



● ● Photo courtesy Raytheon

## Expanding on wearable technology ● ●

It is vital in today's world that soldiers be provided with the best possible equipment. However, that means large amounts of communications, navigation, and situational awareness technology, all of which needs to be moved from place to place in the battlefield. Commercial and military research groups are investing heavily in more mobile and wearable technologies as a solution to the increasing amount of equipment needed in the field. While research is still in its infancy, there already exist a number of viable solutions that are in play today within defence forces around the world.

**Soldiers in the battlefield must make use of every** advantage possible to have the best chance of survival, mission success, and injury avoidance, and having the best possible armour makes a massive difference. Gone are the days when soldiers would cover themselves in heavy plate armour and chainmail; today, thanks to innovative new technologies, armour is lightweight, flexible, and tougher than ever before. Indeed, recent years has seen a massive leap forward in armour. No longer simply a protective coat, today's armour is being developed with secondary features in mind as wearable technologies make all the difference to the warfighter.

As technology has advanced, soldiers require more and more equipment in the field. This might include communications technology like radios or VSAT systems, navigational or computing equipment. For medics, the list of equipment is endless. As such, commercial and military research groups have been working on making equipment increasingly mobile, with wearable technology a key focus. When vital equipment can be miniaturised and worn on the body, soldiers can keep more equipment directly on-hand, enabling enhanced capabilities in the field, while keeping their hands free for more pressing tasks.

The wearable technologies field is one of the strongest growing areas in military research. According to *'The Military Communications Market: 2015-2030 – Opportunities, Challenges, Strategies & Forecasts,'* pressures on defence spending will not halt increasing investments in military communications. The market is expected to provide more than US\$40 billion in revenue by the end of 2020, with spending focused on wearable technology, machine-to-machine (M2M) and sensor networks. Within the wearables category, applications range between enhancing situational awareness,

and detecting and resolving physical and health problems. The report highlighted DARPA's ULTRA-VIS programme, which has developed lightweight, low-powered, wearable display systems for ground troops. The displays enhance situational awareness with an augmented reality view, which includes information on the nearest friendly units, distance to objective, and satellite imagery of the area.

### Providing additional situation awareness through helmets

Helmets are an integral piece of body armour for most military groups, protecting the head from blows, falls, and a host of other attacks. They are also one of the pieces of equipment that developers most commonly focus upon for armour upgrades. A soldier's eyes and ears provide vital information in the battlefield, and through the helmet, both sight and sound can be conveniently augmented with additional technologies.

In July 2016, BAE Systems completed the second set of trials of its Striker II Helmet-Mounted Display (HMD), which saw the technology integrated with the Eurofighter Typhoon combat jet. The trials proved that technology can be integrated with existing aircraft, regardless of whether its electronics systems are analogue or digital.



● ● Photo courtesy Revision

The Striker II HMD technology allows pilots to easily engage high-precision target tracking while providing superior situational awareness. The integrated night vision capability means that the system can be used in any light conditions.

"This phase of testing is a significant milestone on the path to full integration of Striker II with Typhoon," said Peter Kosogorin, Test Pilot for BAE Systems. "Striker II is a real step change for the fighter pilot. It removes the need for separate heavy night vision goggles that increase pressure on the pilot's head and neck to that aircraft manoeuvrability is no longer limited."

Meanwhile, Revision Military, a provider of protective soldier equipment for military applications, was awarded a contract in July 2016 from the Department of Defense's (DoD) next-generation helmet platform programme. In October 2016, Revision unveiled its submission: A Family of Tactical Headborne Systems (FTHS). Several hundred samples have been delivered to the DoD for testing in compliance with the contract.

