo: Conrad Waters

The three KHAREEF class corvettes built by BAE Systems for the Royal Navy of Oman – this lead ship AL SHAMIKH – form the core of an effective and modern fleet.

The Future

With Qatar, Saudi Arabia and the United Arab Emirates all in the middle of large and costly naval projects, the scope for the launch of major new warship procurement initiatives in the Persian Gulf would seem to be limited. Potential exceptions include Saudi Arabia's longer term need to update its Western Fleet and ultimate realisation of persistent rumours that Qatar – and perhaps the United Arab Emirates – intend eventually to match Iran in its ability to deploy submarines of various types

It would therefore seem likely that he bulk of new programme announcements will likely encompass smaller patrol and support shipping, at least in the immediate term. This will probably play best to the strengths of new market players, such as Turkey, who are expanding their presence in the region, as well as supporting the further development of the local shipbuilding industry. The successful emergence of local shipyards able to construct warships of increasing complexity has been one of the most notable events of the past decade and could equally be the defining trend of the decade ahead. ■

Notes

1. The AMI figures were quoted by Bob Nugent in his article 'The Balance of Power in the Persian Gulf' that appeared in MSD 2021/1. These numbers seem unlikely to include the full cost of many of the additional weapons systems, helicopters and equipment associated with Saudi Arabian naval expansion given that official US sources have estimated the total overall cost of the MMSC programme alone as over US$11Bn.
2. In addition to the HSI32 programme, there have been many reports that Saudi Arabia will take over three CMN COMBATTANTE FS56 fast attack craft initially financed by that country for the Lebanese government.

Photo: US Navy

Bahrain's second-hand offshore patrol vessel AL-ZUBARA – was the former British Royal Navy Falkland Islands guard ship CLYDE.

In Action between Land and Sea

Melf Jörn

The German Sea Battalion works closely with the Dutch Marine Corps (*Korps Mariniers*). This requires an adaptation of training, education and equipment.

Qua patet orbis (Lat.: "As far as the World Extends") is the motto of the Dutch Marine Corps, a unit established on 10 December 1665. This tradition-steeped branch of the Royal Netherlands Navy is the spearhead of the Dutch crisis response forces and claims to be able to be deployed operationally anywhere and under any circumstances. There has been plenty of evidence of this since the Corps was founded. For example, Dutch Marines have been deployed on almost all the Netherlands' military operations sinc their formation. The most recent flag ribbon of the Corps was awarded in 2020 for the deployment in "Helmand, Kandahar and Uruzgan". The Corps is led by a Brigadier General of the Marines.

Since 1973, there has been cooperation in operations and exercises with the Corps' British equivalent, the Royal Marine Commandos. This cooperation is so deep that even units and sub-units of the Dutch Marine Combat Groups (battalion equivalent) and the British Commandos are totally interchangeable, as they use the same regulations, training, communications and information systems, and their operational processes are also standardised. This cooperation resulted in the formation of the UK/NL Amphibious Forces (UK/NL AF) in 1972. The 1st or 2nd Marine Combat Group of the *Korps Mariniers* can be assigned to them in rotation. They therefore contribute to the European Multinational Maritime Force (EMMF).

Within the Dutch armed forces, the Corps specialises in amphibious operations. According to Dutch doctrine, these take place in the littoral zone, where units can operate from sea to land or vice versa.

Author

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Photo: Bw / Marcel Kroenke

A soldier ensures the advance of a kayak in shallow waters.

Photo: Schneller Adler Kraatz 131

German soldiers of the Coastal Operations Squadron on a Dutch RHIB

In modern military affairs, these operations are considered perhaps the most complex of all, requiring a high degree of cross-force, expert coordination in the three dimensions of land, sea and air with training, specialised transport, specialised logistics, means and equipment.
In addition, the Dutch Marines are also deployed in direct support of the Special Forces of the *Korps Mariniers* (Maritime Special Operations Forces). Training for this takes place worldwide in all climate zones.

Status of the Sea Bataillon

As the result of the signature of a letter of intent between the Netherlands and Germany on 4 February 2016, the German Sea Bataillon was assigned a new role. The Sea Bataillon is to be tactically integrated into the Dutch naval forces, in particular the Korps Mariniers. The Letter of Intent on the German part states that the ambition is: "...to develop a secure military sealift and amphibious capability and regard the Royal Netherlands Navy as the prime partner for this development."
The Sea Bataillon is currently divided into two seagoing boarding companies for bluewater and embargo operations and an infantry coastal operations company. Although this enables mission-specific teams to be assembled from diverse and highly specialised companies for tailor-made crisis operations and conflict prevention, these are usually only sea-based. The forces range from small squads to a platoon of about 40 marines.
According to the German Army's operational principles, however, infantrymen should generally be deployed at least in a platoon framework.
This has the following implications: the focus of the Sea Bataillon's mission will continue to be on stabilisation tasks in maritime spaces and not on a close combat deployment of the unit in the near-coastal space. This may be sufficient for the Navy's current needs in the context of operational deployments, but for amphibious operations as well as national and allied defence, the operational value of such a unit is limited.
On the one hand, missions such as boarding operations in a peer-to-peer conflict will be the exception rather than the rule, and on the other hand, in the context of national and alliance defence, every personnel resource, every training course and, above all, every operational principle, should be as standardised as possible in order to keep the regeneration capability of one's own units as high as possible. For example, there are planning assumptions in the German Armed Forces that assume casualty rates of up to 20 per cent for personnel at battalion level during a 24-hour combat day.
Due to the very high degree of specialisation of the individual companies, with the accompanying specialised training, an exchange between individual companies is currently only marginally possible, or with a significant lead time in terms of time and training.

Photo: Bw / Marcel Kroenke

Soldier of the naval battalion on the flight deck of the Dutch KAREL DOORMAN

Boarding operations are also carried out by the Korps Mariniers. However, the training for this takes place on an ad hoc basis and complements the infantry training of the Dutch Marines. In this way, it is possible to carry out all missions, both at sea and on land. The German Navy, on the other hand, trains the personnel of the companies of the Sea Bataillon continuously for their respective tasks.
For infantry operations, the German Navy has a company at its disposal that can operate in a similar fashion to the opera-

Photo: Bw / Melf Jörn

Alert Post, Joint Arctic Training, Korps Mariniers, Norway

Photo: Bw / KptLt Jörn Melf

Pathfinder Helipad COP Belize

tional principles of the *Korps Mariniers*. In this way, a sustainable support capability within the framework of German-Dutch cooperation can be provided by a reinforced naval infantry platoon. It is therefore necessary to adapt the existing structure and mission of the Sea Bataillon in line with the current security situation.

Amphibious Forces for the Bundeswehr?

Recent glimpses into the operations and missions of the Netherlands in particular, show how valuable a modern maritime infantry force can be in today's threat landscape.

Amphibious operations do not only take place in the area of highest intensity; most recently, for example, this occurred during the American attack on key positions in the Kandahar area in southern Afghanistan following the 9/11 attacks. In the recent past, various evacuation operations on the African continent (Somalia, Djibouti, Liberia, Siërra Leone and the Ivory Coast) can be added to this list. The force approach is usually an amphibious infantry unit, or at least a reinforced company.

Disaster relief operations can often be carried out with amphibious forces, as critical infrastructure may have been destroyed. For example, roads could be unusable and an operation, supported by the large transport capacity of ships and boats, could be carried out favourably by water. One example is the joint deployment of forces from the Sea Bataillon and the *Korps Mariniers* for disaster relief in the Bahamas after the devastating Hurricane Dorian.

In addition, there is no need to enter into often diplomatically complex commitments within the framework of overflight rights in order to deploy powerful task forces in international waters in advance of an emerging crisis. In this way, one's own forces can be made available quickly or enemy forces can be tied down with a minimum of resources and without diplomatic entanglements.

First Amphibious Steps

As a result of the Future Littoral Operating Concept (FLITOC) in the Netherlands and the Future Commando Force concept in the United Kingdom, efforts are currently underway to further develop existing naval forces and their operational principles, equipment, materiel and command systems in order for them to be able to successfully hold their own in future conflicts. In order to keep up with this, Germany should also take the necessary steps in terms of training, equipment and materiel, but also in terms of the conceptual landscape of our naval forces.

Thus, the training of maritime soldiers at all command levels must also be geared towards a closed combat mission. So far, the specialised training of German naval officers usually ends at the level of reinforced sub-units. Such a lack of training would be unthinkable in the career of seagoing officers.

It is necessary, especially for land-based combat units, to train their personnel in principle at least one level higher than their current area of responsibility. This is necessary in order to act in accordance with the principle of "Imission command" and to be able to react flexibly to sudden leader falls on the battlefield. Furthermore, a further build-up of security forces in the rear areas must be considered. The Navy also has a need for qualified leadership and training of its forces up to the unit level.

Equipment and materiel must follow this training in order to create interoperability at the interface between sea and land and to be able to operate seamlessly with the UK/NL AF.

However, before training, equipment and materiel can be assessed, a conceptual review of the Sea Bataillon's mission must take place. Thus, the German-Dutch cooperation has to be implemented in the context of a corresponding mission framework within the German Navy. Regulations for the Marines must be written, adapted or adopted. Operational and training plans must be set down in writing to enable the Maritime Battalion to move forward.

Germans to the Front?

The German Navy must set a clear course for this unique unit within the *Bundeswehr*. Within the German Navy, the Sea Bataillon is often regarded as a multi-tool asset. A multi-tool is a tool usually carried in the trouser pocket and is quickly at hand to carry out small and mostly provisional repairs at short notice. Professionally planned work, however, is usually carried out with much more precise, heavier, more durable and application-specific tools. So what is the German Navy's ambition and goal?

Qua patet orbis, Sea Battalion? ■

The Incoming Unmanned Naval Vessel Takeover

Peter Layton

Large, imposing warships always capture the mass media's attention. Less in the public spotlight is the accelerating rise of unmanned naval vessels.

These are the result more of push factors, the militarisation of commercially developed information technology, rather than pull factor responses to well-defined military needs. Modern naval unmanned vessel development, then, is somewhat erratic, with much experimentation underway to try to work out what it all means.

There is a further issue: the "brains" of unmanned systems are comprised of Artificial Intelligence (AI) and today's is not perfect. Contemporary AI can be fooled, is unable to use knowledge gained in one task in another, and depends for its performance on the quality of data available to process. The difficulties with AI mean that, for practical purposes, unmanned naval systems will need to work with humans to reliably produce consistent results for the foreseeable future.

In the naval domain, the US Navy (USN) leads; however China and some smaller countries are also active. For many years, mine warfare has involved Remotely Operated Vehicles, while many navies are now quickly embracing aerial drones. Leaving these uses to one side, this article focuses on surface and subsurface unmanned craft and vessels used for naval purposes. In passing, there is also considerable work underway in Norway, Japan and China concerning commercial river-going and coastal autonomous cargo ships. At some stage, this work may cross over into the naval domain.

Photo: US Navy

US Navy LITTORAL BATTLESPACE SENSING GLIDERs pictured aboard the PATHFINDER class oceanographic survey ship MAURY (T-AGS 66). Such "small unmanned things" are being increasingly used to provide persistent environmental and operational data.

Small Unmanned Things

An early use of unmanned systems has been in small devices to capture pertinent environmental and activity data. This employment is becoming more ambitious as the emerging technology starts to offer the promise of an observable and maybe transparent ocean.

The most ambitious is the US Defense Advanced Research Projects Agency's "Ocean of Things." This programme aims to provide large ocean area situational awareness through deploying thousands of small, low-cost floats to form a distributed sensor network able to collect environmental data and detect, track and identify passing ships and aircraft. The floats transmit data periodically via the Iridium satellite constellation to a shore facility. The program is aiming for an operational deployment in 2022 of some 50,000 floats performing surveillance on a 900 km by 1500 km area. The US needs such networks to be deployable into trouble spots worldwide but China is mostly concerned with its periphery, particularly the South China Sea. China is building a functionally similar network using tethered sensors and seabed hydrophone arrays. Both network concepts are making increasing use of small, long duration Autonomous Unmanned Vessels (AUVs).

American companies have developed several types of AUVs. The 4.5 metre-long TRITON Ocean Aero Intelligent AUVs are wind and solar powered, able to both sail and submerge, and capable of extended station keeping and monitoring. Rechargeable lithium-ion batteries power command and control, collision avoidance, sensor payloads and satellite communications. Their three month's endurance can include up to eight days submerged. The two metre-long SEAGLIDER AUVs – now manufactured under the Huntington Ingalls Industries umbrella – can carry various sensors for up to 10 months, over which they can

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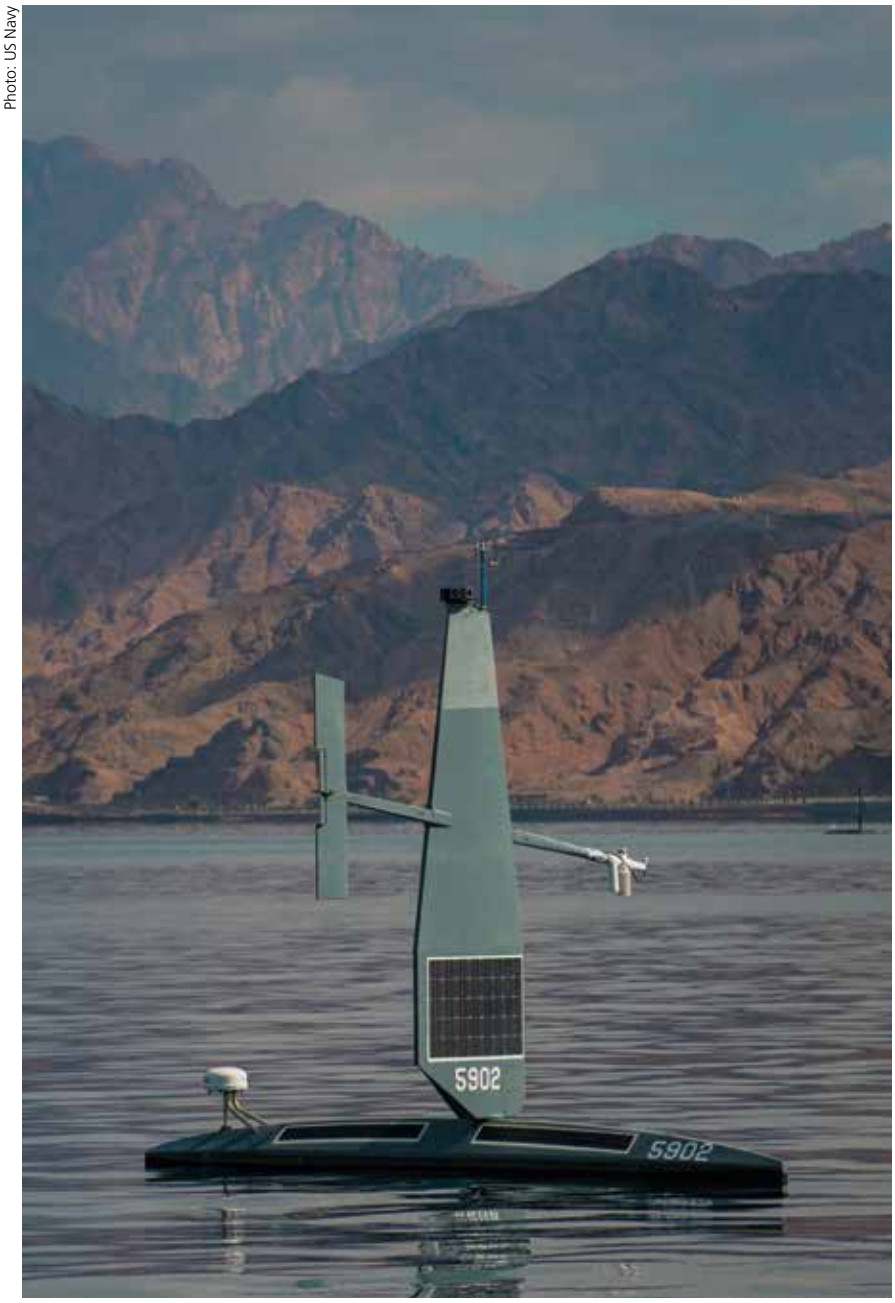
Photo: US Navy



A SAILDRONE EXPLORER unmanned surface vessel sails in the Gulf of Aqaba during International Maritime Exercise/Cutlass Express 2022.

travel 4,500 km and undertake some 650 dives to depths of 1,000 metres. The three metre-long, Liquid Robotics WAVE GLIDERs use wave and solar power to continuously acquire data from the ocean surface for up to 12 months. They can operate in fleets to create a data collection network and may be fitted with thin-line towed array sonars and electronic surveillance equipment.

