SMALL AND MIGHTY SOLUTIONS FOR ARMED FORCES

Introduction

As the World accelerates deeper into the Information Age, emerging technologies are unlocking game-changing capabilities for armed forces seeking to conduct multi-domain operations, particularly against peer and near-peer adversaries.

Innovations in Artificial Intelligence (AI) and Machine Learning (ML); Autonomy and Robotics; 5G communications; Additive Manufacturing; and Quantum Computing to name just a few, have opened up a realm of new capabilities for distributed, layered and connected platforms operating on land, at sea, in the air and in space.

Benefiting significantly from these technology injections are the sensors and effectors employed by armed forces to detect, ID, locate, report, and provide effects across even the most complex of battlespaces.

Continuously reduced in size, weight and power, these small form factor solutions are poised to provide multi-domain forces with the tactical overmatch required to defeat highly capable adversaries in the age of Great Power Competition.

Throughout the contemporary operating environment, sensors provide a key capability for any military operation, tasked with gathering increasing amounts of information and intelligence across a battlespace and providing commanders with critical insight and situational awareness to support decision-making.

The introduction of small form factor solutions not only allows more sensors and effectors to be integrated on board air, land and maritime platforms, it also provides commanders with the opportunity to integrate a series of disparate capabilities across a battlespace to provide even greater operational capability to the warfighter.

When it comes to the implementation of small form factor solutions across the modern battlespace, the US Army is leading the charge within the Department of Defense as it rolls out its Multi-Domain Operations (MDO) concept.

Emerging requirements from the US Army demand single, distributed and rapidly (re)deployable small form factor solutions, capable of providing the warfighter maximum levels of payload flexibility when they need it most. Indeed, small form factor solutions are set to become a decisive factor in the support of Phase Zero (‘Shape’) and Phase One (‘Deter’) mission sets in particular.

According to DoD doctrine, Phase Zero comprises the deployment of “instruments of national power prior to armed combat” while Phase One sees armed forces beginning the process of “seizing the initiative”.

Overcoming Obstacles

Today, some of the greatest developments in small form factor solutions are being made in the areas Electronic Warfare and counter Intelligence, Surveillance and Reconnaissance. However, the US Army and industry must overcome a series of challenges in order to successfully roll-out small form factor solutions across both present day and future operating environments.

First, the US industrial base must overcome multiple engineering challenges (particularly relating to battery power and thermal signature) to provide the military with adequately miniaturized and sufficiently persistent technologies at affordable prices. In addition, industry must also identify the best means of protecting critical technologies, should unattended small form factor solutions fall into the hands of enemy forces with the capacity to reverse engineer technology.

Second, small form factor solutions must be fully interoperable across all domains in order to achieve maximum effects throughout the battlespace. There is no silver bullet when it comes to achieving a mission objective, hence the importance of small form factor solutions complying with Modular Open Systems Architecture (MOSA) standards for ease of integration. This will enable a variety of heterogeneous sensors and effectors that are able to work together across domains to achieve specific operational results.

Third, the training burden for warfighters must be minimal when adopting small form factor solutions in order to avoid any additional cognitive overload ahead of and during an operation. Industry partners are striving to address this problem with a focus on user experience (UX) design, incorporating feedback from real users into the design of next-gen systems and working to develop solutions that require minimal training. The focus on UX will ultimately help to reduce cognitive load and make warfighters' interactions with the technology faster, more fluid and more accurate.

Warfighters will also benefit from updated doctrine, concepts of operation (CONOPS), tactics, techniques and procedures (TTPs) to fully maximize the exploitation of emerging small form factor solutions. This would include the development of Unit Training Plans to enhance the distributed, forward-deployed and heterogeneous capabilities of combat units to provide them with small windows of tactical overmatch whenever applicable.

Supporting US Army Programs of Record

With the emergence of great power competition with China and Russia, non-traditional companies are uniquely positioned to support a resurgence in technology advances to enable tactical overmatch against peer adversaries and maximize the full benefits of small form factor systems across Programs of Record.

The Terrestrial Layer System Echelons Above Brigade (TLS EAB) is a Division, Corps and Multi-Domain Task Force ground capability planned as an extended-range, terrestrial sensing, collection, and electromagnetic attack system of systems providing integrated Signals Intelligence (SIGINT), Electronic Warfare (EW) and Cyber capabilities for situational awareness, situational understanding, and indications & warnings. TLS EAB system components, which include a tethered unmanned aerial system (UAS), will significantly benefit from small form factor sensor payloads to overcome SWaP constraints.

Elsewhere, the Army's Next Generation Combat Vehicle (NGCV) PoR also presents the defense industrial base with significant opportunities in small form factor solutions. Areas of interest include small form factor sensor payloads integrated on board NGCV's Remote Combat Vehicles (RCV) which will be available in Light, Medium and Heavy configurations.

