

Survival Skills: Advances in European Rotary-Wing Self-Protection

By Richard Scott

The Korean War was the first conflict in which helicopters were employed at a large scale, principally in the medical evacuation role. In the 70 years since, rotorcraft have gone on to assume a multiplicity of roles over the battlefield, notably scout/reconnaissance, tactical air mobility, logistic support, anti-armor, armed escort and interdiction. Helicopters have also carved an important niche at sea, executing maritime missions such as anti-submarine warfare, anti-surface warfare and littoral lift/assault.

Today, European armed forces continue to make substantial investments in rotary-wing aircraft for operations in the land, littoral and maritime domains. For example, France in December 2021 contracted Airbus Helicopters for the development and procurement of the H160M Guépard to meet the needs of its Hélicoptère Interarmées Légère light helicopter program; Germany last year announced plans to buy a fleet of up to 60 CH-47F Chinook helicopters for its STH (Schwerer Transporthubschrauber) heavy-lift helicopter requirement; and the UK has developed a need for a New Medium Helicopter to replace four legacy rotorcraft types later this decade.

One key lesson imparted by operations in Iraq and Afghanistan, and latterly reaffirmed by the conflict in Ukraine, is the need to provide rotary-wing aircraft with a robust self-protection capability in the face of an evolving and proliferating anti-air threat set. Operating at low altitude and slow speeds, helicopters are inherently vulnerable to infrared (IR)-guided man-portable air defense systems

(MANPADS) and other low-level air defense systems. Furthermore, current conflicts and crises involving insurgent forces and irregular combatants often mean there is no identifiable "front-line" to delineate threat zones and safe areas.

Shipborne helicopters have traditionally employed passive electronic warfare (EW) sensors for situational awareness and targeting support in the open ocean. However, the increased propensity for operations in the littoral environment – up to and beyond the beach – means that today's maritime rotorcraft also require improved platform self-protection.

The availability of increasingly capable MANPADS to both state non-state actors represents the major risk to rotorcraft and personnel alike, but these low-cost heat-seeking missiles are by no means the only concern. Laser-beam riders and radio frequency (RF)-guided air defense missiles also pose a serious threat to attack helicopters and support rotorcraft operating over the battlefield. Anti-tank guided weapons using electro-optical (EO) guidance have been employed to engage helicopters in the hover or on the ground, and there is also the enduring threat from anti-aircraft artillery, heavy machine guns, small arms and rocket-propelled grenades (RPGs) to consider.

As a consequence, European air arms, defense science labs and industry contractors are today pursuing at a number of different EW/self-protection approaches in an effort to improve helicopter survivability in the face of this increasingly dynamic and stressing threat. In doing so, they must consider a number of different aspects: the aircraft concept of operations; the specifics of the threat environment; the technology and logic required to detect and defeat specific threat types; platform integration and associated space, weight and power/cooling (SWaP-C) constraints; the ability to adapt to threat change; and the realities of program budgets.

EVOLVING ASE TECHNOLOGY

The technology and techniques underpinning platform self-protection have witnessed dramatic changes over the past few decades. Early instantiations of aircraft survivability equipment (ASE) were introduced to front-line platforms in a non-integrated and ad-hoc manner, demanding that aircrew interpret threat data and then execute a rehearsed maneuver and/or initiate a countermeasures response.

Individual ASE components can be broadly grouped into one of three categories: threat warning sensors – operating in the RF, E0/IR or laser wavebands – to provide indication of hostile targeting and/or an inbound threat; onboard effectors such as RF jammers, IR lamp countermeasures or directed infrared countermeasures (DIRCM) designed to confuse the seeker logic of incoming missiles; and offboard expendables, such as RF chaff and IR flares, to decoy missiles away from the aircraft.

Over time, however, it became evident that an increasingly complex threat environment, coupled with the very limited time window available for response, would overwhelm the ability of aircrew to manage and coordinate self-protection responses in real-time. Instead, it would be necessary to tie together disparate, discrete systems into an integrated and holistic defensive aids suite (DAS) with a software-based controller at its core. The DAS controller automates the coordination and control of the countermeasure response at “machine speed” by performing threat evaluation, providing situational awareness, prioritizing threats, and computing an optimum countermeasure response to defeat the threat.

Bringing the whole DAS together as an integrated suite gives a far greater capability than having systems operating discretely. The configuration of a specific DAS fit will be conditioned by the characteristics and operating patterns of

the host platform (bearing in mind the need to ensure unimpeded coverage for sensors and apertures), the operating environment, intelligence on the threat systems prevalent/anticipated within that environment and, of course, carefully considered judgements on affordability.

At the component level, a number of technology trends are apparent. These include digital radar warning receivers (RWRs) providing improved situational awareness and threat alert against RF threats; the development of a new generation of missile warning systems using IR rather than ultraviolet (UV) sensor technology to offer longer range detections and increased warning times; the addition of hostile fire identification (HFI) functionality to detect and localize hostile small arms fire; and the emergence of novel multi-part decoy flares to counter the most modern IR seekers.

Another identifiable trend is the increasing interest in DIRCM fits, reflecting the intensification of the MANPADS threat and the emergence of third-generation IR seekers incorporating improved resistance to countermeasures flares. Significant reductions in SWaP-C have now made DIRCM fits more straightforward and relatively more affordable.

STANAG 4781

The most profound ASE changes have occurred in the area of DAS integration and control. Here, the NATO Defensive Aids System (NDAS) Smart Defence initiative has established a standardized open architecture and common message set to support the “plug and play” integration of threat warning sensors and countermeasure effectors onto operational platforms, and at the same time formalized a NATO standard (STANAG 4781).

Leveraging work previously undertaken by the UK under its Common Defensive Aids System initiative, the NDAS effort has sought to overcome the two main shortfalls of legacy DAS architectures: first, the time and cost required to upgrade

and maintain these systems through their lifecycle; second, the employment of proprietary closed communication links between sub-systems. As a by-product, the implementation of a formalized STANAG should streamline technological exploitation for industry, and so promote wider/faster market opportunities.

A key output from the NDAS activity is the Smart Stores Communication Interface (SSCI) specification. The SSCI, as part of STANAG 4781, enables in-flight communication and optimal use of smart expendables (such as expendable active decoys and multi-shot cartridges). It also enables automatic expendable type recognition and automatically logs payload logistic information, including air carriage life and use-by-date.

HEWS

Turkish company ASELSAN has developed its Helicopter Electronic Warfare System (HEWS) as an integrated DAS for rotorcraft. Integrated via a central processing system, HEWS provides radar warning, missile warning, laser warning, RF jamming, IR jamming and chaff/flare dispensing functions together with aircrew situational awareness and threat-specific countermeasure responses.

The RWR features digital receivers operating in both narrow and wide bands, together with an optional geolocation capability to locate the threats. Additionally, the RF jammer uses DRFM technology together with an active electronically scanned antenna. Other features include indicative audio warnings and alerts, in-flight event recording, pulse descriptor word recording, blanking management, and single point mission data file and mission report loading/downloading.

According to ASELSAN, HEWS has been designed with an open systems architecture to confer flexibility in changing the

system configuration according to platform requirements without software modifications. HEWS system variants have been fitted to both T-129 attack helicopters and T-70 (S-70i) Black Hawk support helicopters in Turkish service.

MILDS

Hensoldt Sensors GmbH has supplied its Missile Indication and Launch Detection System (MILDS) UV missile warner for a wide range of rotary-wing self-protection applications. Designated AN/AAR-60 in US service nomenclature, MILDS comprises four to six self-contained sensor heads that provide high resolution and high sensitivity without extra cooling. The resolution afforded by the sensors allows rapid discrimination of both stationary and moving UV point sources, a feature which, Hensoldt claims, permits MILDS to operate in both urban and battlefield environments with a minimum of false alarms.

Each sensor provides fully processed signals, with no central processing unit required. According to the company, the inherently high spatial resolution of MILDS, combined with advanced temporal processing, enables a very high declaration rate while virtually eliminating false alarms. The system is capable of tracking up to eight targets simultaneously.

MILDS Block 2 adds an HFI function. Originally developed in conjunction with Australia's Defence Science and Technology agency for the Australian Army's Tiger and MRH90 helicopters, this software-enabled upgrade allows the system to detect incoming tracer ammunition and determine the source of the hostile fire.

Hensoldt also markets the Airborne Missile Protection System (AMPS) family of solutions in cooperation with Israeli systems house Bird Aerosystems. Designed to protect against MANPADS and other surface-to-air missile threats, the system has been certified by Airbus Helicopters and the Mil Design Bureau (the latter issuing several service bulletins for installations on

Mi-8/17 helicopters) and has been selected by NATO nations, the US and Canadian governments and the UN. Rotary-wing installations include the EC135, EC635, EC145, BK117, EC155, Cougar, EC225, Mi-8, Mi-17, UH60, S-92 and CH-53.

Different AMPS self-protection systems can be configured according to customer needs. The AMPS-MV system marries Bird Aerosystems' Mission Control & Display Unit (MCDU) with Hensoldt's MILDS missile warning system and a chaff and flare dispensing system. The MILDS system provides an indication/alarm of a missile launch, cueing the MCDU which initiates the optimized countermeasure dispensing program while providing visual and audio alerts to the aircraft crew.

AMPS-ML adds the ALTAS-2Q(B) laser warning system, while the AMPS-MLR variant additionally integrates Hensoldt's Kalatron digital RWR. Finally, AMPS-MD introduces a DIRCM for IR seeker defeat.

SPAIN'S CH-47F DAS

Spanish systems house Indra was in 2022 contracted by the Spanish Ministry of Defence to deliver a fully indigenous DAS to protect CH-47F Chinook transport helicopters operated by the Spanish Army Airmobile Force/Fuerzas Aeromóviles del Ejército de Tierra (FAMET). Under a €35 million contract, the company is equipping the FAMET's upgraded Chinooks – 17 of which are being upgraded by Boeing from CH-47D helicopters to CH-47F standard – with a new self-protection suite featuring the company's ALR-400FD digital RWR, the InWarner electro-optical/laser threat warner and the InShield directed infrared countermeasures system. The upgraded helicopters will additionally be equipped with chaff countermeasure dispensers and flares.

Indra has previously supplied its SIMBA self-protection suite for NH90, Chinook and Cougar transport helicopters and Tiger attack helicopters serving with FAMET. SIMBA combines the

company's ALR-400 RWR, incorporating an embedded defensive aids controller, with the Hensoldt AAR-60 MILDS missile warner, Hensoldt's ALTAS-2Q laser warner, and the MBDA Saphir-M countermeasures dispenser.

MAPPS

Building on its earlier Helicopter Integrated Defensive Aids System (HIDAS) and Advanced Gateway Processor (AGP) products, and work undertaken through the UK Ministry of Defence's Defence Science and Technology Laboratory (Dstl) as part of the Common Defensive Aids System Technology Demonstrator Programme, Leonardo UK has introduced the Modular Advanced Platform Protection System (MAPPS) as a scalable, open architecture DAS solution. The MAPPS architecture, as well as the core MAPPS Controller, underpin sovereign DAS solutions to be rolled out to the UK armed forces under the joint government/industry Team Pellonia construct (see *JED* May 2023, p. 28).

According to Leonardo, MAPPS has been designed as a multispectral, integrated self-protection system capable of detection and defeat of RF, IR and laser threats. At the heart of the system is the software-based MAPPS Controller, which moderates sensor inputs, generates a fully integrated, coherent and prioritized threat picture, provides situational awareness to aircrew, and automatically computes the optimum countermeasures response.

MAPPS' modular system architecture has been engineered to minimize the impact on platform software or architecture for ease of integration. This simplifies the addition of new sensors and effectors or the upgrade/replacement of existing subsystems.

Leonardo offers a number of suitably scaled subsystem integrations – proprietary and third-party – to meet specific platform protection requirements. These include UV or IR

missile warners, a laser warner, a digital RWR (such as its own SEER system), electronic support measures (ESM), a countermeasure dispensing system (such as the Thales UK Vicon XF series), a compact RF jamming system, the Miysis DIRCM system, and the BriteCloud expendable active decoy.

Under the umbrella of Team Pellonia, the UK plans to field MAPPS-based DAS configurations integrating the Thales UK Elix-IR threat warning system. Elix-IR is a new generation multifunction passive threat warning system that uses single color mid-wave IR sensing technology to deliver simultaneous and unimpeded missile approach warning, hostile fire indication and situational awareness. It also provides sufficient angle of arrival accuracy to cue a DIRCM onto an inbound missile target.

As an alternative IR warner option, Leonardo's Italian business is developing its own solution in the form of its Multiple Aperture InfraRed (MAIR) system. Drawing on Leonardo's extensive experience in the design and production IR sensors for surveillance, situational awareness and targeting, MAIR uses a minimum of five sensor heads to cover 360 degrees in azimuth and 270 degrees in elevation around the host platform. An additional sixth head confers full spherical coverage.

A developmental version of MAIR was successfully tested during the SALT III trials in May/June 2018. Having been formally launched to market by Leonardo at the Paris Air Show in June 2019, the MAIR system began flight testing on a helicopter shortly afterwards.

Series production of MAIR commenced in 2021. The first platforms to receive the system include AW169M helicopters procured to meet the Italian Army's Light Utility Helicopter requirement.

EURODIRQM

Italian EW house Elettronica also provides rotary-wing self-protection equipment. For example, the HH101 CAESAR combat search and rescue/special operations helicopter operated by the Italian Air Force features an Elettronica EW/self-protection suite comprising the Virgilius RWR/ESM/RF jammer solution and the ELT/572 DIRCM.

Elettronica, in collaboration with Indra, is currently developing a next generation ITAR-free DIRCM solution, known as EuroDIRQM, based on Quantum Cascade Laser technology. EuroDIRQM prototype testing began in 2018.

IDAS EVOLUTION

Saab's Integrated Defensive Aids Suite (IDAS) and Compact Integrated Defensive Aids Suite (CIDAS) modular product families have evolved over time to meet new operational requirements. Whereas IDAS was conceived as a fully integrated DAS marrying multi-spectral warning (radar, laser and electro-optic) with automatic countermeasures decoy dispensing, CIDAS is a smaller and lighter weight variant with only electro-optic sensors and a more compact controller. Both variants are fully integrated with Saab's BOP-L lightweight countermeasures dispensing system.

According to Saab, the modular flexible architecture of IDAS/CIDAS allows tailoring of individual systems to user requirements with any of the sensor types. Furthermore, multiple interfaces and a low box count are designed to facilitate easy installation in a wide variety of platforms. Human machine interface is via a dedicated full color threat display and control unit, or using existing onboard color multifunction display.

The latest iteration of IDAS, known as IDAS-310, was launched

to market in May 2023. This improved instantiation features an updated EW controller (EWC) with a more modern processing architectures and additional interfaces (including Gigabit Ethernet); the latest MAW-400 UV missile approach warner (with Elix-IR offered as an option for customers seeking an IR band solution); the LWS-330 laser warning system; and BOP-L series countermeasures dispensers. The latter are managed via a fully integrated chaff/flare dispenser controller that resides in the EWC, allowing for automatic dispense upon threat identification.

IDAS-310 can also be configured with the RWS-310 RWR; this is similar in performance to the earlier RWS-300 but offers 0.5- to 40-GHz frequency coverage as standard. The addition of an adjunct digital receiver endows a full ESM function.

The open architecture of IDAS-310 (certified to STANAG 4781) also provides the option to integrate a DIRCM as part of the suite. Saab offers the Leonardo Miysis DIRCM system as a baseline.

Saab has additionally undertaken internally funded engineering development, prototyping and risk reduction activities to mature a new-generation Dynamically Variable Magazine (DVM) smart countermeasures dispenser. The company's approach is to combine the functionality of dispenser network controller device embedding the STANAG 4781 SSCI interface with in-flight variable angle magazines capable of dispensing soft-kill expendables.

An externally mounted DVM-200 variant has been conceived for helicopters. This offers two degrees of freedom – being able to move in elevation and azimuth – in order to dispense for flares. Such a system would also offer sufficient firing accuracy to fire hard-kill expendables to defeat unguided threats, such as RPGs. A developmental DVM-200 is to be tested later in 2023 as part of a forthcoming NATO-sponsored advanced MANPADS defeat trial.

MASE AND LASE

Danish systems and sensors house Terma has long experience as an EW self-protection integrator for rotary-wing platforms. The company's widely sold AN/ALQ-213(V) EW controller is designed to integrate individual subsystems – sensors and effectors – into one combined system with a single advanced threat display aircrew interface.

The AN/ALQ-213 controller and associated display interface is also at the heart of Terma's pod-based Modular Aircraft Survivability Equipment (MASE) solution for medium and large helicopters. MASE also features the company's own Advanced Countermeasures Dispensing System (ACMDS), latterly upgraded to an improved Smart Agile Secure Countermeasures Dispenser System (SAS CMDS) standard.

According to the company, a podded DAS approach offers users a number of advantages: the reduced cost, complexity and time associated with the integration and qualification of an external load on existing hardpoints; relatively "lean" integration with other aircraft systems; interchangeability between aircraft without the need for "whole fleet" airframe modifications; and the latent flexibility to modify pods to accept technology insertions so as to meet future requirements.

Each MASE pod is built up from standardized barrel modules hosting various subsystems: forward and aft missile warning sensors; forward firing flare magazines; and lateral flare dispenser magazines. All modules are mechanically interchangeable, which enables future upgrades simply by replacing the affected modules – for instance the pod interface/lateral countermeasure dispenser may be replaced by a DIRCM module. MASE variants have been fielded on AH-64D, CH-47D/F, AS-532, EH101, HH-60G, Mi-17, Mi-24 and NH90 aircraft.

For smaller rotary-wing aircraft, Terma offers the Light Aircraft Survivability Equipment (LASE) concept. LASE is offered with a compact dispenser solution tailored for any light helicopter utilizing either a pod or scab-on dispensers.

The SAS CMDS dispenser system has now superseded the earlier ACMDS in the Terma product catalog. While developed from ACMDS, the SAS CMDS implements the STANAG 4781 SSCI protocol – via a new digital sequencer switch – to enable in-flight pre-launch programming of a new generation of smart expendables. Other features of SAS CMDS include unlimited mixed payloads in the same dispenser, threat-specific programming in flight, programmable firing characteristics to support smart and multi-shot payload dispense, intelligent inventory management, and long-term adaptability to pace evolving threats.

Europe's rotary-wing operators learned many important EW lessons in Iraq and Afghanistan, and they are also gleaning information about threat tactics and techniques from the conflict in Ukraine. These two factors have significantly impacted the direction of rotary-wing self-requirements and, in the case of the Russian-Ukraine conflict, added urgency to helicopter EW modernization for many years to come.