Soldier Tactical Power:
The Key to Cross-Domain Maneuver

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The battery life issue is not new to the modern battlefield. Take for instance, an experience coming out of the Special Warfare Signals Intelligence (SIGINT) Course (SWSC) that the 1st Special Forces Command conducts quarterly. (This Special Operations course teaches the basics of tactical SIGINT to Special Forces SIGINT teams known as SOT-As.) According to after action reviews from a recent class, SIGINTers left perhaps their most capable piece of SIGINT kit (referred to here after as SYSTEM to protect the actual name) in garrison for the duration of their culminating exercise because of its limited battery life. Instead, they opted to take less capable equipment for the simple reason that the SYSTEM would last no more than a few hours during a week-long training exercise.

> "The actual op went well, but the mandatory inclusion of the SYSTEM was not realistic due to the fact (it) only lasts up to 4 hours on a single charge and we had no additional batteries. It basically became dead weight and something I wouldn't have taken on an actual 48-hour operation."
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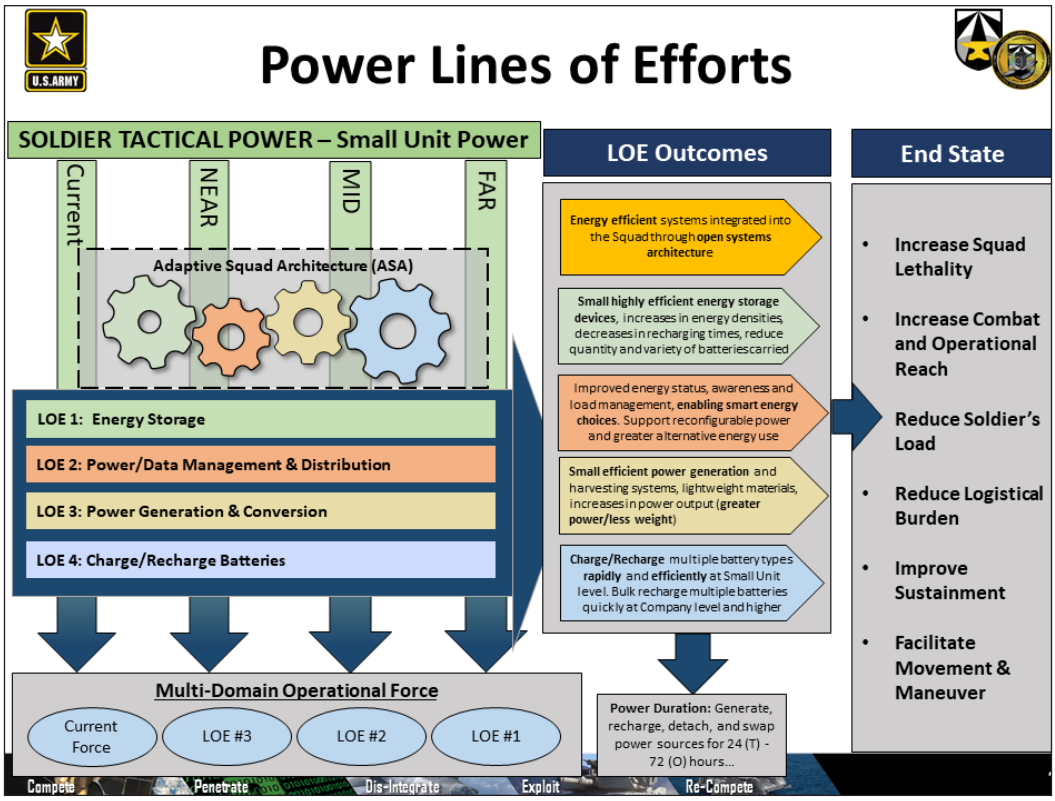
> "The SIGINT Operations Team-Alpha (SOT-As) knew the limitations of the SYSTEM and decided it was not a viable platform for operations. None the less, instructors stamped their feet and 'strongly suggested' that we go out with all the assets available to us. After about four hours of collection, it was a chunk of metal wasting space in a ruck."

At no point during the field portion was the SYSTEM, from a SIGINTer's perspective, a viable option because of its battery life. The BA-5590 battery lasts about four hours, which means for a 48-hour exercise, the team would need 12 BA-5590s. For seven days, 42 batteries would be needed per three-man element. Each battery weighs 3 pounds, which would mean SIGINTers would have to carry 126 pounds of BA-5590s per team. From an Infantryman's perspective, SIGINTers leaving this SYSTEM in garrison would be like an Infantry platoon leaving the M240 machine gun in garrison when on a week-long patrol because it only had 20 rounds of ammunition.

This power dilemma is not, however, unique to the SIGINT community. It is the exact same dilemma that Soldiers will face in a multi-domain operations fight if the Army does not adopt a coherent strategy to address it while making the right technological investments. To exacerbate this issue, maneuver brigade combat teams are planning to fight with a cross-domain maneuver construct where resupply is no longer guaranteed. Simply stated, for the Army to be successful in the future fight, the Soldier must have more efficient power systems that provide a more robust energy supply than ever before.

