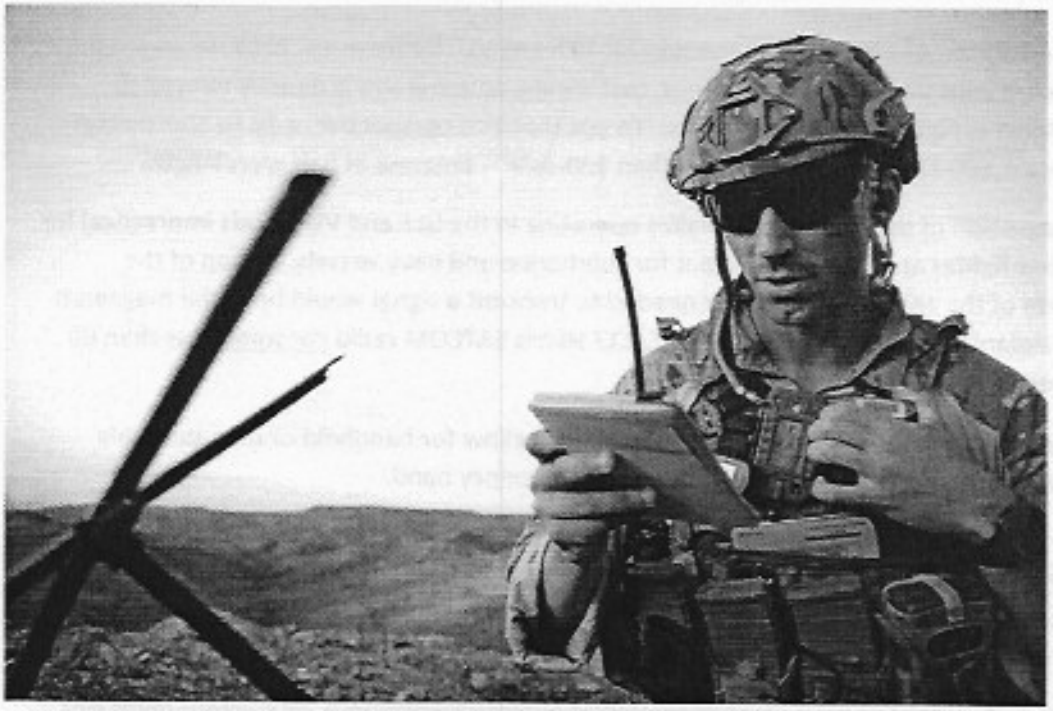
New DARPA radio transmitter could revolutionize battlefield communications

By: Shawn Snow December 29, 2016



U.S. Air Force Staff Sgt. Corey Johnson, Tactical Air Control Party member, communicates with French air force aviators during a tactical exercise Feb. 24, 2016, in Djibouti. Although aviators across the globe speak English, accents and distinctions from both the English-speaking or French-speaking personnel can create challenges under already stressful situations, and the exercise helped both forces become more familiar with each other's accents. (U.S. Air Force photo by Staff Sgt. Kate Thornton)

Military engineers are looking to revolutionize battlefield communications by introducing a new project that seeks to bridge gaps in current military communications capabilities.

The program, by the Defense Advanced Research Projects Agency (DARPA), is called A Mechanically Based Antenna, or AMEBA for short. It is headed by Troy Olsson, DARPA's program manager in the Microsystems Technology Office.

Olsson's program seeks to leverage the benefits of ultra low frequency (ULF) and very low frequency (VLF), which operate in the electromagnetic spectrum band between hundreds of hertz and three kilohertz (KHz), and three to 30 KHz, respectively.

The benefit of the ULF and VLF bands is their ability to penetrate water, soil, rock, metal and building materials, and their potential for long distance communication — as the atmosphere acts as a waveguