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The UK's Future Soldier Vision is part of the Ministry of Defence's (MoD) plan to ensure that British Soldiers have high-quality equipment utilising the latest technologies, as part of an integrated system.

MODERN SOLDIER BY DESIGN

Stephen W. Miller

INTRODUCTION

The light infantryman has been receiving significant attention by many armed forces across the world. In the United States there has been wide focus on increased weapon effectiveness and responsiveness, enhanced ground mobility of opponents, area denial tactics and high operational tempos have been demonstrated as typifying today's battlefields. This has also been reflected by other countries, such as in the United Kingdom where Scientists at the Defence Science and Technology Laboratory (Dstl) continue to work various industry partners to develop the Army's Future Soldier Vision (FSV), showcasing the personal equipment that soldiers could be using by the mid-2020s.

The combination of requirements has raised concerns about the ability of traditional light infantry to effectively execute missions

for which they are designed and intended. To address this, a number of initiatives have been launched by various armies focused on enhancing the light infantry's capabilities to effectively operate in today's combat environment. This is typified by a focus on the individual soldier, the small unit, referred to the fire team, squad or section. The areas covered in this compendium relate to lethality, survivability, mobility, and situational awareness.

Although these appear to be separate functions from a practical sense and increasingly on the battlefield aspects of each can have a major influence on performance or capabilities in the others. Often these concerns are also acknowledged by developers yet too often are somehow lost in the solution that is finally provided to the soldier.

The definition of what encompasses each of

these four functions is shifting and expanding as well. Lethality for example, always high on the list of improvements has essentially focused on the individual service weapon carried by each infantryman. However, today the approach reflects not just the weapon but also the ammunition and sighting/aiming system. The objectives in next generation infantry service weapons are to have modularity, improved ammunition, greater accuracy, and be more discrete. Under mobility the issue is how to balance light infantry's strategic mobility advantage while providing the essential tactical mobility needed to operate on today's battlefields. In survivability the challenge is to enhancing it without burdening the soldier or compromising his ability to fight. Finally situational awareness seeks to expand the soldier's knowledge of his surroundings. ▲

The IWI TAVOR 7 AR 7.62x51mm is the newest member of the TAVOR Bullpup rifle family and has been available since early 2018.

IWI



ADVANCED LETHALITY

The push to enhance the lethality of the infantry at squad level and the rifleman in particular has extended beyond just the weapon itself. It is now encompassing advances in ammunition, the sighting systems and even a more flexible approach to the assigned tasks of squad members.

Stephen W. Miller

Multiple weapons can now be assembled from a single chassis. In this way a squad member can customise his weapon by attaching different barrels, butt stocks, forearms, feed systems, and accessories to potentially create a carbine, a rifle, an infantry automatic rifle, or even a light machine gun or designated marksman rifle. The concept was demon-

strated in the 1960s by Eugene Stoner and his 63A weapon. Today a number of companies are offering similar capabilities. The logistic benefits may be obvious but the tactical ones are equally significant. When each member of a squad has a similar engagement capability it is possible to adapt the role that each member plays in any combat situation. For example, a team being employed to deliver a base of fire could have several members performing as

‘automatic fire riflemen’ rather than only one. Likewise individuals in a team conducting building clearing could simply change roles based on what is needed and where they are located at any given time in the conduct of the assault. Several infantry weapons are being offered with this capability.

MSBS System: The MSBS system (Modułowy System Broni Strzeleckiej) uses a common chamber/receiver which can be

configured in a conventional and bull-pup style. Modules can be attached to this base to achieve up to eleven different tactical versions including a sub-carbine, basic carbine, a carbine with grenade launcher, sniper rifle and a light machine gun. This design flexibility offers a weapon configuration suited for various roles within the infantry squad.

H&K HK416/M27: Heckler & Koch's HK416 has been recently adopted by a number of world militaries including the Norwegian and French Armies, Special Forces (SOF) in 27 countries and (as the M27) the US Marine Corps. It has proven to be highly reliable. A key attraction is that the weapon can fill all the squad roles of assault rifle for the rifleman, designated marksmen rifle, and automatic rifle with minimal adaptation. There is a short version with 280mm (11in) barrel weighing 3.7kg (8.2lb) and standard with 368mm (14.5in) barrel weighing 4kg (8.8lb); it is currently fielded in 5.56 with a 7.62 version the HK417 and other calibres possible. A compact 'C' model with 228mm (9.0in) barrel is also available.

IWI TAVOR: Israel Weapons Industry

TAVOR uses a long-stroke piston bullpup system designed for reliability, durability, simplicity of design, and ease of maintenance. It can be configured to fill roles as an assault rifle, carbine, designated marksman rifle, or submachine gun. It is the standard infantry weapon for the Israel Defence Forces (IDF) and selected units in 30 other countries and built under license in Brazil, India, and the Ukraine.

NEW AMMUNITION

There are concerns in some armies that advances in body armour have limited the effectiveness of some current calibers especially the 5.56 which is widely adopted. In response to this the US Army determined to go to a 6.8mm government developed projectile. It is heavier and will need to be fired at a higher velocity. It has been designated as the required bullet for their new Next Generation Squad Weapons – which includes both a rifle/carbine and automatic rifle. However, industry is open to propose whatever cartridge design that they wish.