In USN service, more than 100 deployed AUVs are regularly controlled from the Glider Operations Center at the Naval Oceanographic Office in Mississippi. Glider pilots can change AUV missions, plan new routes, review vehicle data profiles, compare dives and profiles of the multiple AUVs in an area, and monitor vehicle diagnostics. The Chinese government pays its fishermen if they find and hand in such AUVs; in 2018 nine were found in the East and South China Seas, in 2019 seven. A Liquid Robotics' glider found in April 2021 was declared by China Central Television to be "…a reconnaissance device secretly placed by a foreign country in China's waters."

In the Middle East, the USN's new Task Force 58 formed to trial unmanned vessels is now using a wind and solar powered SAILDRONE EXPLORER AUV in the Gulf of Aqaba for oceanographic and surveillance tasks. The intent is to experiment with integrating such AUVs with deployed manned ship operations.

China has started deploying similar AUVs across the South China Sea and into the East Indian Ocean. Some such as the HAIYI (SEA WING) appear similar to the USN's LITTORAL BATTLESPACE SENSING GLIDERs. HAIYI AUVs have been found by fisherman in Vietnam and around the Indonesian archipelago, including in straits where submarines might transit. The comparable HAIYAN (SEA SWALLOW) cruises at up to four knots, has a range of 1000 km, can operate down to 1,500 metres, and periodically surfaces to transmit data for on-shore processing and analysis. The HAIYAN X AUV is reportedly the world's deepest diving glider achieving a 10,619 metre depth in 2020.

Smaller nations are also embracing AUVs. Australian company, Ocius Technology, has developed the six metre-long, BLUEBOTTLE AUV that cruises at up to five knots; operates on solar, wave and wind power; and carries a 300 kg payload that can include thin-line sonar arrays, radar and imaging sensors. Since October 2021, four BLUEBOTTLEs have patrolled Northern Australian Indian Ocean waters fitted with a payload able to detect unauthorised vessels, alert a shore based command centre and then approach the intruder to identify it. Future concepts include several vessels acting together as a wide-area sonar array to detect submarines and a single Bluebottle acting as a 'gateway node' between underwater unmanned vessels or a seabed sensor system and shore-based control centres.

Unmanned Naval Vessels

The USN is undertaking extensive experimentation with unmanned naval vessels. These activities are focussed on competing with China and aim to improve existing combat practices, principally through building a more distributed fleet architecture. China is now steadily out-building the US in numbers of warships and submarines, making increasing the USN's size in an affordable manner important. Compared to the current fleet architecture, this more distributed architecture planned involves fewer large ships (e.g. aircraft carriers and cruisers), increased numbers of smaller ships (e.g. frigates and smaller amphibious and resupply ships) and a new third tier comprising unmanned surface vessels.

Under the Ghost Fleet effort, designs for Medium Unmanned Surface Vessels (MUSV) and Large Unmanned Surface Vessels (LUSV) are being developed and trialled. The USN envisages its future force structure will include between 59 to 89 MUSVs and LUSVs.

Photo: L3 Harris

L3 Technologies is building the first MUSV prototype for the US Navy

The MUSVs will be patrol boat sized: about 45 to 190 feet in length and around 500 tonnes in displacement. They are intended to be low-cost, high-endurance, reconfigurable ships accommodating intelligence and surveillance sensors, and electronic warfare systems. As part of the MUSV development process, the USN has acquired two SEA HUNTER MUSV test and evaluation vessels, using them for surface warfare tactical training events and in multiple fleet exercises. L3 Technologies is building the first MUSV prototype with delivery scheduled for early 2023; the contract includes options for eight more.

The optionally manned LUSVs will be corvette sized: 200-300 feet in length and displacing 1,000-2000 tons. The LUSVs will carry anti-ship and land-attack missiles in VLS cells, providing a tactically valuable offensive weapons capability. For this role, the LUSVs will be semi-autonomous with remote human-in-the-loop control authorising any weapons firing. In 2019, two proof-of-concept LUSVs, RANGER and NOMAD, acquired under Project Overlord were outlifted with autonomous navigation and engineering systems. In mid-2021, NOMAD sailed some 4,500 nautical miles from Alabama through the Panama Canal to Port Hueneme California, 98% in autonomous mode. With Overload completed, the vessels were recently passed to Surface Development Squadron One for fleet test and evaluation. The USN is also acquiring two additional proof-of-concept vessels for delivery in 2023 for further experimentation and operational concept building.

The US Marine Corps (USMC) is also planning an unmanned future. Indeed, the Commandant recently declared that "… most of our expeditionary logistics [may be] unmanned in the near- to mid-term." Under this vision, work is underway on the Autonomous Littoral Connector, a sensor and software suite that can be fitted to landing craft to give varying levels of autonomy. Assault Craft Unit-2 is presently trialling legacy landing craft outfitted with this system for force manoeuvre and sustainment missions. Associated with this activity, Australian shipbuilder Austral is fitting the under-construction APALACHICOLA (T-EPF-13), the 13th of 15 USN Expeditionary Fast Transports, with autonomous capabilities to allow unmanned logistics support operations to be trialled.

In addition, the USMC is developing a Long-Range Unmanned Surface Vessel (LRUSV) for maritime reconnaissance and long-range precision fires using loitering munitions during sea denial and sea control operations. In early 2021, Louisiana shipbuilder Metal Shark was chosen to develop and build the new type, envisaged to be about 11m long. Entering operational USMC service around 2025-2027, they will be able to form a collaborative swarm with other similar vessels.

For undersea operations, the USN future force structure plan includes acquiring 24 to 76 ORCA Extra Large Unmanned Undersea Vehicles (XLUUVs). The Boeing ORCA is being developed from the earlier ECHO VOYAGER submarine that was about 15 metres long (extendable with added payload modules to 25 metres), 50 tonnes in weight and with a range of 10,000 kms. Five diesel-electric powered ORCAs are being built for experimentation purposes, which should begin in 2022. Their size requires launch from a pier near the operational area, not from a manned submarine. ORCA is to incorporate leading edge, autonomous maritime vehicle technologies. Its reconfigurable, modular payload bay will enable it to support multiple payloads and a variety of missions.

ORCA's initial use is to deploy the new General Dynamics HAMMERHEAD mine, a prepositioned mine tethered to the seabed and armed with a Mk-54 antisubmarine torpedo. Each ORCA may carry more than 12 mines. HAMMERHEAD is conceptually similar to the USN's Cold War-era CAPTOR mine designed to attack Soviet submarines. The HAMMERHEAD is being acquired under the Maritime Accelerated Acquisition

Photo: Boeing

The Boeing ORCA is being developed from the earlier ECHO VOYAGER submarine to meet the US Navy's requirement for ORCA Extra Large Unmanned Undersea Vehicles (XLUUVs).

Photo: US Navy

The Royal Navy's MAST-13 USV (foreground) pictured during an international exercise. The later MADFOX USV is derived from this design.

program with the ORCA under a Joint Emergent Operational Need program.

China – with a different set of operational problems to the USN – is taking a different path in its unmanned vessel development. In an example of this, China appears to be focussing on developing uncrewed fast attack craft for coastal defence.

A small 15m, semi-catamaran test vessel dubbed JARI developed by the China State Shipbuilding Corporation (CSSC) was trialled in early 2020. JARI features phased array radar, a VLS for surface-to-air missiles, a sonar and two lightweight torpedo tubes. This has recently led onto a larger, 25m monohull vessel that with a narrower weapons fit appears more closely aligned to a realistic concept of operations. This vessel appears to have recently been comparatively tested against a similar-sized catamaran design in Dalian in northern China.

In conjunction with this effort, Yunzhou Tech recently demonstrated its so-called "dynamic cooperative confrontation technology" that allows small, high-speed unmanned craft to independently undertake swarming manoeuvres. The demonstration involved six vessels autonomously searching, locating, tracking, working as a formation, intercepting and circling a target ship. In support of such efforts, China has built the world's largest testing facility for surface drone boats in Zhuhai, in the southern Guangdong province. In a possibly associated move, CSSC is now building a 2,100 tonne research ship capable of intelligent remote control and autonomous navigation to enter service in 2022. The vessel is designed to be a mother ship for air, surface and sub-surface unmanned systems.

In terms of underwater technology, the People's Liberation Army Navy (PLAN) appears to have beaten the USN to be the first to have XLUUVs in service. In 2019, the PLAN in a parade displayed the almost 5m long HSU-001, assessed to have an endurance of 24 hours and optimised for intelligence, surveillance and reconnaissance missions. The vehicle with two sensor pylons and twin screw-back propellers appears intended for near sea-surface operations at slow speed.

Media reports suggest China is building an ORCA-like XLUUV but such reports may be of company private ventures rather than PLAN trial vessels. This appears the case with a Chinese SEA HUNTER-like MUSV photographed in 2020 but which seems not to have found PLAN favour.

Beyond the great powers, the middle powers are also active. For example, NavyX, the British Royal Navy's experimentation unit, recently received MADFOX, a speed-boat sized, semi-autonomous fast USV fitted with imaging sensors. MADFOX fired a Switchblade loitering missile against a surface target in a recent NATO exercise. NavyX is also now trialling an autonomous PACIFIC 24 rigid inflatable boat to understand how these might be used by future Type 26 and Type 31 frigates.

Separately, the Royal Navy is experimenting with the lithium-ion battery powered MANTA XLUUV for covert surveillance missions. The British Royal Marines are also looking at unmanned underwater technologies, exploring an Unmanned Surface and Subsurface Vessel (USSV) – able to submerge for short periods – that can support small landing parties, sensor deployment tasks and other attack missions.

Photo: Crown Copyright 2019

The Royal Navy's NavyX experimentation unit is now trialling an autonomous PACIFIC 24 rigid inflatable boat to understand how these might be used by future Type 26 and Type 31 frigates.

Problems

Whilst there are numerous types of unmanned vessels being developed, they do have some inherent problems. In peace or war, unmanned vessels may be susceptible to being captured or boarded as there are no crews to fight off intruders. For example, in 2016 the PLAN abducted and later returned a glider operating in the South China Sea just as BOWDITCH (T-AGS 62) was trying to retrieve it. Similarly, in January 2018, Houthi forces captured a USN REMUS 600 UUV found off Yemen's coast.

Such possibilities may limit what systems are placed on unmanned vessels, espe-

cially when undertaking peacetime tasking. Such vessels might be used in peacetime or times of crisis for intelligence collection, however, the possibility of their capture may mean that their onboard systems are those whose compromise is acceptable. There are a variety of possible anti-tamper methods and intruder warning systems that could be installed but all have their shortcomings. It may be prudent for unmanned vessels on peacetime missions to use readily available commercial systems rather than possibly more capable classified systems.

Such worries partly lie behind, the USN's LUSVs being designed able to carry a small onboard crew. The current thinking is that a crew will sail such vessels into and out of ports and then, when in the open ocean, the crew will leave and the LUSV transition to autonomous mode with mission planning, command and control, and supervision undertaken remotely. Moreover, if refuelling at sea is required later, the crew will return to the LUSV and complete that task.

There are further issues with underway maintenance. Unmanned Vessels (UVs) are inherently very complicated devices. However, unlike a manned ship, UVs are unable to repair themselves from system malfunctions, engine failures, software glitches or battle damage. UVs will need to have specialist maintenance teams on nearby ships able to undertake timely repairs that reduce the UVs time out of service.

Paradoxically, the widespread use of UVs will probably force a shift in a navy's force structure towards an increased at sea maintenance capability. Today, there is a strong reliance on getting a ship that has system failures or is damaged back to a port with appropriate shore-based maintenance facilities. The same concept does not necessarily hold for UVs that – in being smaller and more complicated – will be intrinsically less-robust. Fixing a UV at sea appears more viable than having to potentially use a warship to tow it back to homeport.

Of course UVs are more expendable than manned vessels. If not repairable at sea, they could simply be abandoned and sunk. It's apparent, though, that many of the larger UVs being built will be very capable, expensive and would take time to replace. Like all naval vessels, UVs are disposable in extremis but they are not usually meant or designed to be expended. Their loss would adversely impact the overall combat effectiveness of a task group or fleet. In the special case of UUVs deployed from submarines, however, it seems likely they will be effectively throwaway items. UUVs are unlikely to be recoverable at sea by friendly submarines, especially in operational areas. UUV design may need to take this into account.

In an ideal future, hundreds of AUVs would glide through the world's oceans inputting data into wide area surveillance systems that would cue other UVs of varying types to investigate and if needs be engage. With the current state of technology though, humans will remain essential at many levels to monitor, supervise, operate, and repair such unmanned systems and vehicles.

The near-to-medium term future looks like warships gradually becoming motherships; controlling and supporting nearby unmanned vehicles of many types. If so, and perhaps unexpectedly, warship design and their personnel complements will change. Combat and combat enabler tasks will be increasingly shifted onto UVs, with warships taking on more and more of the combat support tasks needed to keep their UVs operating. UVs may become the driver of future naval force structures, overthrowing the central place of manned warships, sooner than we might think. ■

Launch & Recovery Systems: The Sealartec Example

(cw) The increasing use of unmanned naval vessels is also driving developments in the technology required to ensure their safe handling and recovery. One example of the companies operating in this field is Sealartec, which was formed to develop the next generation of launch and recovery systems. Sealartec comprises a team of naval architects and systems engineers who have an in-depth understanding of the harsh marine environment and what is needed to ensure launch and recovery operations can be carried out safely, with minimum human intervention.

The launch & recovery of boats from mother ships has been done for centuries. It has always been a precarious operation and normally limited to low sea states. With the advent of un-crewed boats, this brings about new challenges.

Safety is a crucial concern during launch and recovery operations. In rough seas, the recovery is further hindered by the vertical change or heave of the respective vessels due to waves. The launch and recovery process must be done in a manner that avoids damage to the off-board vessel as well as the host ship. The act of bringing a smaller vessel on board a larger vessel obviously requires contact. However, Sealartec claim that their unique system ensures this is kept to a minimum. This is achieved through use of the company's state-of-the-art innovative, hydrodynamic floating structure that utilises a robotic capture device and an autonomous processes control decision-making algorithm.

Photo: Sealartec

Sealartec's launch and recovery system under construction

During a series of trials that took place off the Israel's northern shore, Sealartec demonstrated the capability of its system to perform the precise and fully autonomous launch and recovery of an un-crewed vessel in sea conditions at Sea State 4, with gusting winds. They state that the system can be operated up to Sea State 6 at a maximum speed of 15 knots.

Sealartec is confident that their solution can be implemented easily with minor changes both to the boat and to the mothership and can be used with all types of naval cranes, davits, mission bay and stern ramps. According to the company, it is suitable for manned and unnamed boats from five to 15 metres in length, as well as for AUVs up to 10 tonnes in weight and for exercise torpedoes.

For more information see www.sealartec.com

Boxing Clever: Engineering Mission Modularity for Naval Vessels

Richard Scott

Modularity is a concept that continues to arouse interest and generate debate amongst the warship design, acquisition and operator communities. From a design, manufacture, outfitting and integration perspective, modular approaches have in fact been around for almost half a century: the MEKO concept brought to market by German shipbuilding and engineering firm Blohm + Voss in the 1970s blazed a trail that embodied the functional and physical features of 'Mehrzweck-Kombination' (translated as 'multipurpose combination').

Other shipbuilders have gone on to develop their own standardised modular build and outfitting approaches as a means to cut manufacture cost, afford flexibility in equipment choice, shorten construction time, and facilitate distributed build where required. Damen Schelde Naval Shipbuilding's SIGMA surface combatant portfolio and Naval Group's GOWIND corvette/light frigate family both epitomise this approach.

More recently, however, modularity has become adopted as shorthand for a ship system architecture that enables rapid reconfiguration for role or mission change.

Photo: Richard Scott

An example of a Standard Flex module: A Mk 56 vertical launcher module pictured here installed amidships on the Royal Danish Navy's ABSALON.

In this context, modular approaches represent an attempt to square the circle that many navies face in attempting to match finite budgets to an ever-increasing range of warfare and maritime security tasks. In particular, there is a recognition that specialist hulls dedicated to a single task are unlikely to be affordable (in terms of acquisition cost) nor desirable (given the training, logistics, organisation and manning overheads that are required for the series of narrowly-focused and largely bespoke platforms).

Modularity by Design

In its 2016 report Designing Adaptable Ships, the RAND Corporation said that modularity "entails partitioning a system into modules that consist of self-contained elements," adding: "It hinges on a systems engineering process that stresses functional analysis and identification of key interfaces."

Proponents of mission modularity contend that a design methodology founded on built-in volumes, and standardised physical and functional interfaces, enables the efficient decoupling of 'seaframe' and 'payload'. This approach, it is argued, can overcome the high overheads - in terms of both time and cost - traditionally incurred for role change and/or technology insertion.

From the ship design perspective, there is a need to fully understand the impact of modularity on naval architecture design and system architecture. This includes, for example, module access routes, access to ship services, and the way in which modules may condition or influence structural aspects or subdivision spacing. As for the payloads, the critical enabler here is to identify standard "open" interfaces: these include space, weight, power, cooling, data, communications, and heating, ventilation and air condition.

This approach has allowed planners to conceive of platform designs that can be quickly adapted to satisfy different roles according to the specific mission payload embarked. Such reconfigurability is increasingly attractive to navies that want to be able to adjust the balance of roles and missions performed by individual warships in a fleet as tasking priorities evolve or change over time. It also dovetails with the emergence of a new genre of maritime autonomous systems, functioning as unmanned adjuncts, which may require launch and recovery, and onboard storage and support.

Even so, while top-level requirements for 'modular' warships have now been widely promulgated, and some design solutions have arrived on the front line, there is still an active debate as to how modularity should best function. Furthermore, it is increasingly recognised that modularity is not the complete answer when it comes to delivering operational reconfigurability; other factors must be taken into consideration - such as personnel, training and logistics - in order that the conceptual theory can effectively translate into front-line capability.

Author

Richard Scott a well-known author and commentator on naval operations and technology.

Photo: Richard Scott

Photo: Richard Scott

The Standard Flex concept is based on a standardised container designed for installation and removed using a 15-tonne capacity mobile crane. Standard interface connections on each container enable interconnection to a ship's services.

LEGO Navy

The Royal Danish Navy (RDN) pioneered the concept of mission modularity more than three decades ago in the form of its Standard Flex system. Developed for a Cold War scenario, the Standard Flex system architecture was conceived as a means by which the RDN could square the circle between cost and capability: the service needed to replace 22 minor war vessels (six torpedo boats, eight patrol boats and eight minesweepers), but lacked the budget to deliver one-for-one replacements.

So instead of building role-dedicated ships, the RDN envisaged a common surface combatant platform configured to accept interchangeable combinations of containerised equipment according to mission requirements (pre-feasibility studies determined that a force of 16 multirole units could accomplish the tasks previously requiring 22 role-dedicated hulls). This was based on the precept that the main wartime tasks - Mine Countermeasures (MCM), Anti-Submarine Warfare (ASW) and Anti-Surface Warfare (ASuW) - would be sequential rather than concurrent, allowing for rapid reconfiguration and re-roling of ships.

The physical enabler for the Standard Flex concept was a standardised container - 3m in length, 3.5m in width and 2.5 m in depth - designed for installation and removed using a 15-tonne capacity mobile crane. Standard interface connections on each container would enable interconnection to a ship's services.

Feasibility studies for what became the FLYVEFISKEN class Standard Flex 300 platform defined a GRP vessel design featuring one container position forward and three aft. Sensors common to all roles, or not suited to containerisation, would be permanently fitted. In addition, a distributed, modular and reconfigurable C3I system would be installed, based on a databus and standardised consoles.

The lead Standard Flex 300 ship, HDMS FLYVEFISKEN, was delivered in 1987. In the event, budget cuts meant that the class was limited to 14, the last of which was commissioned by mid-1996. In parallel, the RDN procured an inventory of more than 100 Standard Flex containers. These provided for ten ASuW, five MCM, 14 minelaying and four ASW units, plus additional modules for storage and other peacetime tasks (oceanography and environmental monitoring, pollution control and hydrographic surveying).

Standard Flex containers were manufactured by Monberg & Thorsen (now part of MT Højgaard Group) in two configurations: an open sided version unique to the 76/62 SUPER RAPID multipurpose gun; and a closed type (with watertight door and hatches) common to all other equipment. Fabricated from stainless steel, the containers featured a precision-machined flange to ensure accuracy when bolted to the corresponding deck flange. Interface connector panels are fitted on either side, providing connections for power supply, ventilation, water, communications and data.

The weapon or equipment itself is mounted atop the container, with all machinery or electronics installed inside and connected into the interface panels. Installation of a single module could typically be achieved in about 30 minutes, with setting-to-work and check-out testing completed within a few more hours.

Alongside the 76/62 SUPER RAPID gun module, the RDN procured containerised Standard Flex weapon outfits for the RIM-7P NATO SEA SPARROW point defence missile (using a six-cell Mk 48 Mod 3 vertical launcher) and HARPOON anti-ship missiles in two quad launchers. The Mk 48 Mod 3 launchers were subsequently upgraded to a Mk 56 dual-pack configuration to allow for the outload of 12 RIM-162 Evolved SEA SPARROW Missiles.

The end of the Cold War, and the subsequent restructuring of the RDN, meant that Standard Flex was never actually employed as conceived. The idea of rapid reconfiguration and role change was never realised: instead, the 14 Flyvefisken ships for the most part ended up in one of four 'semi-permanent' configurations: general-purpose patrol; ASW; ASuW; and MCM. Of these, the MCM was the most challenging and complex role fit, and also required specialist mine warfare crews.

Subsequently, the force was reduced to just ten ships, and the concept of operations amended so that each was configured in one of three fixed-role configurations - namely, MCM, combat role (ASuW or ASW) and offshore patrol.

In 2010, the decision was taken to retire the FLYVEFISKEN class fleet, with the RDN instead recapitalising around two new ABSALON combat support ships, and three IVER HUITFELDT frigates (the two types being based on a largely common hull design). This move reflected the navy's pivot towards larger ship designs better suited to international crisis management and peace support operations.

Photo: US Navy

The Royal Danish Navy frigate ABSALON, pictured here off the coast of Greenland, is fitted with five Standard Flex container positions.

While Standard Flex did not function as originally intended, the modular concept nonetheless became enshrined in the RDN fleet, and the decision was taken in the late 1990s to re-use the same container-based weapon system architecture for the new ABSALON class and IVER HUITFELDT class ships. Reflecting this, the ABSALON class have been built with five container wells positioned amidships, while the IVER HUITFELDT class frigates feature a slightly different arrangement including one Standard Flex position forward and four amidships.

In addition, the three KNUD RASMUSSEN class Arctic patrol vessels are fitted to receive two Standard Flex containers (with wells sited fore and aft). A number of minor war vessel types have also been enabled to carry Standard Flex modules.

Rapid role change no longer figures in the RDN's planning. However, the service continues to see many other operational, logistical and through-life cost benefits accruing from the Standard Flex system: modules not embarked can be stored ashore in controlled conditions to reduce maintenance requirements; overhaul schedules for ships and systems could be decoupled; and there is scope for technology insertion and upgrades with minimum ship impact.

Enter the Cube

Danish company SH Defence has sought to evolve the modular concept further in the shape of its proprietary Cube system. Unveiled in 2020, the Cube is designed around ISO-standard containers each outfitted with specific mission payloads or equipment packages: the RDN has had two containers under evaluation since 2018.

Described by SH Defence as 'Standard Flex 2.0', the Cube is based on a so-called Flex Frame that enables the conversion of standard ISO containers (both 20 ft and 40 ft types) into Cube-enabled modules. The Flex Frame is a welded steel structure with container corners for lifting and sea fastening, plus forklift 'pockets' for empty handling.

Alongside the Cube modules, SH Defence has also developed associated multifunction and automatic mobile transporter and loader systems for the Cube. The company claims that the ease of module handling for loading/unloading allows for the reconfiguration of vessels in less than four hours.

SH Defence has already engaged with a large number of weapon, vehicle and equipment suppliers to understand how their specific products could be packaged in Cube modules, with over 125 different payload packages catalogued to date. The company is also in dialogue with shipbuilders in order to provide advice and guidance on Cube interface requirements and ship design considerations.

NavyPODS vision

As one strand of its force-wide Navy Transformation initiative, the Royal Navy (RN) has over the last year conceptualised a deployable and interchangeable suite of mission modules that can be employed to rapidly field specific capabilities across a range of ship platforms. Known as NavyPODS - Navy Persistent Operational Deployment System - the concept is being taken forward by the service's Office of the Chief Technology Officer (OCTO).

Speaking at the DSEI 2021 event in London in September last year, then Second Sea Lord Vice Admiral Nick Hine said that the NavyPODS model would enable the RN to procure simpler, cheaper ship platforms. "Capability will be defined by the modules you add to or remove from that ship based on the operational demand at that time," he said, adding: "By placing the capability in the pod, the fleet is fully flexible, adaptable to mission, easily upgradeable and maintainable, [and] exploiting the standardisation of components through a 'podular' design. And using modern, digital open architecture networks afford us the opportunity to develop a new mindset and approach to capabilities."

The RN sees NavyPODS modules being applicable to a range of platforms, including the new Type 26 and Type 31 frigates, amphibious ships, offshore patrol vessels, auxiliary ships, and Future Commando Force elements ashore. It is envisaged that delivery - either ship-to-ship or ship-to-shore - will be via autonomous stabilised platforms, or

Photo: SH Defence

An Unmanned Aerial Vehicle (UAV) side launch container conceptualised by SH Defence as part of The Cube

Photo: Crown Copyright

NavyPODS has conceptualised a 'plug and play' concept to enable the Royal Navy to deploy and interchange different equipment modules.

using a heavy-lift unmanned air system.
As the navy's 'incubator' for innovation and disruptive technology, OCTO has started from the premise that capability insertion is difficult, with significant time consumed in procurement and design assurance: this drives up costs, slows down the introduction of capability, and may itself constrain or compromise the introduction of additional capabilities.
NavyPODS has been developed as an alternative solution to accelerate delivery of capability to the frontline: make ship designs more generic, but then change or 'flex' the capability according to the mission module fit. These could include, for example, mine hunting systems, unmanned aircraft systems, unmanned surface vessels, precision strike, survey equipment, communications, a medical facility, and humanitarian aid/disaster relief supplies.
It is envisaged that each mission module – based on an ISO equivalent container – would use a standard interface panel to allowing maximum flexibility in installation. Furthermore, it is foreseen that these would share a common digital backbone in the form of a pre-installed NELSON Edge Cloud Server: Programme NELSON is the RN's in-house data platform and software house for the rapid exploitation of digital data and artificial intelligence.
OCTO is currently pursuing a twin-track strategy: on the one hand, it plans to perform initial test and evaluation, using a handful of container prototypes, to "test the hypothesis" of NavyPODS; on the other, responses to a request for information released back in mid-2021 are helping the RN understand potential capabilities that could be suitable for modular deployment.

Box Littoral Combat Ship: A Case Study in Mission Modularity

The US Navy's Littoral Combat Ship (LCS) was conceived as a fast, agile mission-configurable small surface combatant marrying a lean-manned and relatively inexpensive 'seaframe' with interchangeable 'plug-and-fight' mission packages. Two LCS seaframes have entered USN service: the FREEDOM (LCS-1) class variant, a semi-planing steel monohull design developed by a Lockheed Martin-led team; and the INDEPENDENCE (LCS-2) class variant, an all-aluminium fast trimaran built by Austal USA.
As a so-called focused-mission ship, it was accepted that the LCS would only be able to perform one primary mission at any given time. This specific mission would be conditioned by the modules embarked and integrated.

Photo: US Navy

The FREEDOM (LCS-1) variant littoral combat ship MILWAUKEE (LCS-5) transits the Atlantic Ocean in December 2021. The US Navy is installing mission packages semi-permanently on individual LCS seaframes, dedicating specific ships to specific missions

LCS mission packages are built on five key tenets: the use of common systems (such as command and control, datalinks, and launch); modular payloads (more, smaller, cheaper, and interchangeable); persistence (to increase endurance and range); pervasiveness (through larger numbers of sensors and weapons); and autonomy (vice just unmanned). An associated programme of "spiral development" is intended to allow for the progressive insertion of additional and enhanced capability over time in line with mission requirements and operational priorities.
Responsibility for integrating the mission packages themselves is vested with Northrop Grumman, selected in 2006 to perform the role of Mission Package Integrator (MPI) for the LCS Mission Modules programme. The role of the MPI is to function as a system engineering partner responsible for bringing the systems and technologies of the mission modules together under the integration and interface requirements established by the LCS Mission Modules Program Office (PMS 420). In this role, Northrop Grumman is working closely with the US government's Mission Package Integration Laboratory to produce and deliver capabilities according to the technical architecture developed by PMS 420.
The US Navy is procuring mission modules for MCM, ASuW and ASW. Each mission package comprises a specific mission system, embarked aboard the LCS platform together with modified ISO support containers and associated equipment, and interconnected to standard interfaces. These mission modules are then combined with the LCS mission crew - plus the organic aviation capabilities offered by the MH-60S utility helicopter and MQ-8B/C series FIRE SCOUT vertical take-off and landing tactical unmanned aerial vehicle - to form the total mission package.
As previously mentioned, the LCS was explicitly designed as a single mission ship, deployed with the appropriate mission package as required by the Combatant Commander. Reflecting this, the original intention was to enable the physical swap of mission package equipment within 96 hours on the proviso that materiel staging and personnel movement had been planned and coordinated in advance.
However, misalignment between the LCS seaframe and mission module programmes resulting from developmental issues affecting the MCM, ASuW and ASW packages has proved problematic. The US Government Accountability Office has noted that the navy has in several cases identified and/or adopted insufficiently mature systems technologies that have failed to deliver as planned.
The non-availability of mission modules has imposed limitations on the operational utility and combat capability of the LCS ships to date. However, the situation is now improving: as of early 2022, all ASuW mission modules certified for deployment, MCM modules are completing final integration testing, and aviation MCM mission modules are certified for deployment on both LCS variants.
Work continues on the development, integration and testing of the ASW mission module (which includes a Variable Depth Sonar [VDS] and a Multi-Function Towed Array sensor). Forthcoming testing will explore the hydrodynamic stability of the VDS towed body through the full range of operational requirements with active controls.
What should also be understood is that the US Navy has itself now moved away from the earlier concept of rapid role change following a 2016 review of early LCS operating experience. Instead, the navy is installing individual MCM, ASuW, and ASW mission packages semi-permanently on individual seaframes, dedicating specific ships to specific missions. Reflecting this, LCS crews will now merge, train and rotate with mission module detachment crews, organising as four-ship divisions dedicated to a single warfare area (MCM, ASuW or ASW). ■

Greek Parliament's Approval for Defence and Intervention Frigate (FDI) Programme

Vincent Groizeleau

It is not yet the end of the process, but it is getting closer. On the evening of Tuesday 17 February 2022, the Greek parliament approved the purchase of three FDI "defence and intervention frigates" from France. The agreement, reached in December, between the French and Greek governments covers the construction of these vessels at Naval Group in Lorient. The first two will be delivered in early and late 2025, with the third following in 2026. A fourth unit, for which an option is in place, could follow in 2027. Following the approval of the Athens parliament, all that remains to be done is to complete a number of administrative steps, including the completion of an audit by the Greek Court of Auditors. After these, the first payment for the contract – worth around €3Bn in total – comes into force. This should occur, it is estimated in Paris, in the coming weeks.

Photo: Naval Group

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Vincent Groizeleau a professional journalist. He is editor-in-chief of Mer et Marine, which he founded in 2005 and which has become the leading French media specialising in maritime news.

In addition to the frigates, it should be noted that the Greek parliament also approved the purchase from France of six more RAFALE fighter jets; in addition to the 18 ordered in 2021 (the first six were delivered last month). This strengthening of military cooperation between France and Greece comes against the backdrop of increasing tensions in the eastern Mediterranean, particularly with Turkey. Set to become the cornerstone of the Greek surface fleet's renewal, the future Greek frigates will be almost identical to the French FDIs, the first of which is currently being assembled in Lorient and will be delivered to the French Navy in 2024. Four others will follow by 2029.

The platform will be the same, but the version destined for Athens will have increased military capabilities. With a length of 121.6 metres, a width of 17.7 metres and a displacement of 4,500 tonnes, the Greek FDIs will be able to reach 27 knots and travel 5,000 nautical miles at 15 knots. They will be equipped with four SYLVER A50 vertical launchers for 32 ASTER 15 and ASTER 30 surface-to-air missiles, a RAM surface-to-air system (21 RIM-116 missiles), eight EXOCET MM40 Block3C anti-ship missiles, a 76 mm turret, two 20 mm cannons and four MU90 torpedo tubes. They will also be able to carry an MH-60R helicopter and a CAMCOPTER S-100 aerial drone. Electronics will include a Sea Fire multi-functional radar with active antenna and fixed panels, a STIR 1.2 EO Mk2 fire control, a KingKlip Mk2 hull sonar and a CAPTAS-4 towed sonar. In addition, there will be four anti-missile and two anti-torpedo decoy launchers.

For the record, apart from the FDI, Naval Group is also offering Greece its GOWIND family of corvettes as an alternative to the costly modernisation of the four MEKO 200 HN type frigates commissioned in the 1990s by the Hellenic Navy.

This article is a translated reprint of an article published in and by courtesy of Mer et Marine; www.meretmarine.com.

MDM Editorial comment: The Hellenic Navy's selection of the FDI marks a major success for Naval Group following a hard-fought selection process that attracted proposals from across Europe and beyond. Parallel to the programme for the Greek Navy, Naval Group's Lorient facility is busy with the French's Navy procurement of its own five FDIs and two GOWIND corvettes for the United Arab Emirates, maintaining production at the important Brittany facility as work on the previous FREMM programme winds down. As mentioned in Periscope, the keel of the first French FDI – AMIRAL RONARC'H – was laid at Lorient on 16 December 2021. (hum)

Technical specifications

- displacement: 4,500 tons class ;
- length: 122 meters ;
- beam: 18 meters ;
- max. speed: 27 knots ;
- autonomy: 45 days ;
- accomodation: 125 + 28 optional personnel

IP for HF

How Naval High Frequency Communications will be revolutionised in the Coming Years

Dennis-Peter Merklinghaus

Navies depend on high frequency radio communications. NATO's BRASS initiative is overhauling how the Alliance's navies handle tactical and strategic information across HF networks.

High Frequency (HF) radio was one of the earliest forms of radio communications. Discovered in the 1920s this reliable and proven technology has been in use for decades. HF radios are difficult to jam making them very secure. State-of-the-art software ensures they suffer minimal weather or solar interference. In contrast to the formative years of HF, today's radios are lightweight and easy to use.

HF radios can communicate across intercontinental ranges. They bounce their transmissions off the ionosphere. This is a layer of the atmosphere between 80 km (50 miles) and 300 km (187 miles) above the Earth's surface. HF radio waves cannot penetrate the ionosphere. When they hit the ionosphere, they are bounced back to the ground. This is known as sky wave HF communications.

HF radio has several advantages compared to Satellite Communications (SATCOM) which can also achieve intercontinental ranges. SATCOM is vulnerable to jamming. Furthermore, it can be degraded by weather conditions or solar activity. There is huge global appetite for SATCOM for everything from television to civilian communications. This means capacity becomes ever-more restricted due to worldwide demand. SATCOM is also expensive. Countries without sovereign communications satellites must lease SATCOM bandwidth from a third party. This can be expensive, and customers may only be able to lease poor quality channels. Those countries with sovereign SATCOM must pay for the satellites, their launch and day-to-day management and maintenance. Apart from the initial purchase of the radio, HF communications are free.

Photos: Rohde & Schwarz

The R&S®M3SR Series4100 HF transceivers, part of the successfully introduced SOVERON® software defined radio family from Rohde & Schwarz, are state-of-the-art radio systems designed to take HF communications to the next level and support future capabilities, such as HF wideband.

HF radios can communicate across intercontinental ranges using their distinctive antennas.

Unlike SATCOM, HF radio is highly resilient. Jamming HF communications is difficult and requires specialist equipment and expertise. As such, HF tends to be robust and reliable even when other links like SATCOM and conventional Very/Ultra High Frequency (V/UHF) radios are being jammed.

Author

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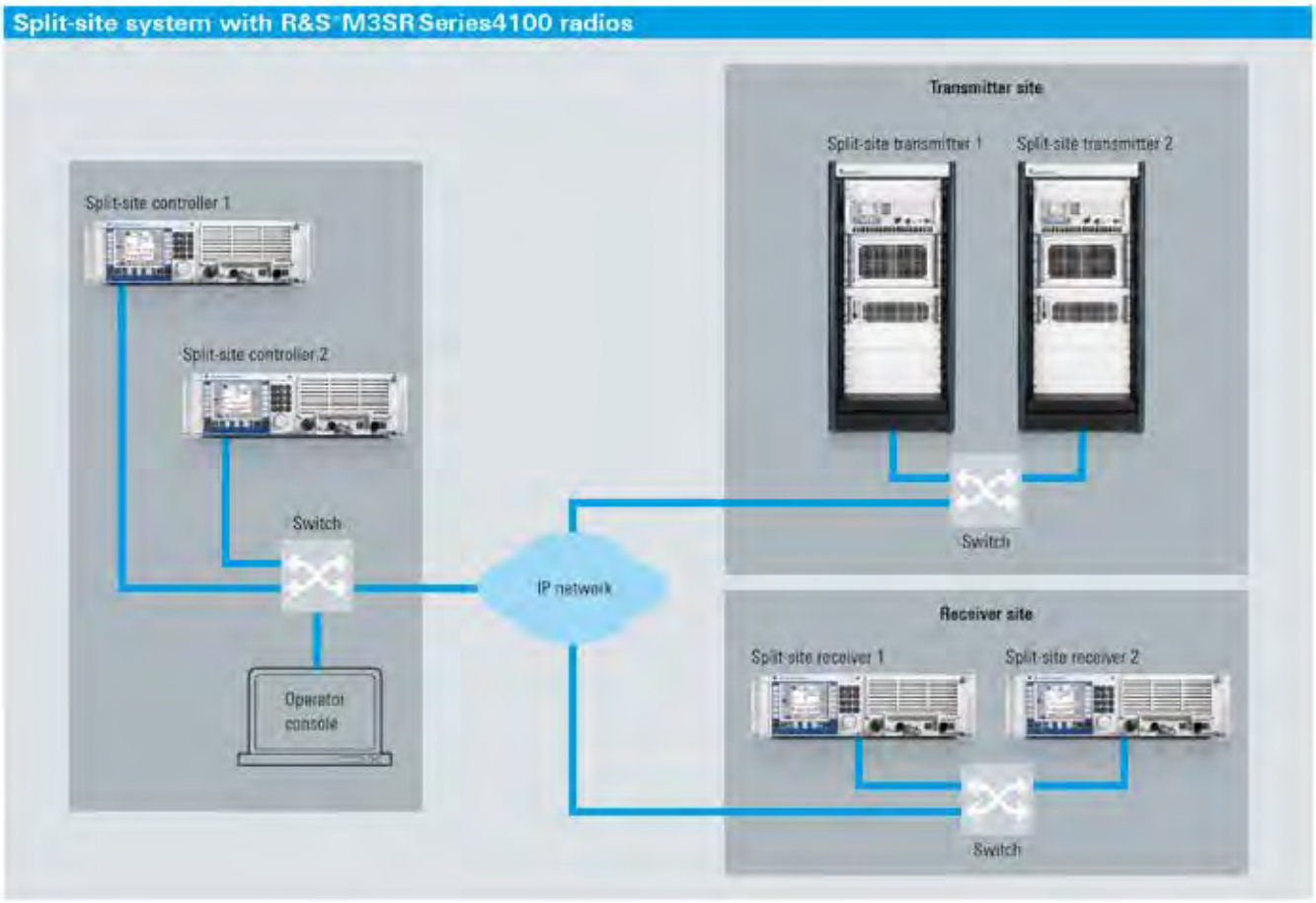
Graphics: Rohde & Schwarz



Split-site operation with the R&S®M3SR Series4100.

HF and Maritime Operations

HF communications were pioneered by the father of radio Guglielmo Marconi one hundred years ago. Today, the feasibility of using HF to communicate from shore bases to ships at sea is still a task that HF radio performs for navies around the world. The intervening century saw HF grow in importance in military and civilian domains. However, the dawn of the space age in the 1950s and the proliferation of communications satellites saw civilian interest in HF wane. HF radio was now mostly the preserve of a global community of amateur radio enthusiasts. Militaries rely on HF as an alternative to SATCOM. Navies are especially dependent for those times when V/UHF or SATCOM are unavailable.

Given the military dependence on HF, NATO usefully drafted some 'rules of the road' on how HF is used. These rules are enshrined in standards and protocols. These are essential for ensuring that NATO members can communicate with one another with ease over HF.

NATO navies using HF must ensure that their HF radios and equipment meet the Alliance's relevant standards and protocols. These standards and protocols include ACP-127, STANAG-5066 and STANAG-4406. Each of these stipulates requirements for specific aspects of HF communications.

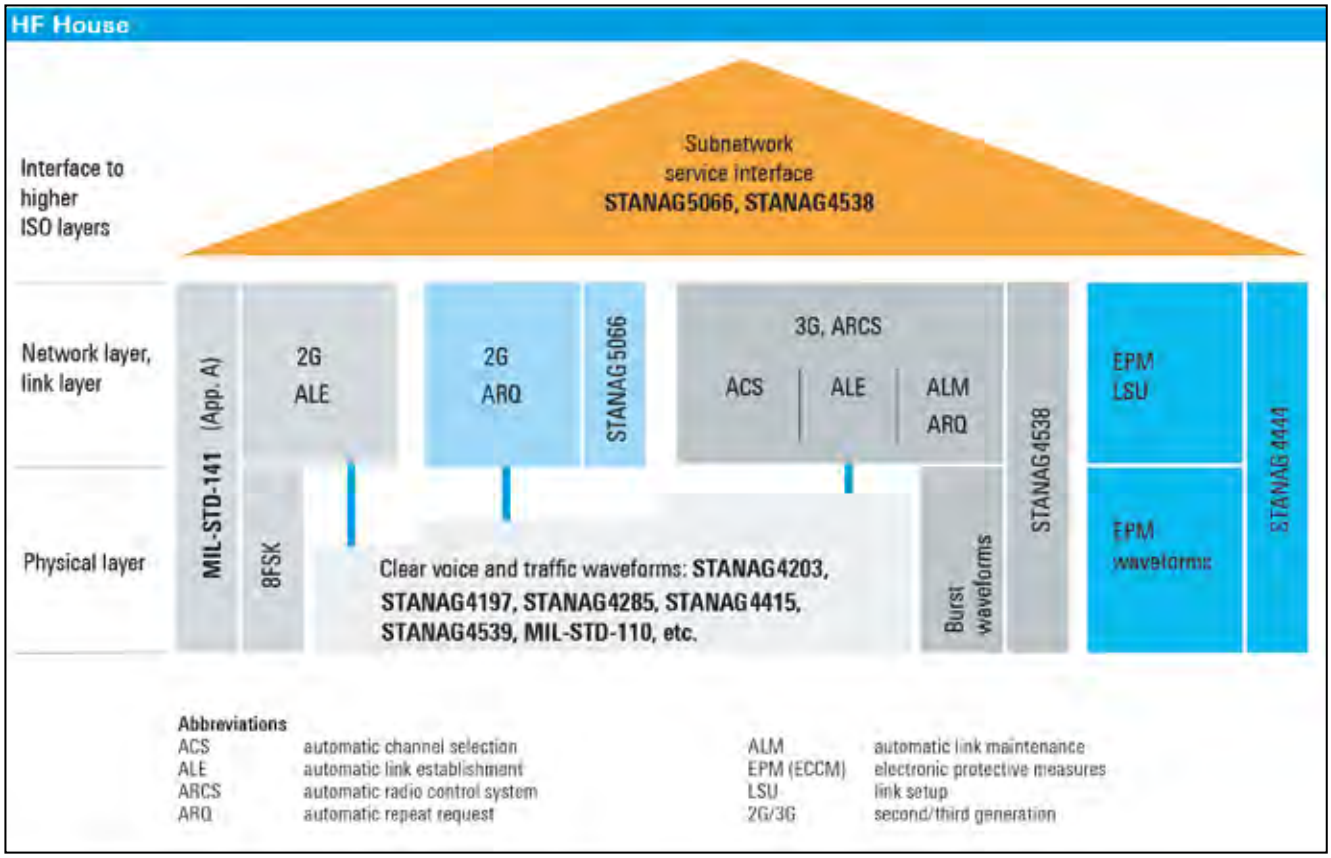
NATO Standards and Protocols

ACP-127 covers written military messages sent across HF links. Of all the standards and protocols, ACP-127 is arguably the most basic. Written messages can be sent across the link using teletype. The recipient will receive a simple, written message. The basic nature of ACP-127 means that the sender cannot include useful additions to their message like attachments like we can with a standard email. ACP-127 also makes no provision for error correction. For all intents and purposes, the sender of a written message transmits this to the intended recipient and hopes for the best.

STANAG-5066 improves things. It acts as a converter. By using STANAG-5066 software the ACP-127 message is transformed into a written email-style message through conversion into an HMTP (HF Mail Transfer Protocol) format. The sender can now transmit their message across an HF link to a standard email server or mailbox and vice versa. Another major benefit of STANAG-5066 is that the sender can add attachments to their message as they would with a normal email. These attachments are converted into CFTP (Compressed File Transfer Protocol) formatted data and sent along with the HMTP message. Returning to our example at the start of this paper, the ship's crew may want to send a Word document with a detailed description of the vessel alongside the written message alerting NATO's command to its suspicious presence. Significantly STANAG-5066 software includes ARQ (Automatic Repeat Request) functions. ARQ is a process by which an HF radio will continue to transmit its traffic until the receiving radio confirms that the message has arrived safely and uncorrupted.

NATO HF messaging has taken a major leap forward with the advent of the STANAG-4406 protocol. This represents the 'state-of-the-art' for HF communications within the alliance. STANAG-4406 takes the advances of STANAG-5066 a step further. It uses an IP (Internet Protocol) architecture to handle HF message traffic.

For example, a ship may have a tactical HF network it shares with other naval vessels in a task group. This is used by those ships to share traffic between them concerning their mission. The commanding vessel in the task group will be connected to a strategic HF network. This will link back to the command on shore and/or to NATO's maritime command. By using IP, messages can be moved easily between these HF tactical and strategic networks. Perhaps the shore command orders the command ship to dispatch two of vessels in the task group to form a radar picket to keep watch for anti-ship missiles. As this message will be



HF house giving an overview of the different standards in use.

in an IP format it will be easy to transfer it from the HF strategic network to the HF tactical network for sending to the ships in question.

BRASS

NATO's Broadcast and Ship-to-Shore (BRASS) standard is a set of requirements for naval HF radios. These stipulate the attributes that a naval HF radio must have to handle the ACP-127, STANAG-5066 and STANAG-4406 protocols. The logic is to ensure that navies can continue using ACP-127 and STANAG-5066 while smoothly transitioning to STANAG-4406. This process will occur in three steps named BICC (BRASS Initial Core Capability), BRE1TA (BRASS Increment One Target Architecture) and BRE2TA (BRASS Increment Two Target Architecture). Each NATO country is required to procure BRASS compatible equipment for strategic ship-to-shore and tactical ship-to-ship communications. The German company Rohde & Schwarz has already delivered BRASS compatible HF equipment to the Royal Danish Navy and other NATO navies will likely follow Denmark's lead in coming years.

BICC represents the first step of the BRASS process. This standard governs the handling of ACP-127/STANAG-5066 traffic. In a nutshell, this provides the ability to convert ACP-127 traffic to meet STANAG-5066 standards. One aspect of STANAG-5066 software is that it adds second-generation Automatic Link Establishment (ALE) functions. ALE is an important aspect of HF. Each radio in an HF network is assigned an address. This is analogous to a telephone number or an IP address. The operator simply needs to know the address of the radio, or radios, they want to connect with. The software will do the rest and establish the connection. NATO's STANAG-4285 waveform forms part of the BICC standard. This has a data rate of 2.4 kilobits-per-second/kbps enabling the carriage of simple email attachments.

BICC is being followed by the BRE1TA standard. BRE1TA introduces the all-important STANAG-4406 IP approach. This standard includes several other important improvements. For example, HF messaging can be sent from one ship to another, or from a ship to a shore base (unicast). Alternatively, one ship can send traffic to several ships and shore bases (multicast). BRE1TA is backwards-compatible with ACP-127 and STANAG-5066. This means that these legacy standards can continue to be used as part of the BRE1TA architecture. A new waveform is being introduced via BRE1TA designated STANAG-4539. This increases data rates to 9.6kbps. Meanwhile, the second-generation ALE standards enshrined in BICC will be superseded with third generation ALE. BRE2TA (pronounced Bright-two-tah) will expand the bandwidths available for HF messaging still further.

Physically, how will the BRASS architecture manifest itself on a ship? Let us consider a standard fit for a ship's Message Processing

The automatic adaptive behavior of the integrated R&S® HX002M1 150 W HF dipole antenna's tuning unit allows antennas to be set up close to neighboring antenna systems and on difficult terrain (e.g. on ships).