Small form factor payloads already available to RCV models include *SRC's Silent Cyclone*™ multi-mission EW system. Designed for dismounted and vehicle operation, the system gives RCVs the ability to engage hostile UAS (Groups 1-2) with low-cost position navigation and timing (PNT) and EW effects.

SRC is working on integration of the *Silent Cyclone* system as the counter-UAS/Navigation Warfare (NAVWAR) payload onboard US Army robotic vehicles over the second half of 2021 in support of various exercises to explore the capabilities and CONOPS for the platform type.

Small form factor payloads will certainly play a significant role in the Army's Future Vertical Lift (FVL) PoR, which includes the Future Attack Reconnaissance Aircraft (FARA) and Future Long Range Assault Aircraft (FLRAA) that will implement Air Launched Effects (ALE). Air Launched Effects are essentially small autonomous or semi-autonomous aerial platforms deployed by FARA to extend its tactical and operational reach and lethality. ALE will deliver kinetic and non-kinetic, lethal and non-lethal mission effects against multiple threats, as well as, providing battle damage assessment data. They will provide scalable effects to detect, locate, disrupt, decoy, and/or deliver lethal effects against threats.

SRC's Silent Swarm™ Unattended EW System has direct applications to ALE. Measuring the size of a coffee cup, *Silent Swarm* multi-mission payloads could be airdropped into an area of operation and tasked with gathering intelligence during Phase Zero shaping operations.

Silent Swarm payloads could also be programmed to deliver cyber and electronic attack techniques should the conflict evolve from Phase Zero to Phase One operations.

Elsewhere, the US Army continues to consider options for its Future Tactical Unmanned Aircraft System (FTUAS) PoR which will replace RQ-7B Shadow UAS in ground maneuver Brigade Combat Teams.

In order to maximize its operational effectiveness across the most complex of battlespaces, FTUAS must be capable of carrying multiple, small form factor payloads which would allow a single air frame to conduct multiple mission sets.

Options include *SRC's* High Roller payload, a multi-intelligence, multi-sensor solution which weighs less than 25lbs and features an Electro-Optical/Infrared (EOIR) camera; Synthetic Aperture Radar (SAR); and Ground Moving Target Indication (GMTI) radar in a single pod.

Finally, the US Army is also exploring how non-kinetic indirect fire effects could support additional mission requirements across the modern battlespace. These 'Munition-Delivered Effects' could be enabled by small form factor payloads integrated into kinetic munitions such as the 155mm artillery shell.

Such a capability requires software defined radio, antenna and high-performance computing technologies to be integrated into the hard steel body of an artillery round, allowing it to conduct additional mission sets deep into enemy territory.

SRC's Silent Impact™ solution is one example of a small form factor technology which could add electronic attack and ISR capabilities to the 155mm artillery shell. The *Silent Impact* solution can be located inside the body of the round and ejected before the munition reaches its apogee.

In the future, similar small form factor payloads could also be integrated on board other munitions, Hellfire missiles for example, allowing the munition to conduct additional EW tasks whilst flying towards its target.

This multi-mission capability would be ideal for US Army formations operating in Anti-Access/Area Denied (A2AD) environments such as those currently witnessed across the Indo-Pacific where units might be expected to engage peer adversaries at extended ranges.

Emerging CONOPS

Finally, small form factor solutions will be critical in shaping emerging CONOPS across the US Army as it seeks to maximize operational effectiveness across multi-domain battlespaces.

Emerging technologies, for example, could be employed to manipulate electronic signatures across a battlespace to confuse an adversarial force. This would involve autonomous systems operating on land, in the air and at sea, equipped with small form factor payloads deployed ahead of a larger force to sense the environment and create false signals and decoys to confuse the enemy.

Autonomous systems equipped with these 'small and mighty' sensors and effectors would force the enemy to show their hand early in a battle, thereby allowing US Army formations to quickly and accurately identify enemy positions and capabilities.

Similarly, improvements in AI and ML will further enhance the ability of small form factor solutions to network, process, exploit and disseminate information across the battlespace.

Emerging AI and ML algorithms will allow the US Army to take advantage of swarms of small form factor payloads across the battlespace, harvesting information in near-real time and understanding the conflict over extended periods. Critical advances in AI and ML will also allow US Army commanders to scale networks of distributed and rapidly deployable nodes.

Conclusion

The design, development and deployment of small form factor solutions across even the most complex of battlespaces promises to provide the US Army and wider DoD with a wealth of additional capability.

Small form factor solutions will not only create multiple dilemmas for adversaries, they will also enhance the situation awareness of the US Army and open up windows of opportunity to increase soldier survivability and maneuverability to ultimately win the battle.