This move by a major small arms user is also facilitating the introduction of some

innovative ammunition designs. Textron Defense is presenting the Cased Telescoped (CT) ammunition where the projectile sits inside a polymer cartridge. Benefits of the CT are that the round is shorter and lighter. General Dynamics Ordnance and Tactical Systems (GD-OTS) is collaborating with the firm True Velocity to offer a fully composite cased round. "These are entirely non-metallic and average 30 percent lighter than traditional brass cartridge" explained Pat Hogan, chief marketing officer. "This equates to him being able to carry an additional 90 rounds at the same weight as 7.62 round". The composite case has proven in tests to be consistently more accurate as it is a heat insulator reducing heat produced during the firing process. That in turn diminishes wear and tear on the gun, he added. SIG is also introducing new three piece construction hybrid ammunition. It features a brass case, steel base and an internal clip to connect the two. This is also true of PCP Tactical which is offering both its own new ammunition case design using polymer cases with a metal base. Most of these are interchangeable with existing ammunition so

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The MSBS is available in either battle rifle 5.56mm or assault rifle 7.62mm versions and is in service with the Polish armed forces.

the adoption of these substitutes for brass in the US programme could provide the impetus for a broad introduction of this approach.

ADVANCED SIGHTS

The push for weapons with increased ranges and target effect offers little benefit if these shots are not accurately placed. To achieve this requires a new approach to target engagement. Adam Maxwell at Vortex Optics suggested that "riflesman optics have moved from 'red-dot' to true 1X, daylight bright, forgiving eye-box, and rugged private proof sights like the Vortex Razor Gen 2 1-6x24. These offer the soldier a reflexive capability, increased PID (proportional integral derivative) [controllers that use a control loop feedback mechanism to control process variables and are the most accurate and stable controller] giving first



A US Marine confirms his 100-metre zero with the M27 Infantry Automatic Rifle during a range exercise.

round hit capability at intermediate ranges.” The ability to make optics more rugged has led to the introduction of variable magnification, previously solely used in sniper scopes. Increased magnification allows the shooter to better detect and identify a target, especially at longer ranges. These capabilities have been further advanced, explained Thomas Haynes, senior manager international sales at Steiner, by “offering small compact rifle mountable units that include laser range finding, illuminators and pointing.” A true fire control system akin to a combat vehicle may be soon available to infantry weapons. An example might be SIG Sauer’s optic that combines a laser range finder with Ballistic Data Xchange software that enables it to provide an adjusted aiming point.


The next step is incorporating these advanced capabilities into a single system and

electronically integrating it with other soldier viewing systems. In fact, this is exactly what is being requested by the US Army in its Next Generation Squad Weapon (NGSW) as part of its pursuit of Rapid Target Acquisition (RTA). RTA intends to further link the weapon, sight/scope and helmet mounted display for “battle sight” situations explained Matt Pickett at the Fort Benning based Soldier Requirements Cross-Functional team.

NEXT GENERATION SQUAD WEAPON (NGSW)

The US Army is currently testing candidate weapons from five companies, up to three of which will be selected to continue in a run off for its NGSW. The drivers behind the programme are defeating advanced body armour and to take advantage of technologies that can improve accuracy and extend engagement ranges.

In October 2018 the US Army Contracting Command in its Draft Prototype Opportunity Notice defines both a Next Generation Squad Weapon, both rifle and automatic rifle. Within the NGSW effort each selected contractor was “...developing two weapon variants and a common cartridge for both weapons, utilising government provided 6.8mm projectiles. The weapons include the Next Generation Squad Weapon-Rifle (NGSW-R) and the Next Generation Squad Weapon-Automatic Rifle (NGSW-AR). The NGSW-R is the planned replacement for the M4/M4A1 carbine and the NGSW-AR is the planned replacement for the M249 Squad Automatic Weapon (SAW) in the automatic rifleman role in Brigade Combat Teams (BCT).” One version must be provided that includes a rechargeable battery within the lines of the rifle. Industry sources suggest that to meet the requirements laid out, the ammunition provided must achieve a muzzle velocity of 3,000 feet per second. Five companies are understood to have delivered NGSW-R rifle and NGSW-AR weapons. These include: AAI, Textron Systems, FN America, General Dynamics-OTS, PCP Tactical, and Sig Sauer. In most cases specific details have not been fully released on what exact configurations have been provided due to competitive concerns.

Candidate weapons are now being evaluated by the Army with a down-select to three for further evaluation anticipated around early August 2019. Brigadier General David Hodne, director of the Army’s Soldier Lethality Cross Functional Team, indicated at a recent conference that the Army’s intent is to begin to field the selected weapons beginning in 2023. 



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MOVING FAST - MOBILITY MATTERS

Light troops need speed of manoeuvre to reach their objectives - and carry their support equipment with them.

By Stephen W Miller

A principle advantage of light infantry is its strategic mobility. Units can be loaded aboard aircraft relatively easily and transported anywhere limited only by the range of the aircraft. Light infantry are the preferred choice when large numbers need to be moved by aircraft so as to be on the scene in hours rather than days. However, a major limitation is that once light infantry arrive their tactical mobility is limited.

Airborne troops dropped by parachute have routinely sought drop zones as close as possible to their objectives. This can be critical as they need to move by foot - 4km per hour - and ideally must have reached their objectives and be dug-in for defence before the enemy

reacts. This may include the seizure of an airfield or other suitable site to establish and air-head into which transport aircraft can be landed. These are needed to bring in follow-on forces and assets essential to continuing operations. Failure to secure this airhead can have serious consequences for the success of the operation.

