Analysis: Maritime C4ISR Trends, Developments & Market Drivers

October 2013

This analysis examines the trends, developments and market drivers that IHS analysts have detected over the last twelve months in the maritime C4ISR sector.

Communications

A number of noteworthy communication-related developments have occurred in the maritime domain over the last twelve months, with satellite communications (SATCOM) being one of the technologies to the fore.

In general, over the past several years, military, security, and governmental organisations in many parts of the world have become major consumers of commercial SATCOM capacity. There are a number of factors at work here. One is the escalating demand for greater chunks of bandwidth needed to accommodate and support the rise in the use of video, multimedia, and other high-speed applications and services in the context of the perceived necessity to network together increasing numbers of defence users, systems, and devices. Set against this are the finite capacities, high costs, and long lead times normally associated with the development and deployment of dedicated military and governmental satellite systems. In principle, but not always in practice, commercial satellite bandwidth can be accessed by the military at relatively short notice and at lower cost.

There are some potential downsides to the use of commercial satellites by the defence community. An obvious one is the reduced level of security routinely offered by civilian, as compared to dedicated military, platforms. Ownership and control of the asset is another. Earlier this year a number of concerns were voiced about reports that capacity on the part of Chinese state-owned Apstar-7 spacecraft was being leased for use by the US military's Africa Command (AFRICOM).

Nevertheless, the military's use of commercial satellites is substantial and likely to increase. You might find different

figures and percentages, but a January 2013 analysis by the Defense Business Board (DBB), a body that provides private sector advice to the US Secretary of Defense and other leaders, calculated that some 40% of the US Department of Defense's (DoD's) USD1.6 billion spend on SATCOM in FY10 was accounted for by the purchase of commercial capacity (the USD1.6 billion figure excludes US civilian governmental satellite consumption). The DBB further estimated the cost of commercial satellite services purchased by the DoD and the US Defense Information Systems Agency (DISA) could grow to between USD3 billion and USD5 billion in the next 15 years.

There are similar expectations in Europe. In September 2012 the European Defence Agency (EDA) signed an agreement with Astrium Services to provide commercial SATCOM services to military users in five EDA countries. The European Satellite Communications Procurement Cell (ESCPC) – operating as a three-year procurement organisation – sees Astrium functioning as a "one-stop shop" contractual and operational interface between the militaries of France, Italy, Poland, Romania, and the United Kingdom on one side and, on the other, commercial SATCOM operators who will provide C-, Ku-, and Ka-band capacities to the five as needed.

The ESCPC involves an initial investment by the five countries of around EUR2.3 million, reportedly in the expectation it will lead to an overall reduction across their current separate SATCOM buy-in costs of around 10%.

Commercial SATCOM: US Navy makes waves

The US Navy (USN), already a major SATCOM user, is becoming an important user of the commercial variety of such connectivity. A key USN commercial-oriented SATCOM initiative is the Commercial Broadband Satellite Program (CBSP), an effort aimed at creating onboard Very Small Aperture Terminal (VSAT)-like systems that provide multiple access management and give access to both commercial and military feeds from one unit. At the same time, the CBSP is intended to boost the bandwidth available to USN ships at sea and replace ageing C-band and Inmarsat terminals.

The USS Green Bay was one of the first vessels to receive the CBSP FLV variant terminals (image © US Navy/DoD)

For the CBSP, the USN divided its equipment requirement into three terminals: the Small Ship Variant (SSV, AN/USC-69[V]1) to equip mine warfare and patrol vessels; the Unit Level Variant (ULV, AN/USC-69[V]3) to equip cruisers, destroyers, frigates (FFGs), and Littoral Combat Ships (LCSs); and the Force Level Variant (FLV, AN/USC-69[V]2) to equip aircraft carriers, amphibious command vessels, amphibious assault vessels, amphibious transport docks, hospital ships, and submarine tenders. Three competitions were run under the CBSP, with CVG-Avtec/Integral Systems (now part of Kratos Defense & Security Solutions Inc) selected to provide the SSV and Harris Government Communications Systems Division chosen to provide the remaining two variants.

The CBSP was materially advanced when, late last year, the USN said it intended to issue a Request for Proposals (RFP) for the production and delivery of up to 118 CBSP ULV systems. A contract, scheduled to be awarded in 2013, was anticipated to consist of a three-year base period with five one-year options.