Masthead

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System (MPS) meeting the BRE1TA requirements. The MPS is used for drafting, reading, sending and receiving written messages across HF. The MPS will include several workstations. One workstation will be for the systems administrator and another for the network manager. Other workstations are there for handling ACP-127 and STANAG-4406 format messages. All these workstations feed into the MPS servers. These servers have all the required software to handle the ACP-127 messages as they are, convert ACP-127 messages via the STANAG-5066 software while also handling STANAG-4406 traffic. One server handles the STANAG-5066 and STANAG-4406 messages. The other handles unconverted ACP-127 traffic.
From these servers the traffic is sent to the ship's HF radios. These radios send the messages to their intended recipients. Likewise, the MPS and ACP-127 servers handle incoming HF message traffic and distribute this to the appropriate workstations. This approach offers great versatility.

Products and Services

NATO is obliging navies to adopt STANAG-4406. At the moment, Rohde & Schwarz has the distinction of being the only military communications provider supplying BRASS-compatible equipment. As mentioned above, it is a proven quantity, having supplied the Royal Danish Navy with BRE1TA standard HF communications. MPSs form one part of the company's offerings. This is in addition to Communications Interface Switching Systems (CISS), Remote Supervisory and Control Systems (RSC), and accompanying IT security.
Several products form the company's BRASS-compatible CISSs including the R&S®M3SR Series4100 and R&S®M3SR Series4100 Split Site System. The Split Site version of the R&S®M3SR Series4100 can be used at locations where high-power HF transmitters and receivers are positioned at separate sites to avoid interference. In this configuration, the operator's console is linked to two Split Site Controllers. These are connected to an IP network. This will move the messaging traffic to the transmitter site and obtain traffic from the separate receiver site. One advantage of using R&S®M3SR Series4100 radios in this configuration is that they require no additional hardware extensions to be used in this fashion. Rohde & Schwarz' ALE 3G approach uses radio pooling to ensure traffic always arrives, pooling all radios at the shore base. This means that if one radio becomes unavailable, communications automatically switch to whichever radio is available. This ensures that there is no break in communication. IP traffic coming and going through the HF radios is routed via Rohde & Schwarz' Trusted IP Filter. This ensures that secure (red) IP traffic is kept separate from unsecured (black) traffic.

Conclusions

The advent of BRASS may seem daunting. It does indeed herald an important change in how NATO and allied nations handle messaging using HF links. However, it will result in major improvements in the security and scope of HF messaging, helped in no small measure by the IP approach enshrined in STANAG-4406, and the retrofit of legacy ACP-127 traffic with the ability to carry attachments and be handled in a similar fashion to standard email using STANAG-5066. The BRASS architecture will help ease workloads and make the handling of HF messaging between ships and between ship and shore more efficient. ■

Aegis Global Alliance – The Whole is Greater than the Sum of its Parts

Scott C. Truver

Potential adversaries – terrorist groups and rogue regimes as well as nation-states – possess cruise and ballistic missiles that can be armed with chemical, biological, radiological, nuclear, and high-yield conventional explosive warheads. China, North Korea and Russia, in particular, continue to develop increasingly lethal land- and sea-based missiles, raising concerns about threats to naval forces at sea and targets ashore.

Rear Admiral (RDML) Tom Druggan, USN, Program Executive, Sea-Based Weapons Systems/AEGIS Ballistic Missile Defense (SBWS/ABMD), warns that "advanced missile threats – from supersonic, sea-skimming cruise missiles to hypersonic missiles to ballistic missiles – are proliferating widely with rapidly increasing capability. These advanced missile threats stress our missile defences at all levels – tactical, operational, and strategic – at sea and ashore," he explained. "Potential adversaries view missiles as a primary method to hold United States and allied/partner forces at risk. It is important that US war-fighters have the capabilities to prevail against today's and tomorrow's threats."

"Globally deployed and land-based AEGIS BMD capabilities are critical to the Nation's integrated defence for our deployed forces, allies, and partners" Vice Admiral (VADM) Jon A. Hill, Director, Missile Defense Agency, underscored. "We enthusiastically reach out to allies and partners to sustain a global missile defence alliance, with the whole significantly greater than its parts."

As of 2022, six foreign navies had embraced AEGIS, whilst several others were testing the waters.

Photo: Via Author

The octagonal antenna of the AN/SPY-1 radar is closely associated with the AEGIS system that forms the core of US Navy BMD capabilities. It will be replaced by the new AN/SPY-6 AMDR in ships currently in the course of construction.

The Threat is Real and Growing

More than 20 states have nuclear and conventionally armed Weapons of Mass Destruction (WMD) ballistic missiles in their arsenals, and many more are armed with anti-ship cruise missiles, manned aircraft, and offensive drones.

- **China** has several variants of anti-ship ballistic missiles. Offensive missiles play an increasingly prominent role in China's efforts to counter US force capabilities in the Indo-Pacific region. China is improving its ability to strike regional targets with medium and intermediate-range ballistic missiles. And China's sophisticated anti-ship ballistic missiles pose a direct threat to US Navy aircraft carriers and other major surface and amphibious warships.
- **North Korea** is accelerating efforts to field new missiles capable of threatening US forces, allies and partners, and the American homeland. Pyongyang continues to improve the performance of existing systems while developing new capabilities. On 28 July 2017, North Korea flight-tested its new road-mobile Intercontinental Ballistic Missile (ICBM); the HWASONG-14. On 3 September 2017, North Korea conducted its sixth and most powerful nuclear test to date. On 28 November 2017, it tested the HWASONG-15, which could potentially target the US mainland. In early 2022, North Korea conducted five ballistic missile tests, two of which were fitted with a never-before-seen warhead.
- **Russia** has conducted an aggressive program of strategic missile modernisation. Moscow has developed a new generation of advanced ballistic and cruise missiles. Russia has demonstrated this advanced cruise missile capability by conducting long-range precision strikes from the Caspian Sea into Syria. Development of new land-based/mobile ICBMs and submarine-launched ballistic missile

Author

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Photos: US Navy

An AEGIS control operator stands watch on the US Navy destroyer CARNEY (DDG-64). Globally deployed AEGIS BMD capabilities are crucial for the integrated defence of American and allied interests.

The ARLEIGH BURKE class guided-missile destroyer RALPH JOHNSON (DDG-114) and the TICONDEROGA class guided-missile cruiser PRINCETON (CG-59) steam in formation.

systems continues, with Russia ultimately building and retaining the largest force of strategic ballistic missiles outside of the United States. Russian President Vladimir V Putin's declaration in February 2022, putting his nuclear forces into "special combat readiness" during the Ukraine crisis, sharpened concern.

Hypersonic seems to be all the rage in early 2022. China, Russia, and North Korea are developing advanced cruise and hypersonic missiles that could negate even the most capable defensive systems. This includes a new class of Chinese missiles that travel at velocities approaching Mach 20 and fly at much lower altitudes than ballistic missiles. In August 2018, China successfully tested the XINGKONG (Starry Sky-2) hypersonic "wave-rider" vehicle.

Subsequently, in October 2020, a Russian frigate successfully test-launched a hypersonic missile from the White Sea, striking a target in the Barents Sea after traveling about 280 miles (450 km). "The missile reached a maximum speed of more than Mach 8 during the 4.5-minute flight," the US Congressional Research Service (CRS) explained. "Hypersonic Glide Vehicles (HGVs), like all weapons delivered by medium and longer-range rocket boosters, can travel at speeds of at least Mach 5, or about one mile per second. The key difference between missiles armed with HGVs and missiles armed with ballistic re-entry vehicles (i.e., those that travel on a ballistic trajectory throughout their flight) is not their speed, but their ability to manoeuvre and change course after they are released from their rocket boosters."

Dangerous, for sure, but all is not lost.

AEGIS…Shield of the Fleet – and More

During Operation Desert Storm (1991), Iraqi forces fired 88 short-range SCUD ballistic missiles against targets in Saudi Arabia, Bahrain, and Israel. Despite the availability of US Army PATRIOT surface-to-air missile units, massive amounts of war materiel and ordnance being off-loaded and harboured behind the offensive lines were at risk of SCUD missile attack. Clearly, the United States, its allies, and coalition partners required missile defences in all phases of a conflict. AEGIS was to be a key part in meeting this requirement.

The provenance of US sea-based BMD actually extends back nearly a decade earlier, to December 1983, when the Navy's AEGIS Weapon System (AWS) deployed in the guided missile cruiser TICONDEROGA (CG-47). In all, 27 CG-47 class warships rounded out the US Navy's "high-mix" of late-Cold War surface warships. Subsequently, in July 1991, the guided missile destroyer ARLEIGH BURKE (DDG-51) joined the fleet. By early 2022, 87 DDG-51 class destroyers were in service or under construction. Even more "Flight III" DDG-51s and next-generation DDG(X) destroyers are waiting funding. Developed and continuously upgraded for nearly 60 years – beginning with the Advanced Surface Missile System (ASMS) in the early 1960s – today's AEGIS is a tightly -integrated package of sensors, weapons, and battle-management systems.

Vital in this regard is the "build-a-little… test-a-little…learn a lot!" philosophy championed by the late RADM Wayne E. Meyer, USN, widely regarded as the "Father of AEGIS" or FOA. AEGIS Program Manager (PMS-400), FOA knew this was the most prudent way to insert revolutionary capabilities into the fleet in an evolutionary manner. Indeed, AEGIS is among the top three or four US Department of Defense programmes – along with nuclear power in surface warships and submarines, and submarine and silo-launched nuclear-armed ballistic missiles – developed and deployed since 1945. The catalysts that drove AEGIS BMD excellence in the last 60 years must now be marshalled for the next.

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The guided-missile destroyer JOHN PAUL JONES (DDG-53) launches a Standard Missile (SM) 6 during a live-fire test of the ship's AEGIS weapons system. The multi-role missile's capabilities include the provision of defence against hypersonic weapons and ballistic missiles in their terminal phases.

Originally designed to counter the threat posed by raids of Soviet anti-ship missiles and aircraft, the US Navy saw the advantage of leveraging the operationally proven capabilities of its AEGIS warships to produce a cost-effective, flexible, and survivable sea-based BMD capability. Sea-Based Weapon Systems, AEGIS Ballistic Missile Defense (SW/AB) programmes include the Navy AEGIS Weapons System Mk 7, which in turn comprises four major elements: (1) the SPY-1 radar system with four fixed phased-array antennas; (2) a Command and Decision (C&D) system; (3) a Weapon Control System (WCS); and (4) the STANDARD Missile (SM) 3 family and STANDARD Missile 6 interceptors.

Mindful of the "FOA" dictum, the Navy has developed seven specific AWS baselines, five AEGIS BMD spirals, three versions of the SM-3 interceptor, and the SM-6 "multi-mission" missile.

The SPY-1 is an advanced, automatic detect and track, multi-function phased-array S-Band radar. This high-powered radar performs search, track, and missile-guidance functions simultaneously, with a track capacity of more than 100 targets at significant ranges, in the order of 190 miles. The computer-controlled passive electronic scanning system uses four antennas providing 360-degree coverage.

The SM-3 (RIM-161) is the US Navy's family of exo-atmospheric ballistic missile defence interceptors. The SM-3 evolved from the earlier Standard Missile Two (SM-2) family and is a four-stage rocket launched from surface warships or ashore. The Navy is evolving to the SM-6 Dual-Mode Interceptor (RIM-174) configurations for area and ship self-defence, including a sea-based terminal missile defence capability.

Two variants of the SM-6 are in service, Block I and Block IA. The third, Block IB version is under development. The Block IB has a completely redesigned body and a larger rocket motor. It promises to reach hypersonic speed and therefore have greater capabilities against hypersonic threats. The SM-6 series "is really the nation's only hypersonic defence capability," MDA Director VADM Hill remarked at a January 2022 conference. These weapons have a "nascent capability" to engage incoming hypersonic, manoeuvring threats. Dubbed the Regional Glide Phase Weapon system, the whole idea is to "handle high-speed manoeuvre."

As of 2022, the US Navy is also developing AWS Baseline 10.0 and AEGIS BMD Spiral 6.0 that include a new SPY-6 Air and Missile Defense Radar (AMDR) providing greater radar sensitivity, increasing performance against additional threats and larger raids, and improved missile performance.

In June 2021 congressional testimony, VADM Hill said AEGIS "is the first regional hypersonic missile defence capability deployed with aircraft carrier strike groups today." He also discussed the Hypersonic and Ballistic Tracking Space Sensor [HBTSS] that provides targeting information to the SM-6 missile. "And it's important that we have that capability now because the hypersonic threat is there now. What we want to do is move further back into that trajectory, engage earlier, make the terminal defence even better.

"In addition to addressing fleet air defence concerns," RDML Druggan outlined, "in the mid-1990s the Navy began to examine the theatre-wide ballistic missile threat to forces at sea and ashore. In January 2002, LAKE ERIE (CG-70) fired the first AEGIS BMD shot, a STANDARD Missile that intercepted a unitary target test vehicle representing a SCUD missile. AEGIS has proven effective in numerous flight tests since 2002, with successful lethal intercepts in 41 of 50 live-fire tests." Four Japan Maritime Self-Defence Force (JMSDF) destroyers – ATAGO, CHOKAI, KONGO, and MYOKO – participated in these tests.

A US Navy AEGIS-equipped destroyer leads allied ships during the RIMPAC 2020 exercises. Growing interest in both AEGIS-based and other BMD-capable systems holds out the prospect of significant expansion in allied BMD capacity.

The most unprecedented event came on 16 November 2020. The AEGIS destroyer JOHN FINN (DDG-113) successfully intercepted on the first shot a target-intercontinental ballistic missile; a remarkable accomplishment. The destroyer used engage-on-remote capabilities in a "defence of Hawaii scenario." After receiving tracking data from the Command-and-Control Battle Management Communications System, FINN launched an SM-3 Block IIA guided missile that destroyed the target, thus satisfying a US Congressional requirement to prove the missile's ability to defeat an ICBM threat by 2020.

"This was an incredible accomplishment and critical milestone for the AEGIS BMD SM-3 Block IIA programme," VADM Hill enthused. "We demonstrated that an AEGIS BMD-equipped vessel equipped with the SM-3 Block IIA missile can defeat an ICBM-class target, which is a step in the process of determining its feasibility as part of an architecture for the layered defence of the homeland."

Allied AEGIS Afloat…

Sales of the AEGIS system to allied and partner countries began in the late 1980s. Since then, allied navies operating AEGIS-equipped ships encompass Australia, Japan, Norway, South Korea, and Spain. Japan's AEGIS-equipped ships are BMD-capable but those operated by Australia, Norway, South Korea, and Spain cannot currently engage ballistic missiles. The AEGIS Global Alliance in 2022 therefore included six navies, encompassing more than 100 warships. Details of these allied operators are as follows:

- **Australia:** The Royal Australian Navy (RAN) acquired three HOBART class destroyers that have AEGIS as the core of their combat systems. The RAN's ships are not BMD-capable. The nine HUNTER class frigates to be delivered from the next decade onwards will also be AEGIS-equipped.
- **Japan:** The JMSDF operates eight AEGIS warships: four KONGO class; two improved ATAGO class; and two MAYA class destroyers. All JMSDF destroyers are BMD-capable. The CRS notes that Japan co-operated with the United States on development the SM-3 Block IIA missile. Japan developed technologies for the missile and paid for the development of those technologies, reducing the missile's development costs for the United States. A July 2018 report noted, "…the U.S. and Japan are looking to jointly develop next-generation radar technology that would use Japanese semiconductors to more than double the detection range of the AEGIS missile defence system."

An SM-3 missile is seen being launched from the JMSDF destroyer KIRIMISHA. Japan has helped finance and develop the Block IIA iteration of this weapon.

The AEGIS Ashore Missile Defense System located at Deveselu in Romania.

- **South Korea:** The Republic of Korea Navy operates three SEJONG THE GREAT class AEGIS destroyers with air defence capability, with the lead ship commissioned in 2008. Moreover, three additional destroyers now being acquired will have BMD capability. South Korea has also decided to acquire SM-3 interceptors to put this expanded capacity into effect.
- **Norway:** The Royal Norwegian Navy operates four Spanish-built FRIDTJOF NANSEN class frigates equipped with the AEGIS, none of which have BMD-capacity.
- **Spain:** The Spanish Navy currently operates five F100 ÁLVARO DE BAZÁN class AEGIS frigates. These will be supplemented by the new F110-class frigates in the course of the current decade. The F-110 class will incorporate SPY-7(V)1 radar and the International AEGIS Fire Control Loop (IAFCL) will be integrated with a national combat system. However, it is not currently planned for the F110 class to be BMD-capable.