The multipurpose helmet suite consists of coastal marine, riverine, ground ballistic and ground bump systems, and will be supplied with a new set of accessories that will enhance the helmet platform for boat, vehicle and HALO/HAHO, as well as mountain, river and direction action operations. The bump helmet is the first in the industry that can be ballistically-enabled with add-on armour for blunt force and ballistic protection. It also reduces neck burden during highly dynamic operations, while still providing the required protection. With the skeletisation of all of the system components, the combined weight is significantly lower than other helmet systems available on the market.

"We can't wait for the warfighter to get their hands on these helmets," said Eric Houchell, Vice President, Armor and Global Operations, Revision Military. "This is a very exciting opportunity

for Revision, and this project continues to drive innovation within our Armor Business Unit. It's a very aggressive program and I believe Revision has proven itself more than up to the challenge, building a full-suite, custom solution from the ground up. All of the significant resources at the company's disposal were called upon to produce this cutting-edge helmet, resulting in a product that will give some of our country's most elite forces the protection, versatility, and manoeuvrability they require for demanding operations. We firmly believe the solutions we've created here advance helmet technology as we know it."

Revision's entire FTHS also includes a headborne personal signature management (PSM) package, daytime visors, blunt/ballistic mandibles, an NVG splash shield, and Revision's new multilayer liner comfort system with a removable fit band and a concave shell design to support NVG use. The FTHS suite will be available commercially this year.

### Enabling power and data relays with next-generation armour

Armour is one of the most essential components for any soldier about to enter the battlefield. It must be ruggedized and durable enough to protect the wearer, while also being suitably lightweight and flexible to allow a good level of movement. In recent years, those in the battlefield have been able to enjoy armour that goes beyond the bare basics, with a wide variety of additional features included, such as power sources, situational awareness, or data relays.

One of the most recent developments came in in July 2016, when BAE Systems announced that it had designed Broadsword Spine, an alternative to the heavy portable data and power supplies currently used by military and emergency service workers.

In partnership with Intelligent Textiles Limited (ITL), BAE Systems will produce the Broadsword Spine in high volumes at low cost. The company plans to supply them to the armed forces, fire and rescue services, and law enforcement agencies, which all rely in mobile electronic equipment that is durable for long periods of time.

Broadsword Spine is an e-textile based layer which, when added to clothing, creates an invisible electronic network and power supply by using conductive fabrics instead of wires and cables. With it, wearers can plug in vital electronic devices into the vest, jacket or belt, and be instantly connected to power and data via USB. The new system is expected to provide around a 40 percent weight saving per user compared with alternative solutions. Robust enough to operate in the harshest environments, and resistant to water, fire, humidity and shock, Broadsword Spine can be easily recharged in the field via an in-vehicle charging point, or through battery replacements.

Meanwhile, in September 2016, a team from the Defence Science and Technology Laboratory (Dstl), Roke Manor Research, QinetiQ, and Systems and Engineering Assessment (SEA), demonstrated their Dismounted Close Combat Sensors (DCCS) technology, which was designed to improve navigation and enable soldiers to more effectively share information.

The system makes use of GPS, but also works in the absence of GPS signal availability or when the signal is jammed, thanks to inertial and visual navigational sensors. It takes the last known GPS location and combined information from visually tracked features captured in a helmet camera, alongside inertial sensors, which can accurately track an individual's location, enabling soldiers to be tracked inside buildings and tunnels.

The DCCS technology will stop friendly forces from being mistaken for the enemy, in addition to enabling commanders to track the location of personnel. Inertial and magnetic sensors on the weapon can track where it is pointing. A combination of camera, laser and orientation sensors mounted on the weapon will allow them to highlight targets to other troops, unmanned aerial vehicles (UAVs) and other aircraft at the press of a button. The system can also identify wounded colleagues, and locate civilians and potential helicopter landing sites. Finally, the acoustic and camera technology automatically identifies where



● ● FORTIS photo courtesy Lockheed Martin

enemy weapons are being fired from, allowing commanders and the wearer to take appropriate steps. The system is expected to be launched in the 2020s.