CBSP capacity is furnished by Intelsat under the terms of a USD542.7 million firm-fixed-price, Indefinite Delivery/Indefinite Quantity (ID/IQ) contract awarded in 2010. Intelsat's partners are Japan's Sky Perfect JSat Corp, Luxembourg's SES, and Astrium/Paradigm of the United Kingdom. The CBSP service contract covers the provision of worldwide telecommunications services, including C-, Ku-, and X-band satellite resources, land earth stations, terrestrial backhauls, and bandwidth management. This contract is due to expire in 2015, and market research was under way in 2013 to select a follow-on service provider.

Indian Navy still reaching for the sky

Last year IHS reported that the Indian Navy could be near to realising its ambition to have access to a dedicated communications and surveillance satellite capability. Unconfirmed Indian media reports circulating in June 2012 quoted unidentified Indian Space Research Organisation (ISRO) sources as saying that a dedicated Indian Navy satellite was in the final stages of testing prior to being shipped abroad and orbited on a non-Indian launch system. Quite a number of local observers saw the June 2012 appointment of India's first Assistant Chief of Naval Staff for Communications, Space, and Network-Centric Operations (ACNS CSNCO), as 'probable cause' for the verity of the dedicated Navy satellite reports.

In fact, the launch did not take place in 2012, and at the time of writing, July 2013, there is much speculation that a launch could be sometime in 2013 (although earlier projected dates of the second quarter of the year have obviously slipped).

Many accounts have identified GSAT-7 as the likely candidate for the dedicated Indian Navy platform. The ISRO has described GSAT-7 as a multiband satellite carrying payloads in UHF, S-, C-, and Ku-band, and noted the satellite employs a standard 2.5-ton bus

platform with the power-handling capability of around 2,600 W and lift-off mass of 2,550 kg.

Initial plans were for GSAT-7 to be launched during 2011 onboard India's Geo-synchronous Satellite Launch Vehicle (GSLV), but the GSLV initiative has not been an unqualified success. The new scheme is for GSAT-7 to be orbited by Arianespace, and a press statement from that organisation in October 2012 acknowledged the receipt of a contract from ISRO to launch GSAT-7, along with INSAT-3D, a weather satellite with data relay and Search-and-Rescue (SAR) payloads.

In another development underlining Indian ambitions in satellite technology, in July 2013 the ISRO reported the successful launch of IRNSS-1A, the first satellite in the planned seven spacecraft Indian Regional Navigation Satellite System (IRNSS). That system is designed to provide two types of services: Standard Positioning Services (SPS) – provided to all users – and Restricted Services (RS), provided only to authorised users, reportedly including the military.

Internal affairs

The modernisation of onboard mobile communication systems is another area that has been getting increased attention in the last 12 months. Although the current incumbent contractor, Harris Public Safety and Professional Communications, is apparently committed to supporting the widely used EDACS-based AN/SRC-55 HYDRA system onboard USN platforms until beyond 2020, last year the Commander Naval Sea Systems Command (COMNAVSEASYSCOM) announced that a search was under way for a replacement Frequency Division Multiple Access (FDMA), Land Mobile Radio (LMR) system to provide force protection, damage control, and flight deck wireless communications aboard USN ships. This initiative was prompted by the circumstance that the EDACS air interface was scheduled to be discontinued and replaced with the APCO-25 Common Air Interface (CAI) starting in 2014.

The use of fourth-generation Long-Term Evolution (4G LTE) cellular telephone technology, in part to service onboard wireless communications, is also being investigated. Earlier this year reports indicated the USN was trialling a 4G LTE system onboard three of its ships. As well as to support intra-ship communication, the system can be used for a number of broadband ship-to-shore, inter-ship, and other applications, including the transmission of video from helicopters back to the mother ship engaged in anti-piracy operations. The project, supplied by a consortium of BATS Wireless, Cambium Networks, and Oceus Networks, was billed as the first operational use of 4G LTE by the DoD.

One LMR technology already adopted by a number of navies for onboard wireless mobile communications is Terrestrial Trunked Radio (TETRA). The reported deployed and planned onboard naval TETRA systems – along with vendors – include: the Italian Navy's FREMM frigate class and the Cavour aircraft carrier (Selex ES); the UK Royal

Navy (RN) aircraft carriers HMS Queen Elizabeth and HMS Prince Charles (Selex ES); and the Spanish Navy's Buques de Acción Marítima (BAM) multipurpose Offshore Patrol Vessels (OPVs) (Rohde & Schwarz).