In addition, the Royal Canadian Navy plans on building 15 Canadian Surface Combatants that will also be AEGIS-equipped. The ships will also have the SPY-7(V)1 solid-state

radar, and the IAFCL will be integrated with the current Lockheed Martin Canada CMS 330 combat management system installed in Canada's HALIFAX class ships.

provides continuous defence of European NATO territory, primarily against Middle East missile threats. AEGIS Ashore Romania operates under NATO command and control, an important consideration during the Ukraine crisis. An additional AEGIS Ashore site in Poland is under construction and will become an integral element of NATO ballistic missile defence. There also have been proposals for an AEGIS Ashore facility in Guam.

AEGIS Global Alliance Exercise: Pacific Dragon Trilateral Coordination

The North Korean ballistic missile threat generates highly focused trilateral cooperation at sea. The biennial Pacific Dragon exercise brings the U.S. Navy, Japan Maritime Self-Defence Force, and the Republic of Korea Navy to improve tactical and technical coordination, including the detection, tracking, and reporting of ballistic targets.

"Pacific Dragon not only allows participants the opportunity to exercise ballistic missile defence but it enhances the already strong relationship of all three nations participating," said Vice Admiral Nora Tyson, Commander, U.S. 3rd Fleet.

Pacific Dragon 2016 brought together the Pacific Missile Range Facility, JOHN PAUL JONES (DDG-53), SHOUP (DDG-86), Japan's CHOKAI, and the Republic of Korea Navy's SEJONG THE GREAT S and GANG GAM CHAN. The exercise featured a coordinated live ballistic target tracking event that tested each navy's AEGIS BMD capability. The test history underscored the benefits: "All participants shared tactical data link information in accordance with a trilateral information sharing agreement. And, while no missiles fired, all participants strengthened interoperability, communication channels, data collection, and capabilities assessments."

In short, this ongoing trilateral exercise strengthens relationships with participating allies and partners while further developing maritime regional MDS capability and capacity.

It is also worth noting that other Allied navies are implementing or exploring BMD systems based on technology of their own design. These different combat systems have the potential for contributing to BMD missions being performed by AEGIS-equipped ships.

AEGIS Global Alliance Exercise: Formidable Shield

Before taking command of Sixth Fleet in 2014, I met with Vice Admiral Jim Syring, Director of the Missile Defense Agency. We wanted to enhance the quality of allied interoperability in missile defence for the European theatre. During the Obama Administration, the United States took the lead on the European Phased Adaptive Approach (EPAA) for the missile defence of Europe. The US Navy accepted a large portion of the task with its four destroyers based in Rota, Spain.

In addition, the Navy constructed two AEGIS-ashore facilities for land-based defence—one in Romania and one in Poland. Jim and I wanted to add realism to the training environment, seeking to obtain funding and execute a live-fire event with an SM-3 missile fired from a Forward Deployed Naval Forces (FDNF) destroyer operating in consort with allied navies. This came to fruition with the first-ever SM-3 fired from the Hebrides range, off the coast of Scotland, during Formidable Shield in 2015.

That first Formidable Shield was so successful it became a biennial exercise, following in 2017, 2019, and 2021. Each subsequent exercise is bigger, with more participants than the last. Allies and partners contribute ships, provide cueing data, and protect the high-value unit by firing anti-ship cruise missiles in a variety of challenging scenarios during the two-week period at sea. It is an outstanding training event, made possible by the forward-deployed AEGIS destroyers in Rota. Eventually, European NATO Allies will lead this exercise.

Admiral James G. Foggo, U.S. Navy (Retired)

…AND AEGIS Ashore

AEGIS Ashore is the land-based version of the AEGIS Weapon System and is operated by the US Navy as part of the European Phased Adaptive Approach (EPAA). An AEGIS Ashore site in Romania is operational, armed with the SM-3 interceptor, and The two AEGIS Ashore sites are equipped with the SM-3 Block IIA interceptor, significantly increasing defended battlespace and strengthening the defence of NATO territory. The EPAA originally planned evolutionary variants of the Standard SM-3 missile to be introduced in phases to defeat the short, medium, and intermediate-range ballistic missile threats to the region. The SW/AB AEGIS BMD option with SM-3 interceptors, complemented by other ground, air, and space-based missile defence systems, meets current regional threats and can evolve to meet future challenges.

Japan had planned to acquire two AEGIS Ashore facilities that were to be located at Ground Self-Defence Force (GSDF) facilities in Akita Prefecture in eastern Japan and Yamaguchi Prefecture in western Japan and be operated mainly by the GSDF. The two sites were to be equipped with a new Lockheed Long-Range Discrimination Radar (SPY-7) rather than the Raytheon-made SPY-6 AMDR that is being installed on the latest US Navy Flight III DDG-51s. They were reportedly to go into operation by 2023 but Japan cancelled the plan in 2020. Instead, Japan will put AEGIS radars on additional warships to upgrade its defence against North Korean ballistic missiles.

Looking Ahead

"Multi-mission missile-defence surface warships are broadly deployable and highly survivable," RDML Druggan asserted, "More to the point, forward-deployed US Navy warships are being augmented by a growing number of allied and partner vessels." Increased ship numbers and enhanced capabilities ensure an unmatched missile-defence capability: The AEGIS Global Alliance.

Note on Sources

Hill and Druggan, *Three Decades of Aegis Excellence, Aegis Ballistic Missile Defense,* 1992-2021 (Dahlgren, VA: Missile Defense Agency, Sea-Based Weapon Systems/Aegis Ballistic Missile Defense, forthcoming 2022); Ronald O'Rourke, *Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress* (Washington, DC: Congressional Research Service," Washington, DC: 60, 9 October 2019); *Ballistic and Cruise Missile Threat 2017* (Wright-Patterson AFB: Defense Intelligence Ballistic Missile Analysis Committee, NASIC-1031-0985-17, June 2017); *Missile Defense Review* 2019 (Washington, DC: Office of the Secretary of Defense, 2019); Daniel R. Coates, Director of National Intelligence, *Worldwide Threat Assessment of the U.S. Intelligence Community* (Washington, DC: Office of the Director of National Intelligence, 29 January 2019); Foggo, "Forward Naval Presence: A Political, not Military, Leadership Program," *USNI Proceedings*, January 2022.

Israel Shipyards Ltd

Based in Haifa Bay, Israel Shipyards has gained an international reputation as manufacturers of fast attack craft, fast patrol boats and constabulary vessels. In advance of the ISDEF 2022 Expo, Maritime Defence Monitor spoke with the company about its current product line-up and future plans.

MDM: Thank you for taking the time to speak with MDM. Would you be able to start by providing a brief description of Israel Shipyards and its current position in Israel's defence sector?

Israel Shipyards Ltd (ISL): ISL was initially established as a government-owned company in 1959 but was subsequently privatised in 1995. In September 2020, its holding company – Israel Shipyards Industries – was publicly listed on the Tel Aviv Stock Exchange (TASE) by the group's controlling shareholders.

ISL is Israel's only shipbuilder, occupying facilities of over 300,000m² and employing a full-time workforce of some 500 employees in addition to contractors. We are able to provide a comprehensive range of ship design, construction, repair and maintenance services as well as associated training, technical and logistical support. We are prime contractor for many of the Israeli Navy's warship programmes, as well as for numerous export customers across the globe. We also manufacture various commercial vessels ranging from 5,000 tonne cargo vessels to tugs and service boats. In addition to shipbuilding, we offer a comprehensive range of manufacturing solutions for coastal and land-based structures. Our 3,000 tonne capacity Syncrolift shiplift in Haifa Bay serves both naval and commercial vessels.

MDM: Please provide an overview of your current naval and maritime security product range?

ISL: We essentially have three main product lines. Our largest warships are our famous SAAR fast attack craft and corvettes that were initially developed for the Israeli Navy and of which the most recent iterations are the SAAR 72 and RESHEF. We also supply a range of offshore patrol vessels (OPVs), based largely on the combat-proven SAAR 4 and SAAR 4.5 hull forms but incorporating weapons and sensors that are more appropriate for our maritime security-focused customers' mission profiles and budgets. This product line also includes our independently-developed OPV 45 design. Finally, we offer our proven SHALDAG series of fast patrol boats ranging in size from the 19.8m MINI-SHALDAG to the 32.7m SHALDAG Mk V.

Photo: Israel Shipyards Ltd

Israel Shipyards occupies facilities encompassing around 330,000m² in Haifa Bay.

MDM: You mention the SAAR 72 and RESHEF designs. Could you discuss the key features that will be incorporated in these ships and the overall importance of the programme to the company?

ISL: The SAAR 72 design was initially developed with the Israeli Navy's forthcoming replacement of its SAAR 4.5 fast attack craft in mind, with the RESHEF reflecting revisions to this design – including greater length and beam – specifically requested by the naval authorities. At the same time, it is readily adaptable to meet overseas requirements. Examples include the THEMISTOCLES type proposed for the Hellenic Navy as well as more affordable, constabulary variants.

The RESHEF class is designed to fulfil a wide-range of combat and maritime operations, providing long endurance whilst also being capable of stable, high speed operation. Key design characteristics include:

- A high payload to displacement ratio combined with advanced signature management and associated technologies.
- Provision of a state-of-the art weapons and sensor suite.
- Ergonomically designed and spacious control facilities, including the combat information centre, bridge and machinery control room.

Photo: Israel Shipyards Ltd

This OPV supplied to Honduras was based on the combat-proven SAAR 4.5hull form.

Photo: Ilsrael Shipyards Ltd

Adapted from the SAAR 72 design to meet Israeli Navy requirements, the RESHEF class is designed to perform a wide range of combat and maritime security operations.

Photo: Ilsrael Shipyards Ltd

The SHALDAG Mk 5 is the largest of the well-established SHALDAG series of fast patrol boats.

- A hybrid diesel-electric/diesel propulsion system. This allows speeds of up to nine knots to be achieved from electrical motors powered by the ship's four diesel generators with up to 30 knots being provided from the main diesels.
- A range of at least 3,000 nautical miles at 15 knots.
- Up to 63 bunks with enhanced standards of crew habitability
- A reserve for through life growth.
- Design in accordance with DNV Naval Vessel Rules.

Design and construction of the RESHEF class will be of paramount importance to ISL over the coming years. We anticipate a firm contract to construct the class within the course of 2022.

MDM: Turning to the other end of your warship portfolio, an important product both for the Israeli Navy and a major driver of export success has been the SHALDAG series of fast patrol boats. Could you please describe the key characteristics of this design and how you are developing it to remain competitive?

ISL: The SHALDAG fast patrol craft family is, indeed, a major product line for us, offering our worldwide customers a reliable solution at relatively low initial acquisition and ongoing maintenance costs. We have been developing the series on a constant basis, utilising the operational experience gained by the Israeli Navy and other users. For example, we now offer SHALDAG variants in a range of sizes, all of which are suitable for operation both in riverine environments and in open waters. We are also focused on the human factor, working hard to optimise crew accommodation and operating conditions.

Important features of all SHALDAG variants include;

- Use of a deep 'V' planing hull form offering low resistance.
- combination of excellent stability with an ability to maintain high speeds in heavy seas.
- Spacious operating facilities and good habitability.
- quipped for operation in demanding conditions with additional security provided by good levels of hull sub-division.
- A capacity for both day and night-time operation.

MDM: You have recently announced a number of important contracts for SHALDAG craft. Could you say something about their importance to the company?

ISL: Last year, we announced two very important contracts relating to the sale of SHALDAG Mk V variants, one to an East Asian Navy and one to the Israeli Navy. [1] Including an option for one vessel, the contracts amount to a total of 13 ships, providing our company's facilities with considerable visibility by ensuring continuity of production of the type over the next few years. The export contract also includes a significant transfer of technology element, including provision of assistance with respect to the upgrading of an existing shipyard to enable the local maintenance and even construction of the new vessels. It is also noteworthy that some of these ships will be equipped with Rafael's SPIKE NLOS (Non Line of Sight Missiles), a first for craft of this family.

MDM: Speaking more generally, what do you perceive as ISL's main advantages in highly competitive export markets?

ISL: We believe that ISL have a number of critical advantages over our competitors. First, it is important to note that our entire product range is one of a very few to be based on real-world combat operations, benefitting from ongoing feedback based on the experience gained by the Israeli Navy. For example, whilst our patrol vessels offer cost-effective solutions for maritime security missions, they are based on adapted warship hulls rather than the more common approach of upgrading designs based on an essentially commercial specification. We find that our own design approach is attractive to many of our customers.

It is also significant that we focus on offering bespoke solutions to meet our customers' precise mission requirements rather than 'off-the-shelf' products with only a minimal level of customisation. For example, when we constructed SHALDAG Mk II patrol craft for the Argentine Naval Prefecture, we spent time aboard their existing vessels to understand their mission profile and then revised our design to make it fully suitable for their needs.

Finally, we focus on providing a comprehensive, 'turn-key' solution based on a single-point of contact for all customer requirements' related to a vessel and its systems, facilitated by our lengthy history of collaboration with the wider Israeli defence sector. This extends beyond construction to encompass ongoing support and training. We have the ability to propose a wide range of transfer of technology options, can facilitate a wide range of financing options and are able to offer the additional dimension of Government-To-Government (GTG) transactions with the support of the Israeli Ministry of Defence.

MDM: Could you please provide some more detail about your relationship with both the Israeli Navy and also other Israeli defence companies?

ISL: We have successfully served the Israeli Navy's requirements for the last 50 years,

providing a comprehensive range of solutions both in terms of new warship construction and ongoing maintenance requirements. This is reflected in the reputation of the vessels we have delivered to date, notably the SAAR 4 and SAAR 4.5 missile boats and the SHALDAG patrol craft. Whilst the navy has very demanding requirements, the fact that many of the company's management team have previously served as officers in the navy helps us to understand and fulfil these needs.

Similarly, we have longstanding relationships with companies across the Israeli defence sector, including the major groups of Elbit, IAI and Rafael but also many others. We usually work with these companies as prime contractor on naval construction projects and highly value the extent of our collaboration as it provides our customers with easy access to a wide range of high quality technologies. At the same time, our focus on providing bespoke customer solutions means that we can readily work with many other defence equipment suppliers across the world, subject – of course – to the normal contractual requirements.

MDM: Israel's naval sector also has a lengthy relationship with its counterparts in Germany, for example with respect both to the MAGEN class corvettes and the DOLPHIN class submarines that you are contracted to maintain. How important is this relationship to Israel Shipyards and what advantages does it bring to you?

ISL: Whilst we are not at liberty to discuss these specific programmes, we have enjoyed a strong relationship with the German maritime sector over a long period of time and are accustomed to sharing know-how and new capabilities with them. This relationship is not only important for ISL but also for the broader Israeli maritime sector.

MDM: As you already mentioned, the provision of training and ongoing logistical support is often as important to customers as the actual characteristics and cost of a ship. Could you elaborate on the support services and training you can provide, both for the Israeli Navy and for export contracts?

ISL: We are able to provide a comprehensive range of maintenance and support services based on specific customer need. Most of our export customers add a package of long-term maintenance support to the purchase contract but, inevitably, the terms of this vary from customer to customer. For example, this can extend from initial on-site support from an ISL team to establishment of a permanent ISL service centre at a location of our customer's preference. As previously mentioned, we can also offer extensive transfer of technology arrangements. We fully recognise the attraction of such arrangements to many customers and see these as a 'win-win' solution.

In terms of training, we offer a comprehensive training service that commences in the months before a vessel is formally handed over as an integral part of our delivery package. The training is provided at our Israel Shipyard Training Centre (ISTC) by instructors who have previously gained experience in the technical disciplines for which they are responsible with the Israeli Navy. It encompasses both operational and maintenance aspects. For vessels ordered by the Israeli Navy, this training programme typically extends over the three months prior to a warship being delivered. In general terms, the programme of support provided to export customers is of longer duration and even more extensive.

Photo: Israel Shipyards Ltd

SHALDAG MK II patrol boats on the Paraná River. Cap[able of operation in riverine environments and in open waters, these craft can be readily adapted to meet a navy's specific mission requirements.

MDM: Finally, could you outline your vision for ISL at the end of the current decade?

ISL: We want to retain ISL's position as the main supplier of naval solutions to the Israeli Navy, as well as to reinforce our reputation as a provider of similar systems and technologies to other countries. Given its critical importance to both ISL and the navy, we are particularly focused on the success of the RESHEF programme whilst continuing to deliver a wide range of affordable and effective vessels to navies and maritime security agencies in all parts of the world.

The interview was conducted by Conrad Waters. MDM would like to thank Michal Lerner of MicCom Marketing Communications for her assistance in facilitating the interview.