Helicopter inserted forces have a similar concern in that their ground movement is also limited once they leave the aircraft. Their initial capture of the initiative can be eroded as time passes after being placed on the Landing Zone (LZ). Here again the answer has been to use an LZ in proximity to the objective. Accurate and timely intelligence is critical to assure that the LZ is not covered by

enemy fires, particularly accurate and effective air defence weapons.

Another increasing concern is the effectiveness and ranges being offered in modern artillery and rocket systems. It has become established that given what has been seen in the Ukraine-Russian conflict a force once located by intelligence, direction finding, shot location or other means can be targeted by overwhelming fires. This leads to the need for the landing force to maximise manoeuvre with as much independent action as possible.

SQUAD MOBILITY VEHICLES

Major General Eric Wesley in an earlier interview with *Armada International*, as then Commander of the US Army Manoeuvre



The US Army Ground Mobility Vehicle (GMV), now called Infantry Squad Vehicle, has been fielded by SOCOM units in the form of the GD-OTS Flyer 72.

GD-OTS

Centre of Excellence (MCoE) Fort Benning summarised the new future scenario as where, “A2AD (Anti-Access Aerial Denial) technology and weapons, like air defence systems and anti-armour, mines and IEDs, have become both more effective and prevalent.” This opens the question of whether traditional insertion drop or landing zone are still feasible. It is increasingly likely that an ‘offset insertion’ will be necessary with the ground force then moving by land to the objective or operating area. The mobility of pick-up mounted ‘technical’s; use of improvised explosive devices, longer range artillery, and use of Unmanned Aerial Systems (UAS) are even prevalent even with lower capability forces. Near-peer opponents offer an even greater challenge.

Improving the ground mobility of the light infantry is viewed as part of a broader solution to these issues. The concept is that the combination of the potential insertion possibilities and the speed of movement will provide the advantage, keep the opponent off-guard and gain and maintain the initiative – in classic manoeuvre warfare form. The adoption of light vehicles is gaining momentum among armies. While some are seeking essentially off-the-shelf vehicles others are pushing for more complex rides.

The US Army is seeking to address this requirement in a vehicle referred as the Infantry Squad Vehicle (ISV), previously called GMV. The ISV is intended provide infantry brigades with the small unit tactical mobility to out manoeuvre enemy forces. Army is evaluating proposals received from industry and plans to award a prototype contract to up to three vendors by 20 August, with a production award contract for one

vendor by March 2020. According to the announcement of the request for proposal (RfP) “the ISV will provide mobility for a nine soldier infantry squad with associated equipment. The ISV is a lightweight, high mobility platform that shall be transportable by all means including vertical lift (via Boeing CH-47 Chinook and Sikorsky UH-60 Black Hawk) and Low Velocity Air Drop (LVAD).” Actually, the Army already has an ISV in their award to General Dynamics for their Flyer (see following) in a version based on vehicles already fielded and in extensive use by US Special Operation Command (SOCOM). However, the US Congress directed that an additional full competition be again conducted to select a vehicle to fill the balance of the Army’s projected fielding needs. The ISV requirements and performance are essentially unchanged from the earlier GMV.

Tactical Mobility Vehicles options include:

General Dynamics Flyer (ISV): Developed by General Dynamics Ordnance and Tactical Systems (GDOTS) the Flyer has already been field by the US Special Ops and Army and other militaries. The vehicle can be carried in all transport aircraft, and also up to two in the CH-47/MH-47 helicopter. Special attention is given to high agility, optimising visibility from the vehicle, maximising on-board stowage, and adaptability through mission kits. With its 2,500 kg (5,512lb) payload Flyer 72 (referring to its 72 inch width) can undertake a number of roles including logistics transport and as a fire support platform. It can also be configured to accommodate nine soldiers while still leaving another 1,062kg (2,336lb) for additional supplies. In fact, the GD-OTS Flyer-72 is already being fielded to selected brigades in this configuration. The GD Team’s previous military user exposure is evident in the design. For example, rather than providing a chassis seat for the ninth rifleman, there is a position in a secured gunner’s seat to man whatever overhead machine gun that will be employed on the vehicle. Flyer is also available in a narrower 150cm (60”) version, the Flyer 60, which fits inside the V-22 and can also be externally lifted by the UH-60 Black Hawk. Both the 72 and 60 share components with the HMMWV with the majority of the balance being Commercial Off-the-Shelf (COTS).

Polaris DAGOR (ISV): DAGOR (Deployable Advanced Ground Off-Road) is a new vehicle from Polaris Defense. According to Jed Leonard, senior manager the design “went from concept to testing hardware in only nine months with much of the design influenced by input from Special Operations (SOF)



Light infantry have acquired and field a number of commercial based all-terrain vehicles like the Polaris DAGOR.