### Making the Iron Man suit a reality

To the general population, picturing next-generation battlefield wearables would likely summon an image of Tony Stark's Iron Man suit. But Marvel's highly-functional exoskeleton armour is no longer a thing of fantasy, since research is ongoing at scientific institutions and commercial companies alike, while the US military has been exploring the field for decades.

Lockheed Martin released FORTIS in 2014, making it one of the earliest exoskeletons on the market. FORTIS is an unpowered, lightweight model that was designed to improve endurance and safety in industrial settings, such as on heavy-duty worksites at Naval docks. It takes the weight of a load, such as a heavy tool, off the operator, making it easier for them to work. The weight is transferred to a mechanical arm and through to the ground using a series of joints, making it appear almost weightless to the operator.

"Exoskeletons can enhance a person's physical capabilities. To increase strength or endurance, you must have a keen understanding about the structure of the human body, the science of how the body moves and the variations among individuals," said Patricia Aelker, Programme Manager of Lockheed Martin's exoskeleton technologies.

FORTIS received a lot of recognition from industry, winning the Gold Spark award for Product and Health Design in 2014, the Product Design of the Year award from ICON Magazine in 2014, and was named one of CNN Money's 36 coolest gadgets of 2014. However, it's not only a matter of novelty. In August 2014, Lockheed Martin sold the first two FORTIS units to the US Navy for evaluation and testing, as the Department of Defense looks to mature and transition exoskeleton technology for industrial hand-tool applications at Navy Shipyards. According to reports, Lockheed Martin is continuing to develop its exoskeleton technology.

Within the military sector, US Special Operations Command and the Defense Advanced Research Projects Agency (DARPA) have been developing a super-soldier suit since 2013. The Tactical Assault Light Operator Suit (TALOS) has been designed



● ● Photo courtesy UK MoD and DSTL

with full-body ballistics protection, integrated heating and cooling systems, power-assisted limbs, embedded sensors, antennas, and computers, with 3D audio and optics for vision in all lighting conditions. For the well-being of the wearer, it also comes equipped with oxygen and haemorrhage controls, and monitors heart rate. Unlike the rigid materials other suits are being made of, TALOS is formed from a liquid material that solidifies when struck.

In 2016 it became apparent that Revision Military's Kinetic Operations Suit, which uses a lower-body powered exoskeleton and a rigid support spine, is a contender for the TALOS programme, while General Atomics is developing power methods for the suit, including a hybrid power supply that can switch to battery for short periods for stealth purposes. TALOS is still undergoing heavy development to enable capabilities such as beyond line of sight communications, and an ongoing rapid prototyping capability to allow new features to be added to the system quickly. Strain on the wearer must also be reduced prior to completion, which is expected in August 2018.

### A long way to go

It's clear that, despite the ground-breaking research ongoing today, wearable technologies for the battlefield still have a long way to go. We're only just beginning to explore what might be possible, and who knows what the next decade will bring.

One key challenge is that defence departments, and particularly the US Defense Department, are increasingly looking to adapt private sector technologies for the battlefield, as innovation moves away from budget-restricted defence sectors and towards commercial entities. However, according to recent reports, much of the technology is not up to government security and durability standards.

At the Defense One Technology Summit in June 2016, Rajesh Naik, Chief Scientist at the Air Force Research and Laboratory and Air Force Materiel Command, stated: "I can tell you at least 70 percent of the devices we tested do not work as advertised."

