According to a 2015 study from the Center for Strategic and International Studies by Zheng and Carter titled “Leveraging the Internet of Things for a More Efficient and Effective Military,” the soldier of tomorrow will be much more connected than the soldier of today. This will provide enhanced situational awareness, communication and health monitoring.

But to make the transition from the soldier of today to the soldier of tomorrow, there are a number of core engineering challenges to overcome.

**Addressing Core Engineering Challenges**

**Size, Weight, Power and Cooling (SWaP-C)**

Today’s soldier already carries or wears a significant amount of equipment. The additional electronics required to create the connected soldier must not hinder mobility or create an additional burden. At the heart of these electronics systems are multiple types of antennas. The increasing use of antennas combined with critical size and mobility criteria are driving highly creative designs with very complex shapes. This design trade space can only be effectively explored by including simulation as part of the design process.

One such design has emerged from a collaboration between Florida International University and Georgia Institute of Technology in the USA. Published in 2014, the teams described “A Novel Reconfigurable Origami Accordion Antenna”. In essence, coupling the mathematics behind origami with antenna performance simulation capabilities in ANSYS HFSS led to the development of an antenna that can expand and collapse so as to fit into a small footprint yet deliver the field performance required. As one of the authors, Professor Georgakopoulos, stated in an interview with Defense Systems in 2014, “by using origami geometries we can reconfigure antennas to...”
whatever shape fits our purpose... A soldier will be able to carry a powerful antenna into combat folded into his back pocket.”

**Sensing and Connectivity**
The connected soldier will be using multiple devices such as a smart watch, smart glasses, wearable sensors and communication packs. Each device must perform as designed without negatively impacting the performance of the others. The electromagnetic interaction of these multiple devices on the soldier’s body can be examined using ANSYS tools to ensure that any potential interference is avoided.

**Integration**
The connected soldier does not exist in isolation on the battlefield. The on-body devices need to communicate and interact with other assets and equipment, such as other soldiers, ground vehicles and unmanned air systems, possibly in the presence of hostile electromagnetic warfare effects. This represents a very complex, electromagnetically large environment where failings can be mission-critical. Simulation is the only effective way to assess the local soldier environment and interactions among assets across the battlefield.

**Durability**
Not only is the connected soldier’s environment potentially electromagnetically hostile, his systems need to be able to resist the harsh physical environment within which the soldier operates. At the extreme end of events, systems need to be durable to perform even in the face of impact. In the image on page 3 we see how simulation is used to understand the performance and deformation of an antenna when impacted by projectile debris.

**ANSYS: The Value of a Consolidated Simulation Platform**
The increased difficulty of overcoming the core engineering challenges created by the complexities of making products IoT-ready is highlighting weaknesses in existing design processes. Independent research has shown that successful development of these products requires an increase in communication and collaboration between functional engineering teams. Without this, product delays, reliability issues, and cost overruns are likely. A product made without collaboration can lead to integration issues, especially when subsystems are built and over-designed because each team added their own safety margins.

Companies with a strong culture of collaboration are leapfrogging their competition through the use of engineering simulation. Best-in-class companies use a consolidated simulation platform to analyze component and system-level behavior, as well as subsystem interactions, before physical prototyping. Designers at these companies are able to quickly explore the performance of numerous design alternatives. This allows them to optimize the design for cost, quality or performance. The metrics below highlight just some of the benefits of a simulation-based design approach executed on a consolidated platform that enables cross-functional engineering interaction.
With the ANSYS integrated simulation platform, applications critical to the success of the connected soldier can be addressed. These include:

**Antenna Design & Placement**
You can rely on ANSYS for accurate results regarding the performance of your antennas, both as components and when integrated into an operating environment. Depending on the scale of the problem and results desired, you can select from a range of solver technologies.

**Chip-Package-System Design**
Power integrity and signal integrity simulation for any integrated circuit (IC) should be performed with the proper noise model of the IC, along with the channel model of the package and board.

**Power Management**
ANSYS provides simulation tools to address a broad spectrum of power management challenges. These include optimizing power consumption and integrity in the system. As Brad Bryant, ASIC Design Manager at L3 Communications, stated when referring to one of ANSYS simulation tools for power management, “The power estimate provided by the tool came very close to what was measured in the lab. All in all, the tools worked as advertised. What more can you ask for?”

**Sensors and MEMS Design**
ANSYS solutions enable simulation of a wide range of sensors, actuators and other MEMS devices, from RF sensors dependent on electromagnetic fields to gyroscopes dependent on mechanical motion to piezoelectric devices dependent on both.

**Designing for Harsh Environments**
IoT devices must be robust and stay active for extended periods and across great distances without maintenance. A malfunction can result in mission failure, significant investment to repair or replace the system, and even risk to human lives. They must be designed to resist vibrations, impact and fatigue. Physical prototyping is simply not a viable option for many obvious reasons. Not only is it difficult to create all the possible test scenarios given the constraints of time, budget, location, and resources, but the measurement results can vary greatly and lack the fidelity needed for IoT and many other critical applications. ANSYS simulation tools can account for all the relevant physical forces, including fluid flows, structural forces, thermal effects and electromagnetic environments.
Engineering the Internet of Things: 
The Connected Soldier

ANSYS: Your Trusted Partner
ANSYS does not develop or manufacture technologies used by the connected soldier. But companies large and small across the supply chain rely on ANSYS to realize their product promise. ANSYS will remain your trusted partner — delivering the proven simulation capabilities you’ve come to rely on, along with new capabilities that support your continued product development success in a transformed world.