Polaris



Vyper Adams

The Vyper Adams Tactical Ultra Light Vehicle

personnel and the company's experience with more than 20 countries that have our ultra-light military vehicles". DAGOR is in service with SOCOM but has been reconfigured to also meet the Army ISV requirements for air and helicopter lift. The DAGOR takes advantage of the rear open bed, used in the SOCOM vehicles to carry additional supplies for extended operation, to accommodate the additional soldiers required in the ISV. Full payload for the DAGOR is 1,447kg (3,250lb).}

VYPER (ISV)

Vyper V4 is being custom configured for the ISV drawing on the earlier V3 Python fast attack vehicles and other tactical ultra light vehicles. Its empty weight is 240kg (529lb) (4,500 lbs), gross weight of 4990 kg (11,000 lbs), and towing capacity of more than 4536 kg (10,000lb). Vyper Adama's CEO Nicholas Chapman told *AI* that "Vyper will utilize the most advanced technologies available in its GMV candidate to achieve the weight, ride and operational performance possible". The company particularly emphasizes its use of patented mission "Modular PODs". These can be installed on any base chassis to convert the vehicle to different applications.

SQUAD/SMALL LOAD CARRIERS

An additional challenge for light infantry is their sustainability. The water, food, ammunition and other consumables that they require to live and fight are largely dependent upon what each soldier can carry. As that load increases so does his ability to move quickly and undertake extended marches. It is not unusual to find infantry carrying between 31-58KG (70-129lb), versus the 22KG (50lb) that is recommended basic load. At best

the light infantryman may have sufficient food and water for a day or two and may be pressed regarding ammunition should they be engaged in an intense or prolonged fire fight. They, thus, require either regular resupply and/or the ability to store and transport with them both essentials like water, ammunition, food and other consumables. These resupplies need to be close at hand and readily accessible to the squads. This is even more essential for the infantry support weapons such as mortars, machine guns, and anti-armour weapons. These are bulky and can have significant ammunition demands in providing fires for forward elements in engagements. Finding a solution to carrying these ready supplies has been a continuing process since the first infantry units were fielded.

One approach has been to use what are essential commercial off the shelf vehicles that have the ability to accompany behind the infantry combat unit. All terrain vehicles have proved capable of filling this need. By taking some of the loads that would otherwise need to be carried by the soldier they are able to potentially reducing the light infantry soldiers load. A number of these have been fielded and used successfully. They are relatively inexpensive and have been shown to be reliable and adaptable. Some of the offering companies have gone forward and developed modifications that better reflect military requirements, such as providing diesel engines, military lighting, and tie downs.

POLARIS MRZR

Drawing from its commercial all-terrain vehicle (ATV) line, Polaris has been adopted by a number of armies to provide a rugged, reliable, adaptable and relatively low cost light vehicle for small unit use. Its well proven off-road use allows it to travel in both close and rough terrain. Provided in two, four or six occupant versions it also offers up to 680kg (1,500lb) payload and can be configured for various mission roles, including medevac litters, weapons carrier, command and logistics. It is ideally suited for both carrying initial supplies and to ferrying necessary supplies from supply points forward directly to the platoon and squad. The combat size of the vehicles allows them to be not only carried in virtually all transport aircraft but also in many heavy lift helicopters including the Sikorsky CH-53 Sea Stallion and CH-46 Chinook. The company on its own funding developed a turbo diesel powered version which addressed



US Army

The Polaris MRZR all-terrain vehicle has been widely fielded to light and airborne infantry units. It is compact allowing transport in or lift by helicopter. Here US Army airborne troops move off the LZ after retrieving the landed vehicles.



GD-OTS

General Dynamics OTS has offered the MUTT, an eight wheeled all-wheel drive vehicle to carry infantry loads. MUTT provides an unmanned platform that can operate remotely, autonomously as pre-programmed or 'leader-follower' where it tracks a soldier.

that the primary fuel used by most armies is diesel or multi-fuel requirements.

Another programme focused on taking advantage of advances in robotic and autonomous driving advances. These seek to undertake the same task but by using small semi-robotic/autonomous vehicles. An advantage is that they have the potential to not require a soldier to physically drive the vehicle. The US program for such a system is named S-MET (Small Multipurpose Equipment Transport). This was previous the "Squad Multipurpose Equipment Transport), however, user trials demonstrated that such a vehicle was difficult to maintain and support at such a low combat unit level. The plan is now to retain the S-Met at battalion and to provide them to lower units as needed.

Candidates that are filling or are proposed to fill the task of carrying the infantry loads include;

JOHN DEERE M-GATOR

The M-Gator is a diesel powered adaption of the commercial Gator. It is from inception designed as a light, off-road pick-up with a substantial rear deck built to carry various loads. Its 454kg (1,000 lb) cargo box capacity is augmented by a substantial 635 kg (1400lb) towing capacity. A number of all-terrain trailers have been offered to take advantage of this.

ARGO ATV

Using an eight wheel design the ARGO ATVs are built to traverse any terrain including desert sand, marsh, snow and mountains

with models can also swim. With up to 680kg (1,500lb) of cargo capacity they have been able to be largely adopted in their commercial versions – the latest being the Aurora and Conquest. The later has a 748cc (45.6cubic inch) liquid-cooled, V-twin, electronic fuel injected Kohler Aegis ELH775 engine providing 30hp. Argo's are rapidly drive on/off air-mobile and can be provided with an optional four-point lift hitch, allowing sling loading by a helicopter.

POLARIS MRZR X (S-MET)

Teamed with Applied Research Associates (ARA) and Neya Systems, Polaris has converted their proven and already in service MRZR to provide an autonomous operating capability. Of particular interest and unique to any other S-MAT candidate their submission also continues to retain the ability to have a driver

in the seat. This has significant advantage in that one system can be utilized based on the needs at any time. It can function remotely when that is preferred or with a driver in the seat when that is more suitable. In addition, it retains all the supportability benefits of drawing on the Polaris commercial network for service and parts.


GENERAL DYNAMICS 4X4 MULTI-UTILITY TACTICAL TRANSPORT (MUTT)

MUTT uses a hybrid electric drive and can be outfit with either wheels or tracks. This adaptability makes it suitable for a number of terrains including soft ground and snow. The hybrid allows it to have a very low noise signature. It uses a line-of-sight remote control with an operating range up to 300m. Soldier trials found it easy to operate and manoeuvrable. These field evaluations found that it could be used to tow an all-terrain trailer permitting carry of up to six days supply.

HOWE AND HOWE RS2-H1

Using full tracks the RS2-H1 is, according Howe & Howe, "a mid-sized high torque electric drive diesel hybrid 'pack-bot' designed to operate in the toughest of terrains while offering unprecedented range, reliability, and mobility." It incorporates state of the art electronics and hybrid technology. It has a range of 128km and can carry 450kg (1,000lb).

HDT GLOBAL HUNTER WHEELED OFFLOAD LOGISTICS FOLLOWER (WOLF) – (SMET)

The HDT vehicle uses six solid composite wheels and a JP-8 / electric hybrid power train that provides both a 'silent drive' and 'silent watch' capability. Its range is 100km range with 72 hour endurance with a 450kg (1,000lb) payload. 



US Army

The 'Grizzly' from Textron Systems was one of the robotic carriers field evaluated by the US Army. The requirement is to carry 455kg (1000lb) and travel 96km (60 miles) in 72 hours with only onboard power.



A US special forces operator uses night vision technology to search a tree line for insurgent activity during a mission in Afghanistan.

THE OPTICAL ADVANTAGE IN COMBAT

Extending visual capabilities through the use of night or thermal vision devices, or even using micro-UAS to see 'over the hill' can help soldiers retain their combat initiative.

Stephen W. Miller



US ARMY special forces using night vision goggles fire an M2 .50-caliber machine gun at Fort Bragg, N.C., 2 April, 2019.

Knowing your surroundings has always been a critical concern and objective in combat from the highest command to the individual rifleman. Having sound information about the terrain, enemy and overall conditions offers a huge advantage. At the small combat unit level this knowledge can not only make the difference between success or failure of a mission but between life and death. Detecting an opponent first provides an immediate advantage through the ability to take the initiative in terms of 'what happens next.' Similarly for one initially taken by surprise the best chance of 'turning the tables' is to regain the initiative by applying fires and movement both of which are predicated on quickly and accurately establishing the situation and responding to it.

Although detecting and engaging an opponent is important for the frontline soldier it is not the only element of his achieving good situational awareness. The task of

simply maintaining his orientation both to the ground and to his squad members is vital. Becoming lost or disoriented can have equally deadly consequences. Not knowing where fellow soldiers are can lead to friendly fire incidents. While serious in daylight, this become even more complicated at night.

Night vision devices, though technology and production advances, are now widely available to the infantryman. In addition miniaturisation, inexpensive digital memory and processing, and wireless networking has meant that information and imagery can be presented, integrated and transmitted much more readily. Together these advances are opening more possibilities to significantly improve the situational awareness of the soldier and small unit.

NIGHT VISION – IMAGE INTENSIFICATION

Image intensification (I²) has become significantly less expensive, more compact,

and more efficient. The majority of devices such as night vision goggles (NVGs) use tubes that amplify the light.

The range of I² devices now includes weapon mounted sights as well as NVGs and every modern combat helmet now includes a NVG mount. The preferred NVG configuration for the infantryman appears to be moving toward a single tube which places the I² image in front of one eye with the other left with normal eyesight. A drawback of the NVG is that it typically prevents normal sighting of the rifle. To provide for this weapons are outfitted with a laser spotter that is alighted with the weapon. The spot can be viewed by the NVG and when placed on to the target and the trigger is pulled the shot should hit. This provides effective and more rapid engagement particularly at combat ranges though it becomes less accurate as the range increases.

The I² and NVG are widely available both commercially and with militaries worldwide



A French infantryman uses a TI monocular sight to pierce the surrounding mist.

so 'owning the night' has become much more difficult and less assured.

THERMAL IMAGING (TI)

TI essentially detects the temperature differences between objects, with warmer objects standing out from colder ones with each having a different signature depending on many conditions and circumstances. TI does not rely on any external light sources and is able to detect through foliage, smoke, and even inside buildings. A major advantage of thermal imagers is that they are digital which allows their information to be readily processed, transmitted and integrated. TI devices are generally larger in size with the majority being either handheld or weapon mounted.

Since thermal uses a digital medium it is possible to display imagery not only looking into the device but also to have it remotely displayed. This offers the possibility of presenting the image into a helmet mounted display worn by a soldier, allowing them to see exactly what the weapon is pointing at without having to face in the same direction. This literally allows shooting around corners. The soldier can point his weapon around the wall or corner, see what is there and chose to engage it without exposing himself.

One of the earliest systems to demonstrate this capability was included in the FÉLIN (Fantassin à Équipement et Liaisons Intégrés, Integrated Infantryman Equipment and Communications) fielded by French infantry and developed by Safran Electronics & Defence. It linked the thermal sight on the FAMAs rifle via cable to a helmet mounted optical device. Units were provided to French soldiers in Afghanistan in 2011. Field results

were mixed; although the capabilities were welcome the overall weight of the weapon/sight combination was considered a drawback. This highlights a recurring concern common with many of the efforts to expand the horizons of the individual combat soldier. Often these systems have weight, bulk, complexity, power demands, and other design aspects that are found to be impractical in real world combat environments. This has even been the case where the concept and even the hardware has been "field" evaluated. It suggests at least the difficulty in truly reflecting the conditions of prolonged combat in test and evaluation, but also the enthusiasm of soldiers asked to conduct such evaluations.

Further advances in miniaturisation are allowing the size and weight of thermal units to decrease. Safran's latest assault rifle thermal





Collins Aerospace

The MV35XC head/helmet mounted display (HMD) provides remote viewing of any composite and RGB device, giving soldiers instant access to video sights, computers, maps, GPS and other data.

sight, the SWORD Light weighs under 0.86kg, but still features an optional red dot sight, low-magnification wide-field thermal channel, digital zoom, integrated remote control and eight hours operation using standard AA batteries.

The US Army Family of Weapon Sights (FWS) development is bringing the rifle/weapon mounted sight to a new level of compactness and integration. The FWS-I (Individual) wirelessly transmits the weapon sight crosshair and thermal imagery to the Enhanced Night Vision Goggle (ENVG) III and ENVG-Binocular, providing a Rapid Target Acquisition (RTA) capability. The Army sees RTA as “providing a new level of tactical capability in that it enables soldiers to detect, recognise and engage targets accurately from any carry position.” Two companies have systems selected Leonardo DRS and BAE Systems with the first production contract

having been awarded to BAE in March 2018 for both the ENVG and FWS-I.

DAY/NIGHT SIGHTS

While TI is exceptional for detecting a target, its recognition and identification capability has been limited, in terms of whether the target is friend or foe or a combatant or non-combatant. For this, the visual optic remains preferable. One solution is to incorporate both thermal and visual into a single mounted system. Safran’s SWORD T&D does just this. It combines an uncooled thermal and day weapon optic. The new generation, digital sight improves direct or offset shooting and observation. Options include remote hands on weapon control and communication links for data and video. It is compatible with not only rifles but machine guns and infantry support weapons such as the Saab Carl Gustav recoilless rifle.

A key piece of providing the infantryman significantly greater situational awareness is to ensure other senses are not compromised. This was felt to be a limitation in infantry use of a dual-optic NVG. By wearing it the soldier completely lost use of their normal vision. Many view the small helmet mounted display as the preferred solution. The MV35XC from Collins Aerospace offers remote viewing of any composite and RGB device. With it the wearer not only has instant access to video sights but can also selective view computers, maps, GPS and other data. The display is small allowing the wearer to remain aware of his surrounding while it can also be pushed up or aside to allow completely unobstructed vision or use of a weapon sight.

LITTLE EYE IN THE SKY

A new frontier for the infantry squad has been via the introduction of unmanned aerial systems small enough to place in the palm of the hand. These micro-UAS have the potential of extending the situational awareness of this smallest dismounted combat unit far beyond what has been previously possible. They are compact and light enough to be carried by a soldier, built simple to use by incorporating autonomous control, and able to fly for moderate periods to provide real-time video of close-by areas of interest. One of the earliest is the Black Hornet from FLIR Systems. This ‘nano’ UAS is in use with armed forces of the United States, France, the United Kingdom, Germany, Australia, Norway, the Netherlands and India. It is also called a Personal Reconnaissance System (PRS), each of which incorporates two Black Hornets, a docking/charging station (they are battery powered), a hand-held touch screen controller and display. Each weighs less 45 grams (0.1lb) and is under 178mm (7in) long. Each Black Hornet can stay airborne for 25 minutes and has a line-of-sight radio-link range of around 2,000m. Each unit has two daytime video cameras and a thermal imager and has the capability to fuse the three feeds for higher fidelity imagery. The operator can pilot the drone manually or use semi-autonomous operation following pre-programmed GPS waypoints and return as programmed or on demand. If the command signal is lost Black Hornet will automatically return to its origin.

These nano or micro UAS offer realisation of the ultimate wish of the combat soldier – to see over the next hill, tree-line, or city block. By being present and specifically configured to the small unit they provide the local information so critical to their gaining the advantage over an opponent. **A**



FLIR

The Black Hornet ‘nano’ UAS from FLIR Systems is now used by the armed forces of the United States, France, the United Kingdom, Germany, Australia, Norway, the Netherlands and India.

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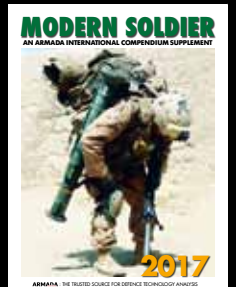
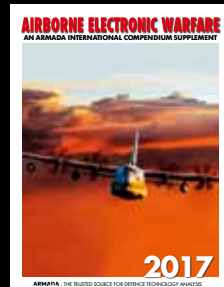
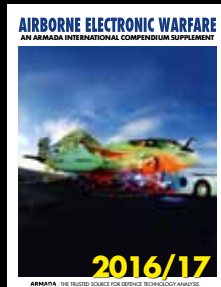
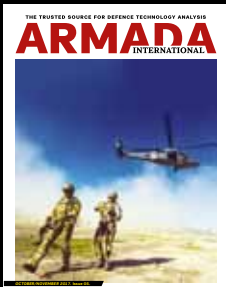
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US Army



US Army

The new Integrated Head Protection System (IHPS) was revealed by the US Army at Fort Belvoir, Virginia, on 4 March 4, 2019. The helmet is a component of the new Soldier Protection System.