Note

1. Although not officially confirmed by ISL, published Philippine sources indicate that country as being the export order's destination.

Securing the United States' Maritime Borders from the Narcotics Trade

Maritime Domain Awareness is too big for one agency

Edward Lundquist

One of the primary missions for the US Department of Homeland Security (DHS) is keeping illegal drugs out of the country. The DHS leads the nation's drug interdiction efforts through a cross-component approach involving the United States Coast Guard (Coast Guard), US Immigration and Customs Enforcement (ICE) – which investigates criminal activity associated with illicit drug trafficking – and US Customs and Border Protection (CBP). Within CBP, the Office of Field Operations (OFO) operates at the ports of entry into the United States while the US Border Patrol (Border Patrol) operates between ports of entry. Meanwhile CBP's Air and Marine Operations (AMO) components supplements Coast Guard activities in patrolling the waters near the United States' maritime borders. This article looks at AMO's collaborative approach as it seeks to counter the narcotics trade.

US Customs and Border Protection: Working in Partnership

For US Customs and Border Protection (CBP), maritime border protection begins with Maritime Domain Awareness (MDA). "We're trying to find bad people doing bad things," said Richard Booth, who just retired in December 2021 as the executive director of the CBP's Air and Marine Operations Center (AMOC), located at March Joint Air Reserve Base in Riverside, California. "And we try to get them locked up."

But the problem is too big for one agency. That's why both partnerships and technology are so important.

The Department of Homeland Security (DHS) was created after 9/11, bringing together 22 different organisations. CBP is one of the seven major agencies in the DHS, and has three operational components: the Border Patrol; the Office of Field Operations (OFO); and Air and Marine Operations (AMO). AMO is essentially CBP's own air force and navy, with a fleet of aircraft and boats. However, according to Booth, "The area we have to cover and all the things that we are looking for are collectively too big for the AMO team alone. So, my focus at AMOC is collaboration and cooperation."

Photos: US CBP

Aircraft of the US Customs and Border Protection's Air and Marine Operations component play an important role in securing the United States' borders against the narcotics trade.

An example of the collaboration is in South Florida. The establishment of the FBI's South Florida Joint Terrorism Task Force (JTTF), and the standing up of the Joint Intelligence Operations Center (JIOC), with participation by CBP, has made a difference. "Coordination has to be on a daily basis," said Vernon Foret, CBP's director of field operations for South Florida. "In a crisis situation, if the coordination has already happened on a regular basis, then you're able to respond to that crisis much quicker, with appropriate personnel and resources."

Sharing is about giving and taking, Foret said. "You can't be a part time partner. You have to be committed with the personnel and the resources, because nobody knows better than your own people about what you need to know and what's going to be beneficial to you." The effort has paid off, he said. "There's no better place for discussion, communication and coordination that here in South Florida."

The Technological Dimension

Whilst AMO also relies on technology, information sharing remains fundamental.

Booth said that domain awareness is much more than sensors. "If I have a blip on my scope, that's all it is. I need information to

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help me understand what that blip means. That information can come from intelligence, a routine patrol, other agencies or partners, or all of that. This system of cooperation with the public and our professional comrades who are out there trying to do this joint mission is fundamental. Information sharing is of paramount importance."

While the technology helps to gather, analyse and share that information, it can also be a limiting factor.

"We need persistent, wide-area sensors. It doesn't have to be radar, but something that's more affordable than the people needed to operate fleets of airplanes or boats. We're still going to need aircraft, and we're going to need vessels that can get to sea, but they can't carry the whole load. And we need the analytic tools and the artificial intelligence to make sense of the huge amounts of data, and to decide the best courses of action," said Booth. "That's where we are headed, but we need to come to a consensus about what we're going to do about it."

Automatic Identification System (AIS) and Automatic Dependent Surveillance-Broadcast (ADS-B) provide vessel and aircraft information and track data respectively. All ships above 300 tons need to have AIS to broadcast information about a ship's name, dimensions, course, speed and other data. However, it can be turned off by vessels that don't want to attract attention. On aircraft, ADS-B shares information aircraft's GPS location, altitude, ground speed and other data to ground stations and other aircraft.

The Federal Aviation Administration (FAA) is divesting itself of air tracking radars and adopting ADSB. But that has unforeseen consequences for the AMOC.

"We've been creating domain awareness from systems that were built for aviation safety, navigation and de-confliction. As the FAA moves to a passive system, like ADSB, which doesn't require a radar environment, the need for the FAA to maintain those radars goes away. AIS and ADSB are useful for tracking cooperative vessels and aircraft. Radar is more important when it comes to tracking uncooperative targets," said John Priddy, executive director of AMO's Southeast Region.

"It's no good to me if you can cut it off," Booth added. "But skin paint is different. I'm going to see you whether you want me to or not. If I can send energy out there and get that energy reflected of the target, and know you're there, and where you're going, then you can't do anything about it. The radar can verify what AIS and ADSB is showing."

If the maritime routes are being rigorously prosecuted, and a smuggler can fly without ADSB without worrying about being tracked by radar, then they will carry the biggest load they can and take it directly to the arrival zone and the market, with the lowest number of touch points and cost. "There are no roadblocks in the sky. If we can't see them, we can't stop them."

Part of a consignment of around half a tonne of suspected seized cocaine aboard the US Navy littoral combat ship SIOUX CITY (LCS-11) after a successful combined operation. Maritime border security requires a partnership approach.

Part of the solution includes having the same information-sharing systems.

- CBP's Air and Marine Operations Surveillance System (AMOSS) takes in data from all kinds of sensors, all sources of intelligence, social media, law enforcement reporting and other open-source information and integrates and shares it with other agencies.
- CBP utilises the Treasury Enforcement Communication System (TECS), which manages the flow of people at the border, and tracks suspicious individuals and cargos.
- The Marine Information for Safety and Law Enforcement (MISLE) system supports the Coast Guard's coordination and documentation of vessel boardings, facility inspections, marine casualty investigations, pollution response actions, law enforcement actions, and search and rescue operations.
- The Integrated Maritime Domain Enterprise - Coastal Surveillance System (IMDE-CSS) integrates multiple disparate sensors like radars and cameras along the maritime border to deliver a common operating picture.
- The US Navy has developed the MINOTAUR mission system architecture to incorporate sensors and command, control, communications, computers, cyber, intelligence, surveillance and reconnaissance (C5ISR) equipment to help aircrews to gather and process surveillance information that can be shared to other platforms and units during flight. MINOTAUR is used by Coast Guard and CBP.

Marine Interdiction agents with US Customs and Border Protection Air and Marine Operations patrol Miami Beach, Florida. Successful narcotics interceptions rely on a combination of technology and effective inter-agency collaboration.

The US Customs and Border Protection agency's P-3 patrol aircraft are amongst its most effective assets.

"We working on developing not just the technology, but the information-sharing architecture so our systems can be integrated and work together seamlessly," Booth said. "We don't have enough people to check out everything that we see. But, if we send you out there, we need to be looking at the same track. That's why we've provided about 1,500 AMOSS accounts to federal, state and local agencies. We have almost 500 accounts with the Coast Guard alone, including accounts on cutters. The US Navy, AMO and the Coast Guard have all invested in MINOTAUR as an agnostic backbone of information, but these organisations have pursued different methods of distributing the data and at different data rates."

Just like information, the technology is best when it is shared. Booth said partnerships benefit all of the participants. "We need to get to know those people operating in the air and maritime domains, and make them our partners. As we explore, evaluate and recommend the acquisition and deployment of domain awareness technology, we will increase and share domain awareness, technology with you."

JIATF-South Maintains Vigilance

Joint Interagency Task Force-South (JIATF-South), located at Naval Air Station Key West in Florida, is a unique inter-agency and international task force protecting the United States and partner nations from the flow of illicit drugs, with representatives from 13 US agencies and 20 countries from Central America, South America, the Caribbean, Mexico, Canada and Europe.

"We collect and share intelligence that we use to help our partners interdict the movement of contraband," said Colonel Mike Phillips, US Marine Corps, operations director for JIATF-South. "We identify specific contacts of interest and pass that information to our maritime patrol aircraft that detect and monitor the suspect smugglers."

Having eyes in the sky makes a big difference.

A patrol vessel – such as a Coast Guard cutter or a navy frigate – operating alone has about an eight percent chance of finding a boat on the water moving contraband, even if there is some intelligence reporting or last-known-position. With a helicopter, that ship has about a 15 percent chance. But with an aircraft overhead, like a CBP AMO aircraft, that chance increases to between 50 and 60 percent.

Not every aircraft is the same, and not every crew is the same explains Colonel Phillips. "We have everything from small KING AIRS that give us about an hour out here on station – maybe equipped with binoculars or a basic radar set – all the way up to the P-3s and P-8s, which are the high end. We even get US Air Force HC-130 hurricane hunters in their off season. The US Navy P-8s are multi-mission aircraft that are built to conduct long-range anti-submarine warfare – they have really good sensors, including radars and cameras, and can see a submarine periscope at 15,000 feet. The Coast Guard uses their aircraft for the search and rescue mission, so they know how to look for small targets in bad weather. They're great at drift analysis, and can figure out the wind and currents to find a missing vessel or person. That can be very useful when smugglers jettison their contraband if they think they've been caught. It's important to find those drugs so they don't fall into the wrong hands, and they can be used as evidence. There are two versions of the CBP P-3 – the long-range tracker and the AEW version with the large airborne early warning radar on top. They have good sensors, as well as trained and experienced crews that have been doing this mission for as many as 15 to 20 years. They know what they're looking for."

"If we know somebody is going to be out flying in our area, we can have them transit or patrol one of our search boxes, even for a relatively short period of time. I'll take anything. If they've got a sensor, and they've got eyes, I'll take them. The more I can get up, the better."

"We don't get a bust every day," Phillips said. "But that's not really that important. This mission isn't about whether we get something or not—it's all about our commitment to look, and maintain that vigilance."

Regional Coordinating Mechanisms

According to a November 2021 DHS Inspector General report, "since 2015, overdose death numbers have risen 35 percent, reaching a historic high of 70,630 deaths in 2019. This rate of increase is greater than for any other type of injury-related death in the United States, and illicit fentanyl and

US Customs and Border Protection Air and Marine Operations' officers train on marine interdiction in the open seas at the CBP's National Marine Training Center in St. Augustine, Florida. The CBP's Air and Marine Operations activities form a crucial part of ensuring maritime domain awareness around US waters.

other synthetic opioids are the primary drivers. According to the Administration's policy, part of the solution to the opioid overdose epidemic involves preventing illicit drugs from entering the United States. Illicit drug trafficking provides most of the funding for Transnational Criminal Organizations. Even though illicit drug trafficking into the United States can occur by mail, air, and other means, it typically occurs across land and maritime borders."

In June 2011, DHS established the Maritime Operations Coordination Plan (MOC-P) to coordinate cross-component maritime operations, planning, information sharing, intelligence integration, and response activities for a synchronised departmental response to drug interdiction. CBP, Coast Guard, and ICE have enforced the MOC-P, and strengthened Regional Coordinating Mechanisms (ReCoMs). South Florida has ReCoMs in Miami, Jacksonville, Key West and Tampa (St. Petersburg), and together they have established Joint Task Force-East, led by AMO's executive director Priddy.

"Joint Task Force East is leading a collaborative working group under the senior leader group at the department, and they are reinvigorating the MOC-P to make it more contemporary and more inclusive, so that it's not just limited to the three original signatories," said Priddy. "I think it will increase the robustness of the ReCoMs.

Priddy referred to the ReCoMs as "the basic manoeuvring element of joint operations in the maritime environment, where different entities working within our own roles and responsibilities can plan, organise and execute operations in a joint environment. De-confliction is a very important aspect of it."

JTF-E and the Florida ReCoMs created a standing intelligence coordination centre that feeds the ReCoMs with reconnaissance information. "Here in South Florida, we're in the arrival zone. Just south of us, we have JIATF-South monitoring the transit zone. They do a marvellous job of task-organising resources, using intelligence and communications architecture to attack really large trans-shipments of narcotics. They can manage different entities in international waters and air space, but once a target is coming into the US it becomes a coordination problem between multiple federal, state and local agencies – multiple governors, mayors, and chiefs of police – and having to deal different jurisdictions, procedures and bureaucracies. And when those illicit shipments come ashore, they start to get split up and become even harder to detect, track and interdict. That's why we need to create that JIATF-South model of coordination here in South Florida" according to Priddy.

US Customs and Border Protection officers at the Port of Savannah celebrate a record cocaine seizure. The CBC aim to make the cost of success for drug smugglers high, and the chance of failure even higher.

"There are about 1,650 Air & Marine people. That's not a lot of people. But if we can leverage the entire DHS enterprise, and leverage that network and those partnerships, then that's a different prospect. We're truly vested in those partnerships," said Priddy. "Our successes are the Coast Guard's successes, and that hold for all of our partners. We're in this together. And that's why we want to further instil with our own people about what it is to be a good team player and assist the other agencies, we will actually move the needle on this collaborative effort."

Priddy said the ReCoM concept is not constrained to or exclusive to DHS components, but advocates also for the inclusion of state and local law enforcement partners.

"Imagine a construct where state, local, tribal, and federal partners within the maritime community start to move from pulsed operations into continuous, enduring and planned coordinated operations," Priddy said. "That's the desired end state. From that you start to get to a point of domain awareness, which includes a combination of sensor technology; not just federal sensors, but also state, local and private-public partnerships."

"Success is how well our network and coordination of all the resources available across the DHS, state, local and tribal enterprise. We need to address these threats to the homeland with the resources that we have amongst us, and execute together on a daily basis," he said.

Measures of Success

According to Priddy, the application of artificial metrics can divide different agencies and impede progress toward common goals.

Success has been measured by the quantity of drugs seized--calculated in pounds or kilograms or tons; or the 'street value;' or the number of people arrested. Those are simply data points.

Having said that, Priddy admits there is no single and simple metric. "Success is not measured in arrests, or boatloads of narcotics. You can't claim success simply because you seize more drugs. And you can't point to failure if the amount goes down. It just means the traffickers have changed their methods or routes."

Priddy said there isn't one job that AMO can do on its own. "Our success is realised when all of the agencies can bring their strengths and abilities to address the threats together. We want to ensure that we have an enterprise success."

Some believe that agencies need to show big numbers to sustain their budgets. But when one agency gets the credit for a big seizure, it doesn't take into consideration the vital participation by other organisations that made the bust possible. "It does not measure cooperation, or emphasise the need to collaborate. We have to look at the problem or solution from an enterprise standpoint, or what it takes for all of us to be successful together," Priddy said.

By flipping the metric, the problem can be viewed from the smugglers' metric for success, which can be simplified as the value of goods sold compared to the cost of doing business—basic profit and loss. Law enforcement's is to make the criminal element's job harder and more costly, and ultimately unsuccessful.

"Smugglers have been around since beginning of time," said Priddy. "If they're not smuggling drugs their smuggling people, or tobacco, or endangered animals, or anything that's taxed or prohibited. They're a transportation network that seeks to be as efficient as possible. We have to make the cost of success high, and the chance of failure even higher." ■

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How Lasers Are Reshaping Naval Warfare

Tamir Eshel

Since first appearing in 1960, lasers have changed every aspect of our lives.

The first Light Amplification by Stimulated Emission of Radiation (LASER) device was built by Theodore H. Maiman at the Hughes Research Labs, implementing theoretical work by Charles Hard Townes and Arthur Leonard Schawlow.

A laser differs from other sources of light in that it emits coherent light. Spatial coherence allows focusing the light beam to a tight spot, resulting in rapid heat transfer. It also allows a laser beam to remain narrow over great distances (collimation). Lasers can also have high temporal coherence, which allows them to emit light with a very narrow band of the electromagnetic spectrum, and thus emit a single colour of light. Alternatively, temporal coherence can be used to produce light with a broad spectrum, but ultrashort pulses known as femtoseconds.

Lasers have an impact on every aspect of our lives, from lithography and material processing in electronics, industrial and medical applications, data communications, and surgical treatments, to spectral and distance measurement in navigation, commerce, mobility, safety, entertainment, and many more applications.

Photo: US Navy

The Naval Surface Warfare Center Panama City Division conducts the first flight of developmental testing for the AN/AES-1 Airborne Laser Mine Detection System (ALMDS) integrated into the MH-60S Sea Hawk helicopter.

The same attributes that have made lasers essential for commercial and scientific uses also have military applications when integrated as part of sensors, communications, and weapon systems. In many military systems, the laser provides critical services – distance measurement, target designation, or secure communications, while in others, the laser acts as the weapon itself, delivering a lethal effect on a target over a long distance.

