Active protection: US and UK vehicle defence projects kick off

Active protection systems have received substantial investment in countries such as China, Israel, and Russia, but in recent years the UK and the US lagged behind. However, the two countries are now investing in near- and long-term capabilities. James Bingham and Robin Hughes examine these efforts

The United Kingdom and United States are following similar development pathways, both seeking to rapidly field active protection system (APS) in the short-term to fill perceived capability gaps, while funding separate programmes to develop a modular, flexible architecture enabling a range of APS components. The parallel programmes are intended to ‘future-proof’ an APS architecture against obsolescence and compromise, as well as enable both countries to scale systems according to platform and operational requirements. Additionally, open architectures in conjunction with a central government-owned ‘controller’ will enable the two countries to quickly change components, increase competition over sensor and effector components within industry, and drive down commercial risk and cost.

**Project Icarus**

In the UK, the drive to prospectively equip the British Army’s fleet of current and future tracked and wheeled platforms with an APS capability progressed in June 2017 with Leonardo securing a GBP10 million (USD13 million), 42-month Technology Demonstrator Programme (TDP) contract, funded by the UK Defence Science and Technology Laboratory (Dstl).

Designated ‘Icarus’, the TDP will develop and demonstrate a UK sovereign Modular Integrated Protection System (MIPS) electronic architecture that is to integrate ‘best of class’ sensors and effectors, layering soft-kill (based on jamming or obscuration of the guidance mechanism) and hard-kill (based on physical interception) effects to mitigate threats.

To deliver the Icarus TDP, Leonardo will lead a team drawn from industry, consultancy, and academia, including BAE Systems, Lockheed Martin UK, Ultra Electronics, Frazer Nash, Brighton University’s Vectronics Research Centre, Abstract Solutions, Roke Manor Research, and SCISYS. Leonardo, in conjunction with Dstl, will also establish and develop an APS ‘Community of Interest’ that is intended to encourage engagement across industry, and guarantee that current and future best-of-class APS technologies are available for evaluation with the MIPS architecture.

The UK is not a latecomer to APS and has, over a number of years, adopted a judicious approach to evaluate available APS technologies and their optimum application to ensure survivability. Across the APS research, Dstl has also established close collaboration with the Defence Science and Technology Group (DSTG) in Australia in support of its Land 400 APS procurement programme – with Icarus potentially feeding into that – and with the US’ Modular Active Protection System (MAPS) programme.

However, until recently the principal funding focus of platform self-protection in the UK has been on an open-architecture integrated defensive aids system (DAS) for air platform protection. While considerable headway has been made with CDAS, the proliferation of anti-tank guided missiles
(ATGMs) and rocket-propelled grenade (RPG)-type threats in ground combat engagements has refocused the UK Ministry of Defence (MoD) efforts to evaluate survivability technologies for land platform protection.

Two Hamas militants with North Korean Bulsae-2 ATGWs, based on the Russian 9K11 Fagot system, are shown here in December 2014. Increasingly sophisticated ATGW are being adopted by militant forces worldwide, driving the requirement for more capable APS. (palinfo.com)

“We’ve recognised for some time now that the UK’s armoured fighting vehicle fleet, alongside other nations, is not able to protect itself to the degree we would like against the range of chemical energy threats that are in the battlespace at the moment, and that are increasingly proliferating across the world,” Tom Newbery, principal systems engineer at Dstl Active Protection Technical Authority, told Jane's.

“To counter this we are researching and examining a number of different protection technology options, a key one of which has been recognised as active protection systems: that ability to defeat a missile threat before it strikes a platform is a key survivability enabler, and also the ability to provide the crew with threat alert and threat warning – to that threat, and where that threat came from – allows a more effective and more timely response to be made by the vehicle. So within that ground survivability space we see APS as really a key enabler looking to the future, both for platform survivability and also expanding that out into mission effectiveness as the systems develop, and as they become more closely integrated into UK platforms,” he said.

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As part of an ongoing research initiative into land platform APS, Dstl announced in July 2016 that it had awarded a 36-month, GBP7.6 million Technical Assessment Programme (TAP) to a QinetiQ-led team that includes Textron and Frazer-Nash. The TAP, designated Project 'Medusa', is to evaluate soft-kill APS solutions based on the Hensoldt Multifunctional Self-Protection System (MUSS): a high Technology Readiness Level (TRL) system that integrates missile and laser warning sensors with a directional electro-optical jammer. The project is to develop an understanding of how a high-maturity system can be integrated into an existing UK vehicle fleet - in this case the Challenger 2 main battle tank (MBT) - and its affect on the platform and the crew.

“Project Medusa was initiated with a view to understanding both what soft-kill in the round offered to the land domain – how well does this type of technology function? – but also using that as an exemplar of an APS to understand how it would effect the way we fight and the way in which vehicle crews might react to the increased level they have available from threat alert, as well as
the increased levels of survivability they get from being able to defeat, particularly in this case, anti-tank guided missiles," Richard Hooper, Dstl’s Icarus TDP technical lead, told Jane’s.

Nonetheless, hard-kill APS solutions have remained a constant interest for the MoD. Dstl supported an assessment of the IBD Deisenroth Engineering Advanced Modular Armor Protection (AMAP) APS system in the 2009–10 timeframe. “Internally, within MoD, we have good understanding of hard kill and the benefits associated with that, whereas we hadn’t conducted this kind of detailed assessment of the soft kill within the land domain, so Medusa was a complementary exercise to fill in that understanding, and to examine long-term soft-kill technology,” said Hooper.

Project Icarus will not, at this stage, use a specific vehicle type to evaluate its MIPS architecture.

“Throughout the Icarus TDP we will be developing a SIL [System Integration Laboratory], which will essentially be our development and test and evaluation bed for the MIPS infrastructure. That’s where we’ll put the key outputs and key deliverables back into UK MoD ownership following the completion of the TDP,” said Hooper.

Under the provisions of the Icarus TDP, the Leonardo team will demonstrate and evaluate an operational prototype of the MIPS architecture against ‘live fire’ weapon engagements. Hooper said weapon engagements during the TDP will be based on an RPG-type threat (live fire) and ATGM threats (simulated).
The Ajax vehicle features a Generic Vehicle Architecture into which a future APS capability will be integrated. (General Dynamics UK)

“We have a threat picture that will be used as the basis of the MIPS capability to make sure that the requirements capture the performance elements that we need to defeat those types of threats,” said Hooper. “So within the threat picture leading to development of the [MIPS] capability, we are looking at current and known future-generation threats; obviously the whole principle of the open architecture is that it gives us that lever to modify the system appropriately, to bring in other sub-systems to defeat other types of particularly counter-DAS ATGMs into the future. So as those capabilities emerge, we are in a position to react.”

In its development of the MIPS architecture, Leonardo will leverage knowledge acquired from the CDAS programme. The CDAS architecture itself draws on the earlier upgrade programmes on UK MoD helicopters, and is also part of the wider move to open standards across complex defence technologies that, crucially in the UK land platform protection domain, includes the Generic Vehicle Architecture (GVA).

The GVA approach is based on the use of open electronic infrastructure standards to support cost effective integration of sub-systems on land platforms – electronically and physically. Director Land Equipment (DLE) in UK MoD (DE&S) has mandated the application of the GVA Approach and the associated GVA Defence Standard (DEF-STD) 23-09 for all future land vehicle platform procurements, current vehicle platform refurbishment, and upgrade programmes.

The Icarus programme will also generate a new draft UK standard for a future MIPS architecture. This work will complement the GVA by focusing on the deterministic electronic infrastructure and the software architecture capable of supporting layered, autonomous system responses to certain threat munitions. In essence the MIPS approach will extend the GVA approach to support modular flexibility in autonomous DAS.

“The key thing we are looking to is standards, so the TDP develops the architecture and then evaluates that architecture against a number of threat scenarios, including live firing, and along the way we will bring the broader industry onboard with the programme as part of that standards process.”