The new Soldier Protection System (SPS) was also on display at Fort Belvoir. It features a modular scalable vest, a ballistic combat shirt, and a ballistic combat belt.

LIGHTER BUT TOUGHER COMBAT VESTS AND HELMETS

Body armour and helmet designs are advancing to give today's soldiers lighter and better protection.

Soldier survivability is a priority. It is not just the desire to reduce or eliminate the injury or death of one's people but also the adverse impacts that casualties have on the unit's ability to successfully execute its assigned mission. At the small infantry unit – typically between nine and 13 – each soldier has a key role to play and each casualty will have an impact on overall team cohesion and effectiveness.

Looking strictly at protecting the soldier from being injured by a fragment from an explosion or bullet, the best solution would seem to be the provision of personal body armour. If this is the case then increasing the armour's penetration resistance should further enhance survivability. However, the field reality, as pointed out by John Yancey, deputy, US Army Soldier Requirements Division, Manoeuvre Capabilities Development and Integration Directorate (MCDID) is that "additional body armour can also restrict the soldier's movement and actions while also adding weight that reduces his agility and endurance."

Reducing weight is also a factor that can enhance survivability by allowing the soldier to move more quickly with greater agility. According to a May 2017 Government Accountability Office (GAO) report on personal protective equipment improvement efforts, US Marines fighting in Iraq or Afghanistan carried an average 53kg (117lb) load, well above

Stephen W. Miller

the standard approach march load of 32.6kg (72lb). This resulted in slower reaction to a contact and reduced endurance in a combat situation.

One body armour designer suggested that a key influence in the trends in body armour configuration preferences is driven by the experiences of the field users. Given recent experiences, the emphasis on counter-insurgency (COIN) operations has led to a focus on protecting against bullets. This has led toward what one ballistic expert referred to as a minimalist approach to body armour - lighter vests that offer better mobility but which usually hold only ballistic or strike plates with little or no soft armour coverage. The US Army Soldier Plate Carrier System (SPCS) reflects this move while its next generation Modular Scalable Vest (MSV) is essentially a 'plates-only' body armour variant. While these are certainly lighter they also cover less than the previous Improved Outer Tactical Vest used by the Army. The question is how will these 'minimal armour' vests fare in near-peer conflict where artillery is employed? Here soft armour fragmentation protection could be essential.

It should also be remembered that

absolute protection is not possible. For example, as was made clear in Syria, the Russians have fielded sniper rifles including the SV98 and SVD that are capable of defeating even the latest body armour at virtually all ranges. So acceptance of some risk is necessary and a balance needs to be struck.

SPCS AND MSV

Yancey suggested that the US Army has recognised that "simply designing individual body armour which is intended for use by all soldiers was not the optimum approach". To a large degree this 'one size (or design) fits all' was the case with its earlier Personnel Armour System for Ground Troops (PASGT). The SPCS and MSV are moves to provide more customisable body armour. The idea is to provide a lightweight alternative rather than a replacement for the Improved Outer Tactical Vest used in the Interceptor body armour system. The US Army chose the KDH Magnum TAC-1 system to fill its requirements for soldiers in Afghanistan. According to the company, it is "highly adjustable for improved fit and can be adjusted 'on-the-run' without removing the vest with its side adjustable straps." The vest can be adjusted real time as mission requirements change. It uses the latest Enhanced Small Arms Protective Insert (ESAPI) plates which weigh 5.9kg (13lb) in their largest size. US and most western plates are made of high-strength ceramics.



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US Army

A new equipment trainer from Project Manager Soldier Protection Individual Equipment at Fort Bragg, N.C., demonstrates how the Modular Scalable Vest (MSV) can be separated into different configurations.

The Modular Scalable Vest was introduced in 2018 to replace the Improved Outer Tactical Vest (IOTV). The MSV is 11kg (25lb) lighter when fully loaded with ballistic plates which weigh 2.2kg (5lb) less than the IOTV. The biggest difference is that MSV is designed to be scaled up or down depending on the threat and mission requirements. The first tier is concealable soft body armour. To this can be adding armour plates offering additional impact protection. The next level includes a plate carrier and ballistic plates, while the last adds a 'ballistic combat shirt with built in neck, shoulder and pelvic protection and a belt system to move items from the vest to the hips.' KDH Defense Systems received the first contract to provide MSV in June 2018.

The latest US Marine Corps plate carrier vest system is designed with more efficient weight distribution to allow the Marine to scale the system dependent upon mission requirements. It consists of a cummerbund style main vest with the option of using the groin and lower back protection of the IOTV (Interceptor). The system is a two-point cut away design with fully integrated side protection, communication routing channels and increased MOLLE attachment points. The plate carrier vest system is an alternative to the larger IMTV vest.

In June 2019 the Marines awarded a contract to Point Blank Enterprises for new light-weight body armour plates that are around



The outer cover of the Russian Army 6B45 ballistic vest is made of wear-resistant fabric. It is modular and can be adapted in the level and area of protection of vital organs.

3.8kg (8.5lb). These are designed to be worn in low intensity or counterinsurgency style conflicts. Major Ken Kunze, a spokesman for Marine Corps Systems Command, shared that the Corps expects to begin fielding the new plates in early 2020.

IOVT replaced the Interceptor Body Armour (IBA) fielded by the United States Army. KDH Defense, the manufacturer of the IOVT, shared that "it has been modified several times based on real-world combat feedback." The vest can use both the Enhanced Small Arms Protective Insert (E-SAPI) and ESBI Side-SAPI plates. The system is designed to have components added allowing full-up system with groin protection, lower back protection, deltoid protection and neck-throat protection. The German Bundeswehr's standard vest is part of it's the IdZ Infanterist Modifiziert (Infantryman of the Future). It is modular using

both SK4 plates and SK1 soft body armour and weighs 10.5-12kg (4.7-5.4lb). Neck/throat, groin, shoulder and lower back components can be added.

Russia's military standard issue is the 6B23 body armour which uses a combination of soft armour and steel plates and has groin protection. The later 6B43 and 6B45 are lighter and protect the neck and surrounding areas but use a removable flap for lower coverage. The 6B45 is modular, has scalable protection similar to the MSV and uses ceramic plates. The use of steel or titanium plates, rather than ceramic, have the disadvantage of a projectile hit breaking up with the resulting shrapnel likely to cause injury.

The Chinese People's Liberation Army (PLA) have adopted and widely fielded body armour. In fact, China is a major exporter of body armour for commercial/security uses. Many design features are similar to US and Western designs including the overlapping front, side adjustment strips, detachable throat and groin protector, hard plate pockets and MOLLE. Chinese hard plates are either ballistic steel (which is heavier than ceramic) or in their higher-end plates, aluminium oxide ceramic.

BALLISTIC HELMETS

The 3M F70 was introduced in October 2018 to address the need to improve wearer comfort while maintaining the required ballistic protection levels. At 0.77kg (1.68lb) for the high cut and 0.87kg (1.91lb) for the mid cut version it is lighter than the current Combat Helmet II L110 but provides greater



US Marines

A US Marine wears an Enhanced Combat Helmet (EHC) during the Urban Advanced Naval Technologies Exercise 2018 (ANTX18). ANTX18 integrates engineers, technologists and operators into a dynamic development team.



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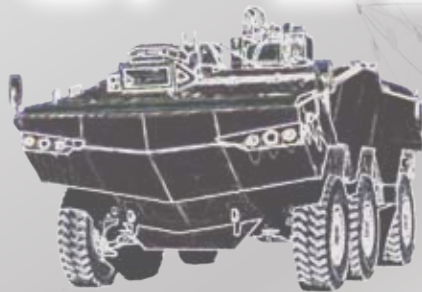
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The Russian Army Ratnik combat helmet is planned to be equipped with an integrated communication system by 2025.

protection than the other current Ultra-Light Weight Bump Helmet N49. Special attention has been given to both lowering its weight and its stability on the head even when the wearer is running or performing other activities, including parachute jumps.

The US Army is introducing its new Integrated Head Protection System (IHPS) - a five percent lighter weight helmet system composed of helmet/maxillofacial and passive hearing protection with increased blunt impact performance. First production deliveries began in mid 2018 from manufacturer Cera-dyne, a 3M company.

The US Marine Corps awarded a contract in June 2018 to Gentex to provide the Enhanced Combat Helmet, or ECH, to every Marine. The ECH is the same weight as the standard Advanced Combat Helmet but is capable of stopping rifle rounds and fragmentation.

The ECH consists of a ballistic shell, suspension pads and four-point retention system. In addition to those components, a reversible helmet cover, night vision goggle bracket and attachment hardware.

The US Marines announced on 4 June 2019 that they are seeking a new lightweight and integrated helmet. This requirement for an Integrated Helmet System (IHS) is aimed at

improving “the integration of several current and future head-borne systems such as optics and hearing enhancement/protection devices,” said a spokesman for Marine Corps Systems Command. It must be between 1.31kg (2.91lb) for a small helmet, to 1.74kg (3.84lb) for an extra-large. It should be optimised to allow power and/or data to flow to the attachments while minimising bulk.

The Russian lightweight 6B47 helmet from Tehinkom is part of the RATNIK (Warrior) combat equipment programme and is being issued to army units. It has a night vision goggle bracket and side rail. The helmet has an outer composite shell, dry aramid fibre and inner composite sheath weighs 1kg and resists a 9mm pistol shot at five meters. It is issued with a balaclava and digital pattern woodland green and snow helmet covers.

SEA, a cohort company, has been working with other companies and the UK's Defence Science and Technology Laboratories (Dstl) on the Future Soldier Vision (FSV) for the British Army (see cover picture). Its aim is to produce an integrated soldier system that balances military need with technological capability. This research aims at reducing weight, increasing protection and incorporating new technology. **A**



ON THE COVER: The UK's Defence Science and Technology Laboratory (Dstl) is looking to develop the British Army's FutureSoldier Vision (FSV), showcasing the personal equipment that soldiers could be using by the mid-2020s. (MoD)

Modern Soldier

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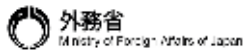
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