To fully understand the need for investments in power technologies for the dismounted Soldier, one must understand the Infantry's purpose. The mission of the Infantry is to close with the enemy by means of fire and maneuver in order to destroy or capture him, or to repel his assault with fire, close combat, and counterattack. The Infantry will engage the enemy with combined arms in all operational environments to bring about his defeat. In simple terms, the Infantry destroys the enemy and holds terrain. In order to accomplish its missions, the Infantry must be able to sustain itself for up to 72 hours, independent of resupply. A key consideration during those 72 hours is the Infantry's advanced technologies that provide it overmatch on the battlefield. Think sensors, laser, night vision devices, and the like. The Achilles heel of these capabilities is their power demand.

Currently, dismounted squads are able to sustain themselves for approximately 12 hours in a combat environment without the need for additional batteries. Beyond 12 hours, without the ability to recharge batteries, squads would be required to carry additional batteries to sustain themselves up to 72 hours before resupply. Each Soldier would be required to carry three to four Conformal Wearable Batteries (CWB) at 2.6 pounds each to meet their power demands based on Soldier technology configuration. With improvements in technology, Soldiers require more power to keep their systems running in order to successfully accomplish their mission. The gap between power available and power required will consequently increase exponentially as new equipment such as the Integrated



Power Lines of Effort

Visual Augmentation System (IVAS), Enhanced Night Vision Goggle-Binocular (ENVG-B), and Next Generation Squad Weapon (NGSW) is added to the Soldier's kit. To put this in perspective, a Nett Warrior-configured squad would require 19 carried CWBs at 50 pounds battery weight to sustain for 72 hours, while a Close Combat Soldier-configured squad would require 60 CWBs for 72 hours at 156 pounds in carried batteries.

To address this issue and many others external to the Soldier, the Army Futures Command created the Army Power and Battery Strategy with Soldier Tactical Power (STP) as its cornerstone. The strategy defines STP as an organic, rapidly deployable, lightweight system that stores, generates, manages, and distributes energy at the small unit level and using the Adaptive Squad Architecture (ASA) to integrate components. The strategy further identified four lines of effort (LOEs) that must work together to supply the Soldier with the right amount of energy on the battlefield. Those LOEs are:

1) Energy Storage;
2) Power/Data Management and Distribution;
3) Power Generation and Conversion; and
4) Charge/Recharge Batteries.

It is important to note that at least in the near term, it will take solutions from all the LOEs to meet the Army's energy demands.

Incorporating new power technology into the Soldier platform in an efficient manner is critical in order to prevent power from becoming the critical limiting factor for Soldier lethality. For LOE 1, Energy Storage, the military decided to pursue lithium ion technology as the right solution for battery power needs. While there have been new advances combining silicon anodes with lithium ion batteries and changing the internal configuration of the batteries (cell structures) that have yielded increased power densities, there are limits to what our current battery technologies can deliver. This fact, coupled with the growing power demand, will require Soldiers to carry more batteries. The more batteries a Soldier carries will, however, result in increased Soldier load that leads to a decrease in the Soldier's performance.

One possible solution to the Soldier load problem, in the context of LOE 3, Power Generation, is a fuel cell. Fuel cells are electrochemical devices that convert chemical energy, cleanly and efficiently, into electrical energy. They

can provide a lightweight, wearable power generation system to recharge Soldier-carried batteries while "on-the-move." This concept could reduce Soldier load and address the ever expanding energy needs of the Soldier and squad. The Army is currently evaluating three types of fuel cells:
1) The Jenny 600S, Jenny 1200, and Emily 3000, Direct Methanol Fuel Cell (DMFC);
2) The Honey Badger, 20 Watt & 50 Watt, Reformed Methanol Fuel Cell (RMFC), which runs on windshield wiper fluid; and
3) The Alane-based (Aluminum Hydride), (Dry Fuel) Wearable Fuel Cell.

These systems are being assessed in the Army Expeditionary Warfighter Evaluation (AEWE) 2020 at Fort Benning. The Combat Capabilities Development Command - Soldier Center and Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) Center are conducting a comparative analysis and testing of the various fuel cells at Aberdeen Proving Grounds, MD, to determine power generation and charging abilities as well.

In conclusion, to ensure the success of the Soldier on the future battlefield, Soldier Tactical Power solutions must provide energy in an efficient and quick manner with an increased duration. As every major Soldier Lethality Cross Functional Team initiative requires an STP enabler, it is essential that the Army adheres to its Power and Battery Strategy while acknowledging that there is no silver bullet solution for the Soldier in the near term. Lithium ion technologies and fuel cells are two technologies that, when coupled together, may produce the right amount of energy at the right time for the Soldier. The Army must continue to invest in these technologies, and others like them, to ensure the Soldier can continue to close with and destroy the enemy.

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