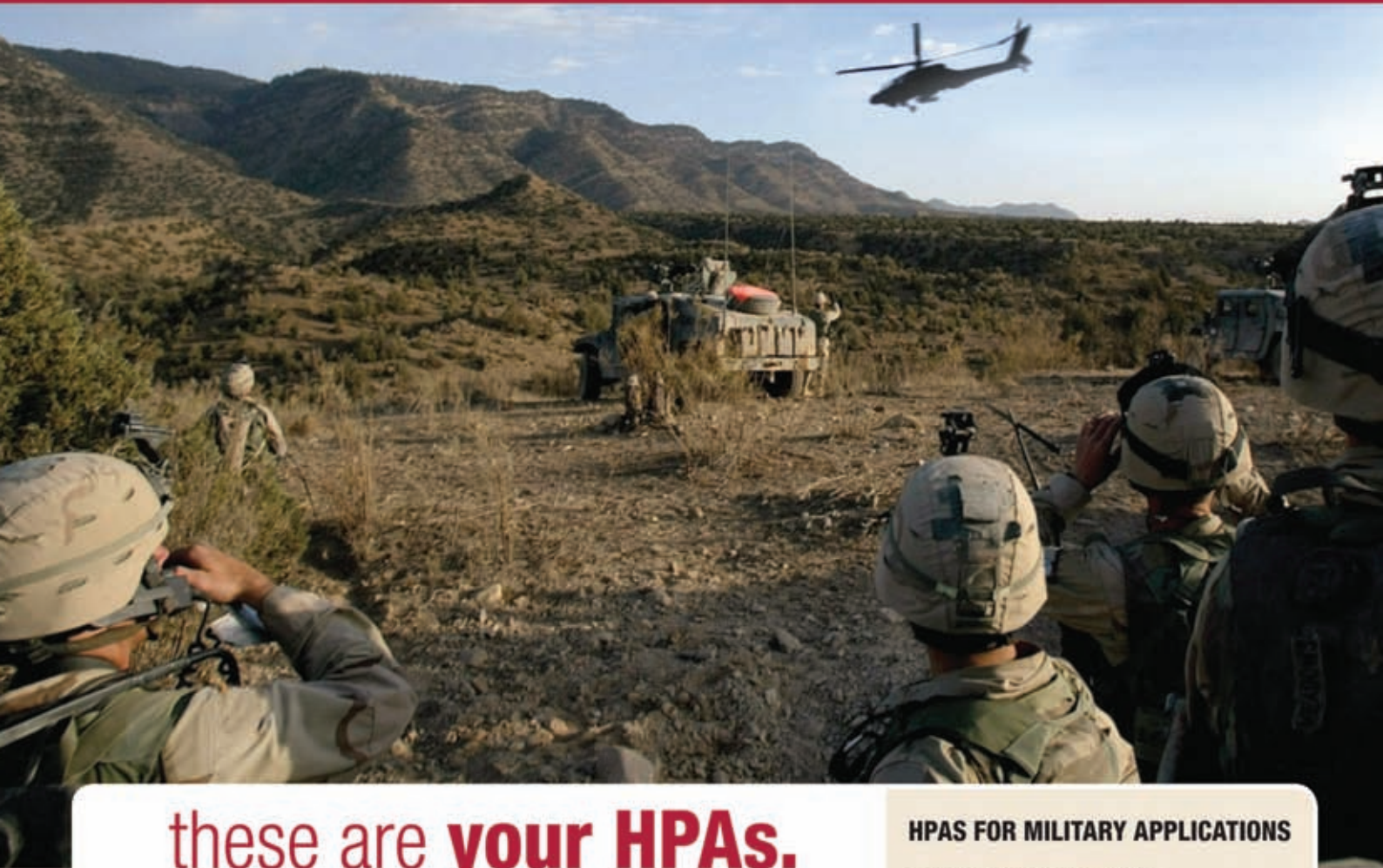
When it comes to commercially-available fitness devices that record health data such as heart rate and blood oxygen level, much of the equipment was not designed with military applications in mind. However, the devices are still of use for training purposes, allowing decision-makers to design more tailored training plans for soldiers. In addition, while some new commercial technologies may not meet military standards, the fact that the initial research has already taken place at no cost to government sectors, means that military research groups can build on these established technologies, lowering overall development costs.

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● ● Broadsword Spine. Photo BAE Systems

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