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Soldier Lethality: From G.I. Joe To Iron Man

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THE SITREP:

SOLDIER LETHALITY: FROM G.I. JOE TO IRON MAN

The American soldier is evolving rapidly from low-tech grunt to high-tech warrior. For decades, the infantry has suffered more casualties than any other branch of the armed services. At the same time they've gotten the smallest investment in new equipment. Now that's changing.

The Army is investing in technology for its infantry the way other services have long invested in jet pilots. That includes high-tech augmented reality simulations for close combat training, much like a flight simulator, and goggles that provide Blue Force tracking, situational awareness, as well as targeting data and tactical intelligence into an infantry soldier's field of view, similar to a fighter pilot's Head Up Display.

The Integrated Visual Augmentation System (IVAS) – the digital helmet-mounted display (HMD) system used by ground forces – is the electronic hub for a host of new technologies on and around the individual infantry soldier. Other innovations range from 6.8 mm smart rifles to palmtop drones to battlefield networks that link soldiers to their squad members and, ultimately, to higher headquarters. The Army is even exploring exoskeletons that, while far short of the Iron Man ideal once pursued by Special Operations Command, can still augment the wearer's strength and reduce injuries.

It's a revolution driven by the Pentagon's Close Combat Lethality Task Force -- launched by former Defense Secretary and Marine Corps rifleman Jim Mattis -- and the Army's Soldier Lethality initiative -- one of the service's Big Six modernization priorities. With $6.7 billion allocated for soldier lethality investments over 2020-2024, the Army is making a major down payment on potentially revolutionary technologies.

The hard part, of course, is making it all work in the real world. To do that, the Army wants industry to get prototypes into real soldiers' hands ASAP, gather feedback and then improve designs.

- Sydney J. Freedberg Jr.
  Deputy Editor, Breaking Defense

SMART RIFLES

As the Army modernizes its infantry from boot to helmet, the most obvious change is the rifle. After decades of half-hearted attempts, the Army is finally replacing the M16 assault rifle, M4 carbine, and M249 Squad Automatic Weapon -- and the controversial 5.56 mm round that they all use -- with Next Generation Squad Weapons (NGSW) that use a more powerful 6.8 mm bullet. While support troops will stick with the older 5.56 weapons, the Army wants to field new 6.8 mm assault rifles and heavier squad automatic rifles to infantry, scouts, special operators, and other close combat troops starting in 2022.

But even the rifle is not a standalone weapon. It's being built with digital links to the rest of the soldier's high-tech kit, the way a Hellfire missile connects to other systems on the Apache gunship. The idea is to treat each item the soldier carries as an integrated component of a sophisticated weapons system, like a tank or helicopter -- the difference being this "platform" moves on foot.

That's not to say the rifle itself will be low-tech. To the contrary, the revolution begins with the bullet. Informed by long-range firefights in the Afghan mountains, where guerrilla fighters increasingly wear body armor, the Army wanted an infantry weapon with much more range and penetrating power than the current 5.56 mm round, so they picked the 6.8 mm.

Sig Sauer's prototype Next Generation Squad Weapons.

But the service left industry wide discretion on how to build the cartridge and the weapon around that bullet, with the aim of reducing overall weight even as the caliber increases. Of the three competitors that won contracts in late August to deliver NGSW prototypes this spring, Sig Sauer is replacing the traditional brass cartridge with lighter metals, General Dynamics is using polymers, while Textron is using a "cased telescoped" round with the bullet embedded in its ammunition and sheathed in a polymer cylinder.

The new rifles will all have attachment rails, electrical power, and digital links to accept a wide and ever-growing range of electronic accessories. Arguably the most important is the Family of Weapon Sights - Individual. Known as FWS-I, the smart gunsight wirelessly transmits targeting data from the rifle to the latest night vision goggles (Enhanced Night Vision Goggle – Binocular, or ENVGB) or, in the near future, to the IVAS so the soldier sees a cross-hairs that indicates exactly what would be hit if the trigger was pulled at that moment. In testing, the gunsight not only improved accuracy, but it saved precious seconds of reaction time, since the soldier no longer had to bring the rifle up to the shoulder and squint through the sights to fire precisely.

