

Jane's International Defence Review

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## Lighten up: shoulder-launched weapon systems come of age

**New generations of light, flexible, and precision-guided missiles promise to put more effective and usable firepower into the hands of soldiers. Robin Hughes takes aim**

The diverse threat spectrum emerging in the contemporary battlefield - in which ground forces are now more likely to be deployed in irregular, complex or urban combat environments - requires modern infantry units to be increasingly agile in manoeuvre and self-sufficient in terms of support firepower.



*The AT4CS HE - one of two new lightweight optionally programmable munitions designed to engage wider target sets from confined spaces. (Saab)*

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In such environments, where heavy fire support is either logistically unavailable or unfeasible, the utility of a man-portable/shoulder-launched assault weapon can deliver tactical advantages as well as time-sensitive effects.

While shoulder-launched weapon systems - recoilless and anti-tank guided munitions (ATGMs) - are principally rooted in the anti-armour domain, rapidly evolving target sets have shaped new requirements for less burdensome, less bulky infantry-borne systems with a wider range of effects. Underlying this is a

tacit operational practice that has emerged from the use of costly heavier-end assets to engage lightly or unarmoured threats.

Although anti-armour lethality remains a benchmark of these developments, the trend is moving towards lightweight, modular solutions for improved tactical flexibility, shorter-range engagements, and maximising the round load per operator. Intrinsic requirements now include multirole effects warheads or munition rounds to address wider threats; improved lethality, but greater precision to avoid collateral damage in complex combat scenarios; the ability to fire from enclosed spaces; short-range engagement, while retaining a stand-off capability; the potential to network the system for third-party designation and command-and-control (C2) interoperability; and, not least, greater affordability.

Ran Kaplan, marketing director at Rafael Advanced Defence Systems' Precision Tactical Weapons Systems Directorate, told *IHS Jane's* that "from the purely operational perspective, there are two ends of the spectrum. At one end is enabling advanced stand-off ranges to increase the survivability of the crew or to engage targets without exposing your position. At the other end, is to be able to accurately engage the enemy in a complex environment at very short ranges - targets can be in the open, in bunkers, or be moving vehicles, and might be visible only briefly, so you have to react quickly. When you consider that you need to address both ends of the spectrum and everything in between, you have to adjust your technology or your systems accordingly."

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### **Recoilless dynamics**

In September 2014 Saab Dynamics' Ground Combat Systems unveiled a new lightweight 'intelligent' launcher variant of the 84 mm Carl Gustaf-series multirole recoilless rifle - the M4 - which is currently in the final stages of development. The M4 will be significantly lighter than its predecessors. At 6.7 kg it weighs roughly 30% less than the M3, and less than half the weight of the earlier 14.2 kg M2 variant. Weight savings of almost 2.8 kg have been achieved through the development of an improved carbon fibre casing, the introduction of a titanium liner and substituting a reduced-size titanium Venturi recoil damper.

A reduction in the overall length of the M4 from 106.5 cm (M3) to less than 100 cm delivers additional weight reduction, while ergonomic refinements - including an extended, folding carry handle, adjustable shoulder rest and front grip - provide for improved tactical flexibility. Saab has also introduced an additional safety feature, enabling the launcher to be carried while loaded, to reduce reaction time and support tactical relocation. The M4 also features a new integrated round counter for improved logistics and weapon maintenance.

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The M4 retains the M3's reserve flip-up open sight, but Saab is also offering an integrated MIL-STD-1913 Picatinny rail-mounted red dot reflex sight as a reserve sight alternative. The benefit is that soldiers can aim the weapon in darkness wearing night-vision goggles, without requiring a bulky separate sight.

While the standard launcher sight is the same telescopic sight with a manual ballistic setting drum featured on the M3, the M4 design also provides an interface for an 'intelligent' sight option. This system will deliver instant analysis of ballistic data using a baseline minimum of an integrated laser rangefinder and ballistics calculator, with additional enabling options for the input of compensatory factors such as propellant temperature and air temperature. This enables the Carl Gustaf gunner to program or 'communicate with'

future 84 mm smart munitions via the sight, to accurately deliver the desired effects to target. Saab will likely qualify an off-the-shelf smart sight for the M4 - possibly the Aimpoint FCS12 (which is currently used by the Swedish Army on their M3) - to be able to offer a system-ready solution to customers. To date the M4 has fired 2,000-3,000 qualifying rounds with the new M4 variant and qualification is scheduled for completion later in 2015, enabling customer deliveries to begin in 2016.

Saab has also added two new optionally programmable munitions to its 84 mm AT4 series pre-loaded advanced light anti-armour weapon, enabling the AT4 to engage a wider target set over longer distances and in more complex environments. The AT4CS ER (Confined Space, Extended Range anti-tank) extends the effective range of the AT4 to around 600 m, while the AT4CS HE (Confined Space, High Explosive) AT4CS ER will be able to engage targets in airburst or impact mode out to a distance of 1,000 m. The muzzle velocity for the AT4CS HE and ER is given at 250 m/s, and the AST (anti-structure breaching) at 200 m/s.



*The Carl Gustaf Ultra Light Missile - a concept 2,000 m-range integrated 84 mm rocket-propelled munition with LOBL seeker guidance, weighing all up around 5 kg. (Robin Hughes)*

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As with the M4, Saab has exploited developments in carbon fibre composites to reduce the weight of the system. The diameter of the launch tube remains the same, but weight has been taken off the launch tube by using new composites; Saab has invested that weight saving in the higher lethality/effects of the warheads, increasing the countermass for a higher muzzle velocity to achieve longer effective range. The new AT4CS variants weigh less than 9.5 kg; an intelligent sight option will add between 1.5-2 kg to the

overall system weight. Saab has also reduced the length of its AT4CS AST, ER and HE variants to 98 cm (from the original AT4CS 104 cm), for improved tactical handling in urban environments.

The ER and HE variants come equipped with an integrated red dot sight that, along with the more advanced warheads and fuses, increase the unit cost of the system by 10% to 20%. Both variants feature a mechanical and logical interface similar to the Carl Gustaf M4, with an intelligent sight offered as a capability option to optimise the performance and precision of the programmable warheads. The company will initially use the Aimpoint FCS12 - as on the CG M4 - to inform the development of the communications interface with the next-generation programmable AT4CS round.

AT4CS is scheduled for qualification in 2015 and for delivery around the same time. The launch customer for both variants is the French Army: the AT4CS ER/HE/AST was selected as the winning solution for the French Army's NG Roquette (Nouvelle Génération) requirement in December 2014.

In parallel, Saab has qualified a new munition to add its 10-strong 84 mm munition range - the HEAT 655 CS - which is understood to be the first time a 'confined space' round has successfully been developed for a reloadable recoilless rifle. While the 655 CS is not a programmable munition, it adds tactical capability for an effective range out to 300 m. According to Saab, the munition can penetrate more than 500 mm of steel armour with a warhead arming distance of 9-20 m.

Saab is now advancing a modular 'architecture' for the future development of a new generation of programmable unguided 84 mm rounds for the M4, the first of which will be derived from the 84 mm programmable round being developed for the AT4CS HE/ER variants, according to Malcolm Arvidsson, Carl Gustaf product manager at Saab Dynamics.

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*Rafael's 5 kg Mini-Spike multi-effects round can be fired from the MICLU and, using an electro-mechanical*

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adapter, from the standard Spike MR/LR launcher. (Rafael Advanced Defense Systems)

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The company is also migrating the 84 mm system's modularity to assess a number of advanced guided munitions for the Carl Gustaf, foremost among which is the Carl Gustaf Ultra Light Missile (CG ULM): a longer range munition concept designed to engage point targets not addressed by the current system's engagement envelope. The current CG ULM concept provides for a rocket-propelled munition with lock-on before launch (LOBL) seeker guidance, integrated in an 84 mm tube weighing all up around 5 kg. This can be launched from an M3 or M4 using an intelligent sighting system, possibly with an option for a separate display to monitor the seeker view, depending on customer requirement, Johan Ekeroot, director of product management, Guided Support Weapons at Saab Dynamics told *IHS Jane's*. The CG ULM will have a range out to 1,500-2,000 m, which potentially doubles the range of the Carl Gustaf system with existing ammunition options. Ekeroot said that the ULM seeker will be developed from existing Saab products, including the IRIS-T air-to-air missile. Ekeroot added that CG ULM is one of a number of different combinations of warheads and guidance/seeker system concept options currently being assessed by Saab to increase the maximum range and hit probability of the Carl Gustaf system.

Dynamit Nobel Defence (DND) in Germany has similarly invested in developments in its 90 mm RGW 90 and 60 mm Panzerfaust family of shoulder-launched unguided munitions, looking to add range, lethality and precision.

DND CEO Dr Wolfgang Böttger told *IHS Jane's* that the company is examining "the gap between what shoulder-launched rockets and guided weapons can achieve" with a focus on the 'aimed' capability between ranges of 500-1,000 m. In that range bracket, "most of the shoulder-launched ballistic rockets lack accuracy, but it is also not very economical to use high-value guided missiles at this range".

In December 2014, the company started production of a new RGW 90 variant to meet a requirement under the German Army's IdZ (Infanterist der Zukunft) Future Soldier System.

The RGW 90 AD (formerly called 'Effector 90') is a 90 mm disposable munition with a programmable warhead, including an airburst function, effective against light armoured vehicles, field positions and targets behind shelter, with an accuracy of +/-3 m at 1,200 m range. DND competed with the RGW 90 AD for the recent French NG Roquette requirement. For urban operations, the RGW 90 AD can be armed at 10 m.

"This is a new 1,200 m-range airburst munition and only works with the use of a fire-control unit [FCU] and a wind-compensated ballistic rocket. For this we use DynaHawk, a new interchangeable intelligent sight developed in collaboration with Airbus Optronics, and already qualified with the German Army," Böttger said.

Böttger said that for improved combat effectiveness, the weight of the RGW 90 AD has been reduced to "significantly less" than the current 10 kg of the standard RGW 90. *IHS Jane's* understands that this is 8.9 kg (11 kg with the FCU), which is similar to the Matador (man-portable anti-tank, anti-door) system developed by DND for the Singapore Armed Forces. The length of the new launcher has also been cut to 990 cm.

"If we say the trend is to go light, it also means that you do not carry a specialised tool for every problem, but you have one tool for all problems. In short, this means we are now establishing a datalink between the Airbus Optronics DynaHawk FCU and the ammunition. So the gunner can select from his sighting system certain capabilities, and program the rocket to match."

However, he noted, "There is a limit to everything - the 1,200 m-range RGW 90 AD/Effector 90 weapon is an affordable lightweight multipurpose system - but it will not be able to hit a 'point target' at 1,000 m. We will have a dispersion of +/-3 m. To achieve [a point target hit], and to keep the guided missile boys out of our garden, we must do some kind of course correction.



*The latest capability improvement to the 66 mm M72 Light Assault Weapon (LAW) family can fire high calibre rounds from enclosed spaces using the new M72 launcher. (Nammo)*

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"In collaboration with Diehl BGT Defence, we are now looking into course correction as an upgrade for the ballistic rocket [including integration of a Sustainer Rocket Motor] to make a 'point hit' at 1,000 m. That will be a new course-corrected munition and tanks, armoured vehicles will be our target spectrum with this capability. This will be an add-on capability. It is something that will give the user, the German Army, a cost-effective solution for ranges up to 1,000 m so that they don't have to use their high value guided missiles at this range. This is about the limit of the area of interest of an infantryman."

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### **Guidance required**

In the guided sector, MBDA has, since December 2014, been in the development and manufacture phase of Enforcer (KFK), a new 86 mm disposable LOBL multipurpose precision munition derived from three initially separate MBDA activities: MBDA's 2010 Concept Visions: 'Infantry Weapon System for 2030 and Beyond'; MBDA Germany's Kleinflugkörper (KFK - small missile) technology demonstrator programme - ongoing since 2009; and MBDA's LoCoPE (Low Cost Precision Effects) technology programme.



The 6 km-range man-portable *Missile Moyenne Portée*. MBDA is pushing vehicle integrated solutions to sustain production. (MBDA)

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Housed in a composite rectangular launch tube, Enforcer (KFK) has an all up weight (comprising munition and launch tube) of less than 9 kg. The munition features a multi-effect warhead (penetration/blast/fragmentation) manufactured by TDW and is powered by a two-stage (eject and boost) rocket motor manufactured by Bayern Chemie (part of MBDA).

The launch tube is expected to be qualified for the munition in 2016. Enforcer (KFK) features an electro-optical "strap-down guidance chain which uses electronic image stabilisation ('virtual gimbal')". That is, the seeker optics are fixed within the missile and do not move independently of the airframe. Saving on weight, space and cost, the non-gimballed solution uses an MBDA UK-designed fin actuator system design and the missile autonomously tracks the target after LOBL is initiated.

The munitions' optical sensor is capable of detecting near-IR wavelengths, and can therefore detect laser spots for night engagements. Emma Morris, Enforcer Win Team leader at MBDA told *IHS Jane's* that the current Enforcer (KFK) is not "currently designed with a datalink or man-in-the-loop option, but future evolutions of Enforcer could have an LOAL (lock-on after launch)/image processing and update capability."

The maximum engagement range for Enforcer (KFK) with the detachable Airbus Optronics DynaHawk FCU as selected for the German Army's RGW 90 AD system is given as 1,800 m (this is predicated on a prospective, but to date unconfirmed, requirement from the German Army).

However, Marcus Brendel, Enforcer project head at MBDA Germany told *IHS Jane's* that during test firings Enforcer (KFK) achieved a range of 2.9 km using a lofted trajectory and that "the missile can easily achieve ranges in excess of 2 km." A minimum range is given as 100 m, although MBDA is working on a 'stretch requirement' minimum range of 50 m. A selectable fuze (airburst/impact/delayed impact) is programmed

from the DynaHawk FCU prior to firing. Brendel said that Enforcer (KFK) will be able to be fired from an enclosed space of "at least 4x5x2.5 m".

MBDA is positioning Enforcer (KFK) as a low-cost 2 km-class range munition to address the 'cost gap' in the shorter-range shoulder-launched guided weapon system market.

Designed to complement existing shoulder-fired infantry weapon systems and to engage "the most common lightly protected battlefield/urban targets" at relevant combat ranges, with high precision and exposing the operator to minimal exposure, MBDA says Enforcer (KFK) is a response to the anticipated evolution of military operations/scenarios: asymmetric conflicts - local operations - and an increase in Military Operations in Urban Terrain (MOUT).

MBDA envisages a typical Enforcer (KFK) combat deployment as two disposable munitions and a detachable sight (weighing 2 kg) delivering an all-up carry weight of less than 20 kg. Brendel said that the modular design of Enforcer (KFK) allows for a range of future development options, including a more powerful warhead. "These options are currently being evaluated but are not yet under development." However, he added "there is a future for a family of lightweight guided missiles derived from the Enforcer (KFK)".

At the heavier end of the guided shoulder-launched spectrum, the Javelin Joint Venture (JJV) has initiated a three-phase (Spiral) development programme to deliver a lighter weight, and expanded target set for the 127 mm FGM-148 Javelin fire-and-forget ATGM system: the Javelin G-Model (FGM-148G).



*A new 1,200 m-range 90 mm disposable munition programmable with the re-usable Airbus Optronics DynaHawk FCU. (Dynamit Nobel Defence)*

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Rich Benton, JJV vice-president and programme director (Lockheed Martin) told *IHS Jane's* that Spiral 1, scheduled to complete qualification in 2015, will address obsolescence and weight reduction issues, with some updates to the control actuation systems: "This includes reducing two circuit cards down to one - this helps reduce weight, but also changes it from an analog system to a digital system for future modernisation and upgrades so that we can carry the all-up round out to the 2050 timeframe."

Spiral 2, also scheduled for qualification this year, will incorporate a multipurpose warhead for additional effects against multiple targets while retaining the Javelin's core anti-armour performance. JJV has also improved the IM compliance of the pre-cursor and the warhead.

Spiral 3 - which will become the G-Model - converts guidance from long wave IR-cooled seeker technology to an uncooled seeker, encompassing a new generation of the Javelin system. Weight reduction is achieved by elimination of the battery coolant unit (BCU) and the gas lines.

"We have improved the battery life and now have more time to acquire and lock onto the target." Benton said that JJV is not planning to incorporate automatic seeker lock-on and non-line-of-site capabilities such as LOAL into the G-model. "The technology for a wireless communication link with the missile to allow target adjustment, re-targeting or LOAL has been developed, integrated and tested, but is not currently planned for fielding."

A US Army notice on 20 January 2015 announcing 2013 Aviation and Missile Research, Development and Engineering Center award recipients cites the work of a team in the Infrared and Optical Technology Area within the Weapons Development and Integration Directorate at Redstone Arsenal, Alabama, who "advanced the state-of-the-art of extended-range fire-and-forget missile seeker technology with the in-house development and demonstration of a new seeker design. The design permits an increase of 40% in engagement range capability for man-portable missiles." The new seeker, which uses off-the-shelf technology, is understood to be for the Javelin round, which would extend the range of the G-Model from 2,500 m to 3,500 m.

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