Unless conducted by a transparent medium or fibre, light crosses an air gap to reach its target. When operating in an open environment, visibility conditions, such as clouds, dust, or haze degrade light transmission, thereby limiting the laser's usability. This is an essential aspect as the minimum optical attenuation coefficient for ocean waters is found in the blue-green part of the spectrum. That is why designers turn to blue-green lasers for underwater applications.

Photo: US Navy

A Naval Aircrew man operates the common console used for both the Airborne Laser Mine Detection System (ALMDS) (pictured) and the Airborne Mine Neutralisation System (AMNS), aboard a MH-60S SEA HAWK helicopter. The console controls the ALMDS pod.

Sensing Above and Below the Sea

Blue-green lasers operating in the 470-475 mm range were found to be useful in anti-submarine warfare (ASW) and mine countermeasures (MCM) operations. Employed on helicopters, aircraft, and, in the future, on satellites, such lasers provide efficient sensing underwater, augmenting or replacing conventional means of sonar and magnetic anomaly measurement. The US Navy employs such laser sensors in the Airborne Laser Mine Detection Systems (ALMDS) system. Housed in an external pod carried by a MH-60S SEA HAWK helicopter, the system enables naval forces to detect, classify and localise floating and near-surface

Photo: US Navy

The ALMDS pod, which collects laser data for initial and requisition mine sweeping missions, attached to an MH-60S SEA HAWK helicopter

moored mines. ALMDS became operational in 2016 and is expected to deploy on MQ-8C FIRESCOUT drones.

While blue-green lasers can detect, classify and localise mines or submarines, other drone-based laser applications address the detailed inspection of objects, especially mines, infrastructures, or surveillance systems located on the sea floor. For these missions, Unmanned Underwater Vehicles (UUV) equipped with laser scanners are deployed.

The integration of a laser scanner and camera sensors into Autonomous Unmanned Vessels (AUV) enables these vehicles to assist in the mine identification phase and achieve the full potential of unmanned technology for MCM operations. Recent results from Hydroid REMUS 600 demonstrations at Exercise Autonomous Warrior 2018 showed the capability for a laser sensor integration into an AUV.

For the demonstration, a Remote Mine Classification Module was integrated into the REMUS 600 in just two days, replacing the existing Synthetic Aperture Sonar (SAS) module. The ULS-500 Dynamic Underwater Laser Scanner supplied by 2G Robotics generated true-scale 3D point clouds. Such high-density point cloud data enabled the identification of small features, defects, and accurate measurements. Laser mesh, combined with still image overlay, offers the potential to contribute to the identification phase of MCM operations.

Laser Warning

Aware of the evolving threat, submarine operators are considering adding Light Detection and Ranging (LIDAR) warning devices on the submarine. Saab is offering such devices as part of its naval EW solution suite. The system has a high probability of intercept and also provides the command team with the threat bearing, laser classification, and identification information required to deploy proper countermeasures.

The Naval User Laser-Warning System (NLWS) detects and analyses the laser transmissions used for ranging, targeting, and confusing adversaries. Installed in the submarine fin, NLWS-600 provides vital warning of LIDAR lasers from sources such as ASW helicopters.

Other laser applications exploit pulsed light emissions for distance measuring. A recent project by KETMaritime used a blue laser for laser distance measuring (LIDAR) underwater. Laser technology offers much higher resolution and directional sensitivity, compared to acoustic sensing. Unlike sonar, LIDAR is harder to detect (by the target) and offers interception-proof communications. Enhancement of Laser Detection And Ranging (LADAR) combines long-distance object detection. Each laser pulse scans a specific target with over 100 readings per second, providing accurate measurements of objects in 2, 3, and even 4 dimensions (3D plus time). Its water penetrating capabilities enable very high-resolution detection of objects in the surface layer up to approximately one nautical mile distance and 30 feet deep. The modular design incorporates unique technologies such as laser diodes together with optical cameras, gyros, optional AIS, and/or radar and sonar feeds to produce a comprehensive analysis of the ocean surface layer ahead of a vessel. It can detect, distinguish, classify, and track such targets in real-time. Such 'objects' can include anything from divers, underwater drones, floating containers, icebergs, whales, or small crafts. It can also indicate the existence of waves and pollution. LADAR can detect sub-metre objects at close and long-range and 1,000-times better resolution in azimuth and elevation, compared to conventional radar and sonar. The system is independent, and therefore able to operate on fast boats or stationary platforms alike. Machine Learning helps to improve the system's classification and detection capabilities over time.

Communicating in the Deep

In 2012, the US Defense Advanced Research Projects Agency (DARPA) demonstrated live communications between maritime patrol aircraft and submarines using blue-green laser communications. This capability was first tested in the 1990s under the Tactical Air-

Photo: Lockheed Martin

The ATHENA system shown here destroyed multiple drones in a real-world demonstration for the U.S Air Force.

borne Laser Communications project, which tested blue-green laser communications to link submerged submarines with Navy P-3 maritime patrol aircraft. TALC matched a blue laser to a caesium atomic line resonance receiver at 455.6 microns; the downlink was a green diode-pumped laser compatible with existing submarine receivers at 532 microns. In 2010, DARPA contracted QinetiQ North America to prepare the Tactical Relay Information Network (TRITON) to validate improvements in blue lasers and demonstrate this technology's ability to link submarines and aircraft while the submarines are either submerged or underway. Using both blue and green also enables its operation in different environments; blue is superior in clearer water in the open ocean, while green is superior in murkier coastal waters.

The US Navy wants submarine laser communications to reduce its reliance on towed-buoy receivers, to enhance the communications reliability and data throughput to ballistic missile submarines, and to enhance coordination among aircraft and fast attack submarines for ASW.

Blue light also enables secure and silent communications between UUV and between surface vessels and underwater objects. Naval users already embrace Commercial Off-the-Shelf (COTS) systems, such as Sonardyne's BlueComm, which enables wireless transmission of high bandwidth tactical data, including video, over ranges of a few, tens or even hundreds of metres, at rates of up to 10 megabits per second.

Australia's Defence Science and Technology Group (DST) has acquired a BlueComm undersea communications system, as part of its ongoing programme in Maritime Autonomous Systems (MAS). The objective of the acquisition is to understand the operational implications of optical data transmission and its dependence on water clarity, geometry, and ambient illumination. Ioseba Tena, a global business manager for Defence at Sonardyne, calls BlueComm a 'game changer' for underwater operations claiming that, "It enables autonomous and unmanned underwater vehicles, unmanned and manned vessels to communicate, without compromising their position. As we envision new concepts of operation which require interaction between different off-board assets subsea, the ability to share data covertly and securely cannot be underestimated."

Photo: US Navy / John F. Williams

The Laser Weapon System (LaWS) temporarily installed aboard the guided-missile destroyer DEWEY (DDG-105) in San Diego, Calif., is a technology demonstrator built by the Naval Sea Systems Command from commercial fibre solid state lasers. LaWS can be directed onto targets from the radar track obtained from a MK 15 Phalanx Close-In Weapon system or other targeting source.

Photo: US Navy

Operational demonstration of the Laser Weapon System (LaWS) aboard the Afloat Forward Staging Base (Interim) PONCE (AFSB(I)-15).

Weaponising with Lasers

In conducting their missions, naval ships face an increasing range of threats today, including from missiles, guided weapons, UAVs, small armed boats, adversary Intelligence, Surveillance and Reconnaissance systems (ISR). The deployment of a Directed Energy Weapon (DEW) onboard a ship provides immediate warfighter benefits as it offers the commander increased decision space and response options with scalable effects for engagement.

In such deployments, DEW packs a triple, scalable effect. First and foremost, a High Energy Laser (HEL) weapon can eliminate threats by burning anti-ship missiles, cruise missiles, guided bombs, and loitering weapons, at a safe distance from the protected ship. It can also destroy unmanned aerial systems, or opt to destroy only their sensors if they pose a threat to the defended ship. Operators can tune down the HEL to operate in a counter-ISR role, or as a laser dazzler, blinding EO sensors and obscuring manned aircraft or UAS-based ISR activities without harming their systems or crews.

For those benefits, several navies are developing and testing HEL systems onboard naval ships, and such applications are expected to become operational as part of a future ship self-defence suite as early as the mid-2020s.

The following represent some of the systems currently in development:

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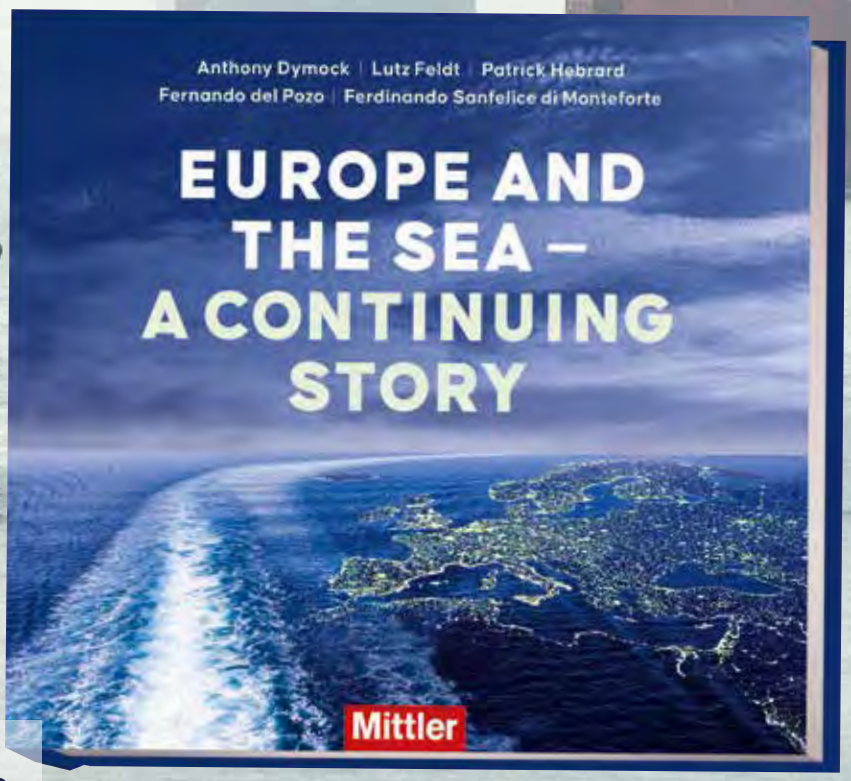

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LaWS

The first laser weapon tested by the US Navy was the AN/SEQ-4 Laser Weapon System (LaWS) built by Kratos Defense and developed by the U.S Naval Research Lab. installed aboard the Afloat Forward Staging Base PONCE (AFSB(I)-15). The laser consists of six fibre lasers combined with the beam director integrated with the vessel's Phalanx Close-In Weapon System (CIWS). The Phalanx provided radar tracking for laser targeting and guidance. The infrared beam from the solid-state laser array can be tuned from maximum output (30kW) to low output for less than lethal effects. At the high output, such a laser can destroy targets, fry sensors, burn motors and detonate or deflagrate explosive materials. At the low output, LaWS can deter potential hostiles at a distance with its dazzle effect. During an operational demonstration at sea, the PONCE's laser laser destroyed small metal targets on two floating platforms and blew up a target drone.

LWSD

Encouraged by the LaWS success, the Office of Naval Research turned to Northrop Grumman to build a laser weapon module that would be integrated on a larger amphibious vessel – PORTLAND (LPD-27). In May 2020, PORTLAND tested its new laser in live firing, disabling a small drone using the Laser Weapon System Demonstrator (LWSD) the ONR ordered. It was the first system-level implementation of a high energy class, solid-state laser. "By conducting advanced at- sea tests against UAVs and small crafts, we will gain valuable information on the capabilities of the Solid-State Laser Weapons System Demonstrator against potential threats," Capt. Karrey Sanders, commanding officer of PORTLAND, explained.

Photo: U.S DoD

HELIOS will be the first Department of Defense contract to field a fully integrated laser weapon system with fixed price options for additional units.

HELIOS

Lockheed Martin has built the marinised High-Energy Laser and Integrated Optics-Dazzler (HELIOS) under a US$150M evaluation programme funded by the U.S Navy. The system consists of a Spectral Beam Combined Fiber Laser (SBCFL) with a maximum output of 60 kW. It is designed with full structural integration with the ship, and its Flight IIA AEGIS Combat System. Marinisation features also include the use of beam director and sensor positioning systems, refrigerated cooling by the ship's chilled water, and dry air distribution. HELIOS will be capable of defeating boats and drones from a distance, and will provide a secondary role as an ISR & Optical tracker, using proven algorithms and high-powered optics.

"HELIOS will provide an additional layer of protection for the fleet—deep magazine, low cost per kill, speed of light delivery, and precision response. Additional HELIOS systems will accelerate the warfighter learning curve, provide risk reduction for future laser weapon system increments and provide a stronger demand signal to the supply base," said Brendan Scanlon, HELIOS programme director, of Lockheed Martin Rotary and Mission Systems.

HELIOS underwent systems integration in Moorestown, New Jersey - the home of the AEGIS Combat System development for 50 years -in the course of 2020. It was then tested at the Wallops Island US Navy land-based test site to reduce programme risk prior to planned installation aboard the destroyer PREBLE (DDG-88) during 2022. If HELIOSis successful, the feature`s options will be worth up to US$942.8M, after delivering HEL systems for additional ships.

Photo: MBDA

An MBDA High Energy Laser demonstrator

DRAGONFIRE Laser Weapon

MBDA is leading an industry group building the UK-built laser directed energy weapon known as DRAGONFIRE. It is developed under a £30M contract awarded by the UK MoD and managed by Defence, Science and Technology Laboratory (Dstl). The industry team includes the UK DRAGONFIRE consortium, led by MBDA and includes Leonardo, QinetiQ, Arke, BAE Systems, Marshall, and GKN. This new UK sovereign capability is designed to provide short-range air defence and close-in protection for naval vessels using a range of different effects depending on the tactical scenario. These include identifying, tracking, and

deterring a potential threat by dazzling its targeting sensors, as well as damaging or even destroying the incoming threat.
Leonardo is providing the system's beam director which is integrated into a turret to aid the target acquisition of the incoming threat at various ranges and in varied weather conditions over land and water. The DRAGONFIRE consortium showcased the beam director developed for live trials at DSEi 2017 and, following further contract awards, is scheduled to be tested aboard a Type 23 frigate before the end of 2023.

German Marine HEL

Germany has also turned to the maritime high energy laser as a scalable self-protection measure onboard naval vessels. The German Navy intends to test such a system on one of its BRAUNSCHWEIG class K-130 corvettes. MDBA Deutschland and Rheinmetall have joined forces in the development, demonstration, and testing of high-energy laser effectors. Both companies have already developed and tested laser weapon prototypes and demonstrated their capability to defeat drones. Rheinmetall has used an industrial high-power laser and space-qualified laser platform combining 12 fibre lasers supplied by the Danish company NKT Photonics. The core of the system consists of 12 narrowband fibre laser modules with nearly diffraction-limited beam quality. In the spectral coupling unit, the individual beams from each module are couples to form a single, combined beam via a precision dielectric grid (grating).
According to NKT, the advantages of the dielectric-grid coupling method include minimal performance dissipation, maintenance of the beam quality of the individual beams in the single combined beam, and scalability to higher performance levels, by adding more modules. Within a few years, it may be possible to gradually increase the beam output to 100 kW, considered as the grid's operational limit.
MBDA Systems have also tested high energy lasers. In 2012, the company used a 40 kW laser system to shoot down airborne artillery from a distance of 2 km. That system combined four 10 kW industrial fibre laser sources provided by IPG Photonics.

Submarine Lasers

The U.S Navy also plans to integrate high energy lasers in its VIRGINIA class submarines. As with lasers installed on aircraft carriers and large destroyers, submarine-based lasers could draw unlimited electrical power from the submarine's nuclear reactor, which means it can fire an 'endless magazine' against hostiles. Inserted in the submarine's mast, such HEL could be used when the vessel is submerged, near the surface. Such a laser could also be used against anti-submarine helicopters, patrol aircraft, unmanned systems, or ships. Such a laser system would likely employ specially designed compact beam control and directing systems that fit into submarine masts. Optical Physics Company (OPC) announced it had developed an advanced concept for end-to-end HEL beam-phase control using only the HEL source. As such, it requires no beacon and no illumination laser. The company also offers a phased array Holographic Beam Control and compact beam director that contains adaptive optics components to condition the laser beam wavefront to compensate for the atmospheric distortions that reduce beam effectiveness in a maritime environment. OPC has designed such a beam director with the right form factor for insertion into a submarine mast. This beam director can track the target and aim an approximately 12-inch diameter beam onto the target. ■

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