The Battlefield Battery Burden

Sustaining an ever-changing requirement

by Eric J. South

There's no getting around the fact that batteries are needed on the battlefield—small batteries, large batteries, batteries for radios, batteries for vehicles. Batteries are used for communications, navigation, and computation. Batteries help us see at night, and batteries help us win the fight.

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Combat in a post-9/11 world has driven a rapid capability insertion that is dependent on electronic technology. Radios can talk farther. Unmanned drones have increased battlefield and information awareness. All of this provides the next-generation Marine with increased capability. But, it also adds stuff into his pack. Weight onto his back. The small unit is 45 percent more energy intensive than it was twenty years ago. A typical assault load in the year 2000 was 41 pounds, with batteries consisting of only two pounds. Today, Marines take over 100 pounds of gear into the fight with up to 13 pounds battery weight. But the battlefield battery burden doesn't just mean a heavier squad.

It takes a lot of logistical support to keep the latest technology supplied with batteries and chargers. Oftentimes, each new tech comes with its own unique battery and charger. Multiply that by the number of troops, by the number of new technologies coming online, and we have ourselves a bunch of unique batteries to move around and sustain.

In today's world of widgets, batteries are often taken for granted. This is quickly appreciated by anyone who has ever owned a smartphone. Over time, we find ourselves needing to plug in our phone more often, only to find it loses charge more quickly. Batteries on the battlefield are no different. They also have shelf lives and need to be periodically charged before degrading. Battlefield batteries, though, are much more complex and expensive than what is in your tablet or cell phone. Military low-volume battery packs can cost up to 50 times that of commercial technologies, and that can mean thousands or tens of thousands of dollars per battery. If these advanced batteries are not properly sustained and maintained, they will go bad, which can cost many millions of dollars. Storage and appropriate recharge of all batteries are key to their longevity and to avoiding heavy fiscal penalties.

How much energy is required to recharge the squad? How much energy does it take for one gallon of gas to go from ship to shore and find its way to the generator that's recharging those batteries?

Keeping all the different kinds of batteries recharged is an underappreciated task. Ask any group of Marines who have been on a patrol about their wish list for the future, and a "better battery charger" will be often stated. Some existing and fielded solutions for battery charging in operational settings depend largely on solar power. The Marine Corps has fielded a small portable system that uses solar power to recharge all the many types of batteries a Marine squad commonly uses. The system includes a controller, cables, solar panels, connectors, and more cables (one for each battery type). The weight and volume of this system often does not offset the weight of spare batteries. The juice is not worth the squeeze. Marines at the tip of the spear simply will not depend on solar power. They'll take extra batteries instead, thus increasing their battery burden.

In most cases, battery recharging is in some way tied to the logistical fuel chain. Battery chargers are plugged into a generator that runs on fuel. Then, fuel-based convoys (large and small) provide re-supply. Recharging technology has increased and continues to grow more efficient, but battlefield batteries will remain a critical part of the overarching battlefield energy spectrum.

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Batteries are used in a wide variety of radios and communications equipment. ***(Photo by Cpl Santino Martinez.)***

It is time for the Marine Corps to re-evaluate the power profile of the infantry.

We can no longer afford to deploy new technology and capabilities without considering the cost of energy up front during the early stages of research and development. Just as aircraft, ships, and tanks are all engineered as a complete and holistic system, we must also consider a similar system of systems architecture (SoSA) for the infantry.

Applying SoSA to the infantry is not as daunting as it may sound. Consider the Marine Corps squad. A first step to applying SoSA is to simply list the equipment that is needed. What equipment runs on batteries, and how much power does it use?

A second SoSA step is to identify potential commonality. What equipment uses the same battery type? What equipment runs off similar voltage? What equipment *could* run off similar voltage? Identifying electrical commonality among various pieces of equipment can give way to their potential use of similar batteries. For our squad, a standard battery would mean our PRC-153 radio, PRC-152 radio, and PRC-148 radio would no longer require their own unique batteries and chargers. The batteries would be interchangeable. Standard batteries for equipment would reduce battery incompatibility and increase interoperability. This would mean fewer spares and fewer pounds.

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Standardizing batteries also simplifies the recharge component of the SoSA. No longer would recharge systems need multiple cables for multiple batteries. Standard batteries would be interchangeable among equipment. The squad as a system would be more efficient regarding the number of batteries charged to the number of systems powered and with less recharging infrastructure. It would be able to charge faster, carry less, and improve its lethality.

Applying a *scaled* SoSA to the squad, platoon, and company could give way to an optimized family of systems. Small batteries, medium batteries, and large batteries could be standardized to power small systems, medium systems, and larger systems. A family of systems with a corresponding family of batteries would greatly reduce the types of incompatible batteries that plague the battlefield.

With 21st century technology, this concept is quite achievable. The challenge is not technical. The challenge is merely philosophical. The challenge is programmatic.

In the case of aircraft, ships, or tanks, there is one controlling entity for that system. The energy component of a tank, for example, is a sub-component of the tank system itself. The infantry is not defined as a system in the same way as a tank or aircraft and, therefore, is harder to architect without a controlling entity. However, this does not detract from the reality that energy is the underlying and implicit component that ties the infantry together as a system.

Therefore, the challenge is to identify methods that ensure maximized collaboration between infantry system developers and requirements analysts early in the acquisitions cycle.

The problems associated with battlefield batteries cannot be solved by a lone scientist or teams of engineers in a lab. The high variance of energy demand depends largely on tactical missions, gear sets, the environment, etc. Requirements developers, operational analysts, and the technical community must collaborate more effectively to establish frameworks for energy interoperability. Standard batteries and common connectors can be defined as system requirements early in the development process. This would promote a holistic engineering of the infantry, where power and energy become inherently included as central aspects of the SoSA. Only then will problems associated with incompatible battery types, unique battery chargers, and proprietary dependence be mitigated. Technology will continue to give the warfighter the fighting edge. But to date, we have not been calculating energy metrics early in the design process. This must change, or the exponential growth of battlefield batteries will continue to burden our Marines.