In 2013 this group of TETRA users is being joined by the Royal Canadian Navy's Halifax-class frigate following the announcement in October 2012 of a deal to upgrade the Internal Communication Systems (ICSs) of that platform. The contractors in this instance, DRS Technologies Canada and Selex ES, note that the ICS, which is part of the SHipboard INtegrated COMmunications (SHINCOM) system, includes internal technology that facilitates non-wired communications between damage control teams, flight deck crews, and 50-calibre gun teams during operations. Additional applications include supporting non-mission-critical operations and conducting maintenance activities where wireless communication among maintainers is required. TETRA equipment delivery will take place in 2013 and is scheduled to be complete in 2015.

Light fantastic

An alternative to radio technology for mobile communications on board naval platforms is Infrared (IR). One user of IR for this application is the RN. In July 2013 UK contractor Link Microtek reported the receipt of a four-year contract from the UK Ministry of Defence (MoD) for the provision of spares, repairs, and other support services for the company's Azdec mobile IR communications system.

Installed on board various ships within the RN fleet, the Azdec system is designed to provide secure, wire-free, short-range voice communications, giving personnel the freedom to have unrestricted roaming from their base positions. According to this contractor, in this application IR scores over Radio-Frequency (RF) systems because the latter may cause interference with other systems, can be detected and intercepted, or may cause problems with munitions or flammable atmospheres.

Light, in the form of laser communication, is also capable of delivering very high bandwidth. In an effort to harness such capacity, in September 2012 it was announced that ITT Exelis and partner Innovative Technical Solutions (commercially known as NOVASOL), had been awarded a USD7 million contract to develop a laser communications system for the USN and US Marine Corps.

ITT Exelis and NOVASOL were contracted to complete development of a Line-of-Sight (LoS), high-bandwidth laser communications system that will be used for ship-to-ship, ship-to-shore, and ground-to-ground mission applications. The contract is with the USN's Office of Naval Research in Arlington, Virginia, and the Naval Research Laboratory in Washington, DC.

Command and Control

The year 2013 has seen some significant progress in the development of Command and Control (C2) systems, especially in the expanding field of Ballistic Missile Defence (BMD).

April saw Aegis Baseline 9, which has been developed to offer a simultaneous BMD and Anti-Air Warfare (AAW) capability, complete its first live firing test, having successfully detected, tracked, and engaged a medium-altitude subsonic target. The system aboard USS Chancellorsville engaged the target using an SM-2 while controlling the ship's 5 in gun.

March saw a successful test by Raytheon of its dual (X- and S-band) datalink, designed to enable the integration of the SM-3 ballistic missile defence missile into non-Aegis-equipped ships. The trial, jointly funded by Raytheon and Thales Nederland, validated the ability of the dual-band datalink to communicate with the Thales Active Phased-Array X-band radar. The Dutch De Zeven Provinciën-class frigates are already receiving an improved BMD capability. This involves upgrading the SMART-L radar with an Extended Long-Range (ELR) mode. The number of warships in Europe equipped with APAR/SMART-L radars means that several European navies could also now upgrade their BMD capability and, thereby, their potential to participate in the European Adaptive Phased-Approach BMD programme.

Reflecting the increasing pressure for integrated BMD, it was announced in April that an RN Type 45 destroyer (expected to be HMS Daring) would participate in a US ballistic missile defence exercise. The test is expected to explore the ability of the Sampson E-/F-band radar to detect and track ballistic missile targets. This is particularly pleasing to note following the decision by the RN in 2012 not to proceed with the procurement of the Co-operative Engagement Capability (CEC). The exchange of BMD data using Link 16 is satisfactory for longer engagement times. However, in short-range scenarios, more bandwidth is needed and, accordingly, CEC is used by the USN to share track data, so it will be interesting to see the results of the BMD trial, which will presumably concentrate on the long-range picture in the absence of CEC in the UK vessel.

The Ticonderoga-class Cruiser Modernization Program progresses, and in May the second-generation BMD 4.0 system in USS Lake Erie detected and tracked a separating short-range ballistic missile target with the AN/SPY-1 radar. An SM-3 Block 1B missile was launched and successfully manoeuvred by the Aegis system to a point at which it could release its kinetic warhead. The BMD 4.0 system has recently been upgraded with more powerful Commercial, Off-The-Shelf (COTS) processing equipment, with upgrades to the weapon system computer programmes.

Aegis BMD 5.0 will introduce a new multimission signal processor, and 5.0.1 integrates the SM-3 Block IIA

missile, which is expected to commence flight testing in 2014. A full engage-on-remote capability will then exist.

Looking away from BMD, the first of two Falaj 2-class corvettes for the UAE was commissioned in January 2013. Equipped with VL MICA Exocet MM 40 and a 76 mm Oto Melara Super Rapid gun, these vessels, in common with the Abu Dhabi-class corvette Abu Dhabi , are equipped, under its new ATHENA umbrella, with the IPNS combat management system.

The first Project Khareef corvette for the Royal Navy of Oman, RNOV Al Shamikh , which has the TACTICOS combat management system, was handed over by BAE systems at the end of June.

Radar

In the United States, the Air and Missile and Defence Radar (AMDR), which is being developed for the Flight III Arleigh Burke-class destroyers, is still expected to replace the ageing SPY-1 with weight, power provision (necessitating the upgrading of generators), and cooling issues being addressed. The aerial faces are expected to be only 70% of the size originally intended for the radar when it was to be installed in the now-cancelled CG(X) programme. Despite this, the radar is reported to be capable of delivering “at least a 15 db increase in capability over its predecessor” and as being “35 times more powerful”, according to the DDG-51 shipbuilding programme manager.

Three contenders – Lockheed Martin, Raytheon, and Northrop Grumman – were each awarded technology development contracts for the AMDR in 2012. The announcement as to which of the approaches has been selected is expected in the third quarter of 2013 and, accordingly, at the time of publication, an announcement is still awaited. The AMDR-S will provide wide-area volume search, tracking, and BMD discrimination, while the AMDR-X will provide horizon search, tracking, and illumination guidance for the missiles. Nevertheless, the first 13 vessels to receive the AMDR will do so with the X-band element being provided by the existing SPQ-9B radar.

The dual-band radar, in which the AN/SPY-3 (now referred to as the Multifunction Radar [MFR]) and AN/SPY-4 radars are integrated and which was to be installed in the DDG-1000 Zumwalt-class vessels, is now expected to appear only in the Gerald R Ford-class aircraft carriers. The MFR, which has no dedicated radar operators and is fully integrated into the combat system, will thus be the principal sensor for the Zumwalts, providing both volume and horizon search capability.

In Europe, April 2013 saw the first Sea Acceptance test of Thales’ APAR MFR in the Danish Iver Huitfeldt-class aboard HDMS Peter Willemoes . The project now moves on to test the radar’s AAW and fire-control capabilities. APAR is designed to enable automatic detection and tracking of low-altitude targets and provide missile support by the detection and tracking of air targets. It is

specifically designed for the terminal guidance of the SM-2 and Evolved SeaSparrow Missile (ESSM) missiles using its interrupted Continuous Wave (CW) illumination that enables a single fire-control radar to control several missiles simultaneously.

Integrated or enclosed masts are also "trending" in the naval radar scene. They are intended to offer protection to electronic sensors while maintaining all-round coverage. A compact, lightweight example has been developed by French shipbuilder CMN, Cassidian, and Ineo Defence, which can accommodate the TRS-3D radar. DCNS has also developed an enclosed mast for its Gowind corvette/OPV family, which can accommodate a Scanter, Sea Giraffe, SMART-S, or TRS-3D system. More importantly, at its base the mast can also accommodate a complete combat information centre with its equipment.

Thales has developed the I-mast (IM400), which has been selected for the Holland-class OPVs and the Karel Doorman-class joint support ship. Among other subsystems, the I-mast 400 houses a Sea Master 400 (SMILE) radar, as well as a Sea Watcher 100 surface surveillance radar.

A new "face on the block" radar from Thales is the Pharos Multitarget Tracking radar, which is intended for the control of guns and SHORAD systems. Displayed at IMDEX Asia in May alongside the Oto Melara 76 mm Super Rapid system, it has integrated guided ammunition control.

At about the same time, the Australian Department of Defence released a Request for Tender (RfT) to CEA Technologies for the development of a high-power, phased-array radar concept demonstrator. This will be a development based on the existing CEAFAR radar intended for the Royal Australian Navy's Future Frigate programme through Project Sea 5000.

And finally, a farewell: the last Type 909 fire-control radars used to control the Sea Dart missile have been retired with the decommissioning of the last UK RN Type 42 destroyer, HMS Liverpool. Following the earlier decommissioning of HMS Ark Royal, this also means that only one Type 1022 surveillance radar now remains in service in HMS Illustrious.

Electro-Optics/Infrared

Naval operations in the 21st century are no longer conducted by large fleets of what were called 'capital ships' – heavily armed battleships and cruisers. Set-piece fleet actions are history. Today's big ships are aircraft carriers and nuclear ballistic missile submarines. The current-generation warships are smaller but pack a larger punch than their predecessors. However, the changing nature of the maritime threat means that navies find themselves involved in a wider variety of lower-key missions, such as anti-piracy patrols, close-range force-protection surveillance, pattern-of-life observation, and anti-FIAC (Fast Inshore Attack Craft) operations.

The need for situational awareness (clear 360° vision around the naval vessel, by day and night in all weather conditions) has seen the increased adoption of Electro-Optic (EO) and IR sensors to provide such coverage. Since the mid-1960s, EO/IR technology has evolved to the extent that the Size, Weight, and Power (SWaP) elements of these systems have dropped dramatically, while the resolution (equating to range) of the imagery obtained has risen at an almost equivalent rate.

During the course of the year, activity in this field has been steady. In France, Sagem Défense Sécurité used the Euronaval exhibition in Paris (October 2012) to launch its latest EO/IR observation/surveillance product in its Vigy range. Known as the Vigy Observer, it is derived from the company's MPS LR/MR (Long-Range/Medium-Range) panoramic day/night stabilised observation sights for armoured vehicles. It is a gyrostabilised multisensor observation system that incorporates one cooled Long-Wave InfraRed (LWIR) (8 to 12 microns) thermal imager, three daylight colour TV cameras, and an Eye-safe Laser Rangefinder (ELRF).

Sagem also announced at the show that it is to supply 80 Vigy Observer systems to an unnamed customer. IHS sources indicate these systems will be installed on the 80 fast interception craft ordered by India in 2011 from Sri Lankan shipbuilder Solas Marine Lanka. Deliveries began in November 2012.

It emerged in October 2012 that the two Mistral-class Bâtiment de Protection et de Commandement (BPC) vessels being built in France for the Russian Federation Navy will be equipped with Sagem's VAMPIR-NG (Veille Air-Mer Panoramique InfraRouge – Nouvelle Generation) Infrared Search-and-Track (IRST) system, the latest in its line of IRST systems.

The sensor head of VAMPIR-NG, in production for the Russian Mistral-class BPC and the Royal Australian Navy (image © Sagem)

VAMPIR-NG is a dual-mode (ocean and littoral) IRST system using third-generation Mid-Wave Infrared (MWIR) high-definition thermal imaging technology. It provides long-range coverage with circular panoramic observation/surveillance with automatic detection, reporting, and tracking of threats (principally sea-skimming anti-ship missiles) and is said to be capable of handling about 50 simultaneous targets.

The French Navy already operates the earlier VAMPIR-MB (Modular Bispectral) version on the aircraft carrier Charles de Gaulle , various AAW frigates, and ASW frigates, as does Italy (on Horizon-class AAW frigates) and South Korea (on LPX-class Landing Helicopter Docks [LHDs] and KDX-III-class AEGIS destroyers). Australia has the VAMPIR-NG version on order for it ANZAC-class frigates, LHDs, and the AWD AAW destroyers. The first Russian BPC vessel, Vladivostok , will have VAMPIR-NG installed in 2013, while the second vessel, Sevastapol, will follow six months later.

Moving to Italy, Selex ES (formerly Selex Galileo) announced in October 2012 that the Armed Forces of Malta had ordered two Janus Naval (Janus-N) EO/IR observation and fire-control panoramic sights. Janus-N features a stabilised, multisensor turret weighing less than 30 kg. It contains an Enhanced Reconnaissance IR CAmera (ERICA) MWIR thermal imager for night work, a daylight Charge-Coupled Device (CCD) TV camera, and an ELRF to detect the distances of targets under observation.

The Janus-N EO/IR system – shown here on an Italian Comandante-class patrol vessel – has now been ordered by Malta (image © Selex Galileo)

A console allows the operator to manage the various modes of the system, and the open architecture of the Janus-N allows it to be integrated with the existing C2 systems of the parent vessel. Already in service on four Comandante-class patrol vessels of the Italian Navy, the Maltese models will be installed on a pair of the country's Maritime Squadron Fast Response Craft as part of an upgrade programme that is part-financed by the European Union's External Borders Fund 2011 (80%), with the other 20% from national Maltese funds.

During the course of the year, information has emerged from Russia's Urals Optical and Mechanical Plant (UOMZ) on the MTK-201ME EO/IR/laser sensor for surveillance

and use as a fire-control director, which the company describes as a “multifunction shipborne TV system” and may possibly carry the other designation of MTK-201M5. Two units are fitted to each of the Steregushchiy-class frigates, the first of which entered service in November 2007. The MTK-201ME system is housed in a streamlined, ovoid, gyrostabilised gimbal with three main aperture windows. The upper window is for the transmitters and receivers for the two Laser Rangefinders (LRFs) (operating in the 1.54 and 1.06 micron wavebands); the centre window is for the dual-FoV colour and single-FoV monochrome TV cameras; while the lower window is for the LWIR thermal imager, which company literature appears to indicate has a dual FoV. Although not specifically mentioned in company literature, one may assume the below-decks operator consoles will feature improved displays and image processing, better detection and tracking algorithms, and possibly, digital interfaces into other shipboard systems.

With these examples of EO/IR systems covering a range of applications, the technology is continuing to permeate into the naval infrastructure and enhance situational awareness and force protection for naval vessels. As more navies and maritime forces seek to detect, identify, and track ever more difficult targets, EO/IR will continue to make its contribution.

Sonar

Below the horizon – the underwater battlespace

While counter-piracy has typically dominated maritime news in 2013 and is likely to do so for some years, maritime commanders and strategists continue to recognise the potential risks associated with the underwater environment. The buoyant market for small, effective, conventional, and Air-independent Propulsion (AiP)-powered submarines around the Pacific Rim will provide significant new capability for ASW/Anti-Surface Warfare (ASuW), previously the prerogative of traditional Western nations to the emerging maritime navies of the region.

In addition, concern over the threat posed by sea mines has been exemplified in priority given to international Mine CounterMeasures (MCM) exercises such as IMCMEX 2013, which was hosted by US Naval Forces Central Command (NAVCENT)/US 5th Fleet in the Gulf area and involved forces from more than 14 nations. IMCMEX 2013 sought to build on previous experience from IMCMEX 2012, which involved more than 30 contributing nations and highlighted the issues of C2, information exchange, and the need to establish commonly understood tactics, training, techniques, and procedures. This year saw the inclusion of additional tasks such as maritime security operations and protection of offshore platforms in the Gulf.

Led by the USN, the RN provided the MCM commander, and contributing platforms included Avenger-, Hunt-, and Sandown-class Mine CounterMeasures Vessels (MCMVs), MH-53 Sea Dragon airborne MCM helicopters, and afloat command platforms.

International Explosive Ordnance disposal, minehunting, diving operations, and small boat exercises combined with Unmanned Air Vehicle (UAV), Unmanned Underwater Vehicle (UUV) operations, and port clearance tasks focused against underwater Improvised Explosive Devices (IEDs) and a terrorist threat as the principal areas of activity.

These themes reflected concern about the threat posed by state and non-state actors potentially conducting acts of terrorism and commercial sabotage against vital coastal and offshore commercial facilities. It is these fears that have fuelled the demand for more complex, capable, and integrated port and harbour defence systems that can monitor and control the littoral areas and seaward approaches.

The operational commander is demanding more timely, detailed, and increasingly accurate information. This individual requires the ability to fuse all source data and understand the dynamics of the subsurface environment in order to provide both offensive and defensive capability in totally networked forces ashore, in the air, and at sea. An enduring need prevails to provide innovative integrated solutions for improved situational awareness of the underwater battlespace.

Sonar solutions

These challenges are being met by system designers and defence manufacturers with the introduction of new sensor technology and, most importantly, data-handling and processing that, coupled with the increasing application of open architecture in system design, will allow more accurate and rapid delivery of information to aid decision-making.

While the major manufacturers market increasingly sophisticated sonar suites, it is the developments of smaller software development houses that have facilitated the step changes in both active and passive sonar performance. This has given rise not only to the development of new sonars but also to the exploitation of existing systems during refit and upgrade programmes for surface ships and submarines.

The re-use of technology has been incorporated with scalable designs such as that demonstrated by Thales' CAPTAS programme, which allows effective modern systems to be incorporated in vessels from corvette size to destroyers.

CAPTAS has been widely marketed in its own right, entering service with eight navies and also in the RN, where it is known as Sonar 2087. A version is a candidate

solution for the US LCS programme, in which it will undoubtedly be given a US designation in future.

As with most other current designs, CAPTAS seeks to provide options for fully integrated active and passive sonars, environmental measurement, and torpedo warning/alertment.

This challenging combination of requirements will continue to drive the development of processing and data management in scalable solutions for both newbuild and retrofit opportunities.

Mission packages?

The Royal Danish Navy (RDN) introduced the concept of role-neutral vessels with its Stanflex concept, which emerged in the Thetis class in 1991 and included exchangeable operational modules for ASW, AAW, and MCM. This is not the place to re-introduce the arguments for and against the success of this programme. However, the RDN abandoned the concept as impractical at that time and with the technologies available.

The idea did not die, however. The requirement for modularised and containerised capabilities has now been progressed through the DNK MCM programme. This version of modular capability components has seen the embarkation of a modularised MCM capability onboard Thetis in 2012 and the achievement of Full Operational Capability (FOC) in two Holm-class MSD vessels in the MCM role. Further work is ongoing, and the Danish approach has seen interest from the RN and others seeking options for the conduct of MCM operations from about 2020 when the current generation of Hunt- and Sandown-class vessels will be approaching the end of their effective service lives.

The emergence in the last eight years of the US LCS concept has also contributed to wider interest in designing ships and capability packages in an exchangeable, modular form. Other nations are following suit.

USN LCS

At present, the LCS programme has the highest profile in the concept of modularisation and is perhaps pointing the way forward. This year has been a testing one for the LCS. Neither the ASW nor the MCM packages have been without problems and will be subject to congressional review in the coming months. Since 2011 the LCS MCM package has been subject to a range of independent and shipboard trials. Phases 1, 2, and 3 to prove handling of offboard vehicles and integration of the MH-60S helicopter with the platform were completed in August 2012.

In January 2013 the Pentagon's director of Operational Test and Evaluation (DOT&E) revealed in his annual report that as a result of the trials with the MH-60S and the Airborne MCM package (AMCM), it was concluded that the helicopter was insufficiently powerful to safely tow the AN/AQS-20A sonar mine-detecting set or the Organic

Airborne Sweep and Influence System (OASIS) (minehunting/minesweeping system).

This capability was a major component of the LCS MCM concept and contributed significantly to the requirement to reduce risk to personnel by conducting the operations from well outside the mine danger area using offboard sensors and weapons. AMCM was pivotal within the overall MCM mission module, and this has now been cancelled.

The MH-60S will be limited to the conduct of near-surface minehunting using the Airborne Laser Mine Detection System (ALMDS) and mine neutralisation capability with the Airborne Mine Neutralization System. The LCS MCM capability will be delivered from the ship-launched Remote Minehunting System (RMS), which includes the AN/AQS-20A sonar vehicle hosted on the Remote MultiMission Vehicle (RMMV). The RMMV is a semi-submersible, unmanned vehicle that is launched on handling cranes over the stern. In this case, there are some positives, and progress on EdgeTech's Littoral Mine Countermeasure Sonar (LMCS) has seen it demonstrate a long-range capability with ultra-high resolution and at speeds to meet the USN statement of requirement. It has been integrated with the Automated Target Recognition (ATR) software manufactured by SeeByte to deliver the necessary detection and classification aids and processing.

The RMS and an AN/AQS-20 minehunting sonar are brought aboard the littoral combat ship USS Independence (LCS 2) during developmental testing of the mine warfare mission module package1478588The RMS and an AN/AQS-20 minehunting sonar are brought aboard the littoral combat ship USS Independence (LCS 2) during developmental testing of the mine warfare mission module package

Although not deployed from the LCS, the USN has instigated a life extension programme for the MH-53E Sea Dragon helicopters 'to provide an AMCM capability to 2022 or beyond', it was stated at the Sea Air Space conference in Washington, DC, in April 2013. The USN now plans to introduce an Unmanned Influence Sweep System (UISS) for Increment 3 of the MCM mission package for the LCS based on an unmanned surface vessel. This will see the emergence of manufacturers' proposals for the UISS engineering development in the next 12 months.

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