“Affordability is a key point here,” Mike Dalzell, Dstl Capability Advisor to Army HQ, told Jane’s. “Being able to specialise an APS installation to a platform need, and then react to a theatre need, and then react to a threat development, we believe gives us the best survivability benefit, but we also believe that by having a modularised capability where that standard is open and published, that allows us the most affordable solutions. So this is not about gold-plating active protection systems for the UK armed forces, this is about putting in place the building blocks now to make it the most cost-effective and affordable through life so that they can be most widely deployed, and most effectively used."

There is also now a NATO GVA, Newbery noted. “In a similar way, it is probably fair to say that a lot of our NATO partners are interested in where we are going with this [MIPS architecture]. There is the potential that this may form a wider NATO standard – and an option to create a STANAG for APS joint architectures, so that is something we are looking at, but it is very difficult because we don’t know what the scope of standardisation can be or should be to support our capability; there are also vulnerabilities that could be leaked in those standards, so we have to be very careful in terms of security,” he said. “So hopefully, throughout the Icarus TDP we will understand what the scope of that standard will look like, and it could pave the way for a NATO standard in active protection."

The Icarus TDP and Medusa TAP are being executed under separate contracts, both of which are under Dstl’s overall direction and management. Consequently, Dstl will have full visibility and ownership rights of the outputs of both programmes, and will be able to provide inputs to either as appropriate. “Medusa and that [soft-kill] capability is very much looking at a short-term solution, as opposed to Project Icarus which is looking towards long-term hybridised and modularised capabilities,” said Hooper.
The Challenger 2 MBT has been the focus of the Medusa TAP, seeing the MUSS soft-kill APS integrated. (IHS Markit/Rupert Pengelley)

At the time of writing Medusa had been under way for about 18 months and is scheduled for completion in early 2019. The Icarus TDP was under contract from 1 June and is due to be complete in November 2020. However, Dstl declined to be drawn on specific developments or procurement timelines beyond the Icarus TDP.

“The purpose of the Icarus TDP is to help our customer understand the benefits of this modular agile architecture approach for a longer-term APS capability, so we are currently working with Army HQ to look at what their longer-term vision needs to be in the round. So it’s partly waiting for the results from the Icarus TDP to help inform their decisions as to where they go in the future,” said Hooper.

“The timelines associated with that are really dependent on strategy being drawn up by Army HQ and by [the UK MoD’s] DE&S as to how APS should be rolled out across different parts of the vehicle fleet, and where timelines would be appropriate dependent on the output from Icarus. So there is a user need to have survivability in the near term as well as in the long term, and we are currently looking at what vehicle programmes this could align with,” said Hooper.

He added that it is too early for Army HQ to reveal deployment strategies because they would be informed by Medusa and Icarus. “That will very much influence their roadmap; whether they choose to go early with off-the-shelf systems, or whether they choose to wait and go for a modularised system, or a combination of both. In all likelihood, it will be staged progression to an Icarus TP or MIPS solution,” said Hooper.

Ultimately neither Medusa nor Icarus is about selecting a system. Medusa is about understanding soft kill, while Icarus is about developing the architecture to support integrating a modular APS that enables rapid reconfiguration.

The Icarus TAP contract award to Leonardo should therefore be seen as one element of a wider research project, where Dstl is looking at currently available systems – soft and hard kill – and how it can best exploit technologies on the marketplace to provide protection and capability in the near and longer term.

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US programmes

In the US the equivalent to Icarus – the US Army’s Research, Development, and Engineering Command (RDECOM)’s Modular Active Protection System (MAPS) – took a step forward in April with a soft-kill demonstration. The demonstration, which involved RDECOM engineers, Lockheed Martin, and Northrop Grumman, was the first ‘end-to-end’ engagement combining the MAPS Framework (MAF), the Modular APS Controller (MAC), and integrated sensors and countermeasures.

Lockheed Martin and Northrop Grumman worked in partnership from 2015 to the end of March 2017 to integrate the former’s Open Architecture Processor and the latter’s Passive Infrared Cueing Sensor (PICS) and Multifunction Electro-Optic System countermeasure (MEOS) systems onto an M1 Abrams MBT ahead of the soft-kill trials in April. A similar hard-kill demonstration is scheduled for the first quarter of 2019, followed by mixed soft- and hard-kill component testing.
In addition to the MAF demonstration, the MAPS programme will develop the MAC, similar in concept to the UK’s MIPS architecture and central controller, the IP of which will remain with the US government. Built around open standards and common interfaces, the MAC will enable a variety of sensors and effectors to be rapidly installed into the MAPS.

The MAC’s open standard is formalised through the MAF’s technical and non-technical standards provided to industry, the 1.0 version of which was released in August. Following the release of a beta version in February 2016, sensors and countermeasures required for three different ‘defeat approaches’ were integrated, followed by the soft-kill demonstration in April 2017.

Released to the MAPS Community of Interest (COI), the MAF 1.0 is regarded by the US Army as the first major step to enable industry and government stakeholders to begin and continue development of MAF-compliant components. In addition to the MAF 1.0 release, the MAPS programme uses knowledge points (KPs) as releasable summaries of integration developments to allow stakeholders to stay up to date with programme developments. MAF 1.0 was released as part of KP7.

The second, parallel US APS development programme is analogous to the Medusa TAP. Known as the Expedited, Non-Developmental Item (NDI) programme, this effort seeks to integrate three hard-kill systems onto in-service vehicle fleets: the Rafael Advanced Defense Systems Trophy-HV (Heavy Vehicle) on the US Army’s M1A2 Abrams and US Marine Corps (USMC)’s M1A1 Abrams MBTs; the Israeli Military Industries (IMI) Iron Fist on the M2/3A4 Bradley infantry fighting vehicle (IFV); and the Artis Iron Curtain on the M1126 Stryker IFV.
The IMI Iron Fist, as displayed in September 2017, with twin-round pedestal launcher and sensors. (IHS Markit/James Bingham)

The Bradley A4 configuration adds some power and this has enabled integration of an Iron Fist 'fly-out interceptor', the same concept as Trophy. Without the A4 configuration there would not be enough power to integrate an APS, Colonel Glenn Dean, the US Army programme manager for the Stryker Brigade Combat Team and lead for its APS effort, said in October.

While Iron Fist appears to be lagging in terms of its potential fielding on the Bradley in its current configuration, Trophy-HV has apparently been advancing at a faster rate. In late September the US Army awarded General Dynamics Land Systems a USD9.9 million contract modification to install the APS on an Armored Brigade Combat Team's (BCT's) M1A2 System Enhancement Package version two (SEPv2) MBTs, with this scheduled for completion in late March 2019. While not necessarily indicative of forthcoming full-scale procurement, the fact that an entire Armored BCT's MBT contingent – 90 tanks – are to have Trophy-HV integrated, illustrates the extent to which the NDI programme has progressed the integration efforts of the system onto the M1A2.

Col Dean said the army anticipates buying a number of APS via urgent requirements, but its long-term goal is to integrate these efforts under a Program of Record that will fall under an upcoming Vehicle Protection Systems office that will include a variety of active and passive protection technologies.

While these are regarded as interim solutions, given the open architecture nature of MAPS, the best components from the three off-the-shelf could be brought into the MAPS purview. Additionally, other commercially available APS could be brought into the NDI programme, such as Rheinmetall's Active Defense System (ADS). The systems are being mounted onto the vehicles as an appliqué package, rather than undergoing full integration into the vehicle's architecture.
The Active Defence System (ADS) seen mounted onto a Leopard 2 MBT, with the hard-kill countermeasure seen located between two pairs of electro-optical sensors. (IHS Markit/James Bingham)

NDI is intended to inform the US Army’s Vehicle Protection Suite (VPS) Program of Record’s analysis of alternatives, while MAPS will become the primary APS development component for the VPS. The VPS is intended to provide "modular, kittable protection utilising active, reactive, passive (or a combination) defeat mechanism", according to the US Army. An Initial Capability Document (ICD) is scheduled to be presented to the US Army Requirements Oversight Council (AROC) in late 2017.

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