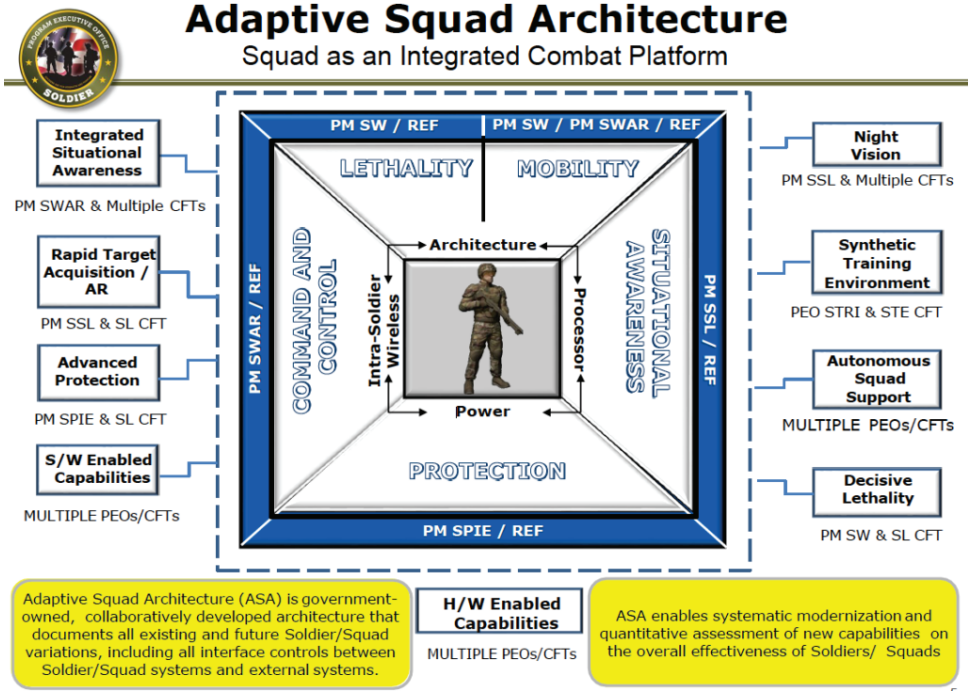
Soldiers train with the IVAS augmented-reality headset at Fort Pickett.

WEARING WIFI TO WAR

The targeting cross-hair is far from the only data new soldier-worn systems will display. Through products like the ENVG-B system and later IVAS, soldiers will have access to the tactical data currently displayed on converted smartphones like the Nett Warrior handset.

Instead of looking down and staring at a screen -- not a good idea when on the battlefield, where you need to watch constantly for any hint of ambush -- the soldier will be able to view desired data projected through augmented reality. That data could be fairly simple, like direction and distance to tactical objectives and friendly unit icons displayed in space, easing navigation and avoiding friendly fire. Or it could be more complex, like a "picture within picture" display of what your rifle-mounted camera sees when you stick it around a corner. There might even be live feeds from one of the palm-top mini-drones the Army is issuing to 9,000 infantry squads.

In training, IVAS will also be able to download simulated enemies from the Synthetic Training Environment (STE) and project them on the soldier's goggles, rather like a deadly serious game of Pokémon Go. The goal is that



The new IVAS headset will be the linchpin at the center of an Adaptive Squad Architecture to connect soldiers' electronics.

soldiers anywhere, be it back at home base or at a forward outpost between patrols, can train at any time against realistic, intelligently adaptive enemies, while running, jumping and crawling over actual terrain, instead of sitting in a sterile simulator.

The Army's even exploring how to connect IVAS to artificial intelligence for automated target recognition. The idea is that, even as the soldier scans the battlefield, a wearable camera is scanning along with them and feeding the image to an object-recognition algorithm, trained on a massive database -- yet to be created -- of friendly and enemy weapons systems. Not only might the AI help tell soldiers exactly what they're seeing --increasing threat detection, while reducing the risk of friendly fire -- it would also pick out high-priority threats, like a long-range anti-aircraft missile battery, and then automatically relay its coordinates to distant artillery units. There would then be no need for the often-prolonged verbal process of a "call for fire" over radio.

The inset image shows what the soldier can see through the wirelessly linked ENVG-III goggle and FWS-I gunsight.

But here's the hard part: All this data doesn't just fly around in the ether by itself. Even connecting different electronics on the same soldier's body requires a short-range wireless network, since dangling cables are a disaster waiting to happen on the battlefield. Sharing data with distant units requires a long-range network that can not only transmit past physical barriers such as hills and buildings, but also defeat enemy efforts to jam, spoof or hack it.

The foundation of this network is a new Adaptive Squad Architecture (ASA) that prescribes how all the different electronics soldiers wear or carry into battle have to connect to one another. But that squad-level mesh must connect to the battlefield-wide Integrated Tactical Network the Army is now developing to field to combat brigades. The tactical network, in turn, needs to connect back to the global defense department networks and ultimately to massive servers in the United States, which will house the big data needed to fuel artificial intelligence.

The ultimate goal is to build what's called a hybrid cloud, one model being the controversial JEDI program. When the network is up, even frontline troops should be able to tap into massive centralized data servers for up-to-date intelligence and AI analytics. When the network is not available -- because the enemy has attacked it, or the squad's fighting in subway tunnels, or the commander deliberately turned it off to avoid any transmissions the enemy might detect -- the troops will still have access to a

local cache of the data most relevant to them.

ROBOTS & EXOSKELETONS

If the Army can get this kind of tiered network to actually work in wartime, it could enable new technologies and new tactics. The Army and Marine Corps are both fielding mini-drones to their infantry, for instance. By giving each squad the ability to scout ahead with a disposable machine, instead of a human point man, the objective is to make infantry operations not only more effective, but much less bloody. But that requires a reliable network link, so soldiers can see through the drone's electronic eyes, without adversaries electronically eavesdropping.

The Army is also testing golf cart-sized ground robots to help the troops -- already overburdened by body armor, weapons, and ammo -- to carry bulky supplies like water, food, and (of course) even more ammunition, much like a mechanical mule. But none of the competing prototypes for the Small Multipurpose Equipment Transport (SMET) can follow everywhere a fit young human can crawl, climb, or wade, so they won't be assigned permanently to individual squads. Instead, they'll be loaned out as needed from a robotic motor pool. That means the robots' control links need to switch from working in a support unit, to working with a squad, to working with a different squad, to potentially driving back to base without a human escort.

But what if, instead of the robots trundling along behind the soldier, the soldier could wear the robot? That's where exoskeletons come in.

From Robert Heinlein's 1959 novel Starship Troopers to Robert Downey Jr.'s star turn as Iron Man, science fiction has dreamed of powered armor: a protective suit that gives its wearer superhuman strength, toughness, and mobility. But as far back as 1959, Heinlein wrote the vital component would be the feedback system that made the suit move fluidly with the wearer's body, and decades of experiment proved him right.

Early exoskeletons responded sluggishly, and the wearers got worn out fighting with them. It's taken recent advances in sensors and software to make exoskeletons smart enough to detect the wearer's motion immediately – or, in the near future, as soon as the nerve impulses tell the muscles to contract – and move with him. Effectively, exoskeletons are becoming so sophisticated – of necessity – that they've evolved into wearable robots.

But even as artificial intelligence improves, there are still fundamental structural limits to exoskeletons. As SOCOM found in its effort to create an "Iron Man" suit called TALOS, you can either have a strong, rigid exoskeleton that can carry heavy loads, or a light, agile exoskeleton that lets the wearer move quickly and nimbly, but not both -- at least, not yet. At one end of the spectrum, you have suits like the SARCOS Guardian, which can lift 200 pounds but moves at three miles per hour, a potential boon for ammunition handlers and supply troops, not much for frontline infantry. At the other end of the spectrum, the Army is looking at what amount to motorized knee braces such as the Lockheed Martin ONYX that help troops carry their heavy loads -- decreasing fatigue and injury -- without slowing them down.

So the future foot soldier will be surrounded by robotics, from the exoskeletons they wear to the drones they sends to scout ahead, all linked by invisible wireless networks. That's a far cry from their grandfathers slogging into battle with a rifle, a helmet, and a prayer. But despite all the technological advances, for the foreseeable future, the essential, central element remains human ingenuity and courage.

Supporting the warfighter with the latest in technology to make each warrior more effective, efficent and capable is the goal of Army Futures Command.

VIEWPOINT FROM ELBIT SYSTEMS OF AMERICA

HOW TECHNOLOGY INCREASES SOLDIER LETHALITY

ALDRIDGE SOWER, VICE PRESIDENT, GROUND COMBAT AND PRECISION TARGETING SOLUTIONS

Mr. Sower has more than 20 years of experience in the aerospace and defense industry, providing capabilities in the areas of Thermal Imaging, Aircraft Survivability, Electro-Optics, Advance Ground Munitions, and Precision Targeting.

He has a range of experience leading teams and executing successful program performance. Previously, he held diverse leadership positions at BAE Systems in operations, business development, and program management. Mr. Sower held full profit and loss responsibility for portfolios up to $150 million per year, including a wide range of specialized technologies for the warfighter, including thermal weapons systems, handheld thermal devices, and precision targeting systems. Also at BAE Systems, he served Business Development and Growth Strategy roles for the company's Survivability and Targeting Solutions business unit.

Mr. Sower came to Elbit Systems of America in February 2017 as Program Director for the Electro-Optics and Precision Targeting business segment. In this role, he was responsible for the business growth and execution. Mr. Sower holds a Master of Business Administration Degree from MIT and a Bachelor of Science Degree in Manufacturing Engineering from Boston University.

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1 What's the most game-changing technology Elbit is working on for the individual soldier to wear or carry? How can it empower new tactics?

There is no single game-changing technology, rather Elbit is working on the integration of multiple emerging technologies that together are game-changing, and these include: Augmented Reality; Aided Target Recognition (AiTR); Precision Targeting with Low SWAP Self Location; and an Advanced Targeting Processor, the backbone, to host these and other technologies.

2 What Israeli innovations and lessons learned can Elbit bring to the US military in soldier lethality and other Army modernization priorities?

In Israel acquisitions do not suffer from the extended source selection timelines that the US Military as often operated in. Israel is a continuous Battle Lab with Elbit engineers serving in the Reserves with fellow soldiers who require, design, deliver and iterate emerging technologies at an accelerated rate. This speed of innovation is commonplace at Elbit and allows our organization to match the speed that the US Army modernization is determined to move at.

HOW TECHNOLOGY INCREASES SOLDIER LETHALITY

3 As we add more technology to the individual soldier, we also increase their burdens — more weight, more batteries, more complexity. How can minimize burden?

More capabilities must go into fewer systems while decreasing that systems SWaP from its less capable, legacy equivalent. Weapons sights should work day and night, and should also provide range and angle to targets while displaying Red and Blue Forces in the field of view. Targeting systems should provide multi-spectral image fusion, not just day color and thermal imagery. They must be able to generate precise target coordinates in contested environments, and they must work seamlessly across the network to inform the Forward Observer and provide actionable data up stream. Given all of these necessary capabilities the burden on soldiers is real and can only be mitigated through smart, innovative system architectures that prioritize the soldier as a system of systems and treat human factors as a KPP.

The Enhanced Night Vision Goggle-Binocular (ENVG-B) provides the U.S. Army's close combat forces with capability to observe and maneuver in all weather conditions, through obscurants, limited visibility, and under all lighting conditions. This system signifies an evolution in technology that stems from innovative and collaborative efforts and successfully demonstrates rapid prototyping process that help meet the Army's modernization priorities.
Image: Elbit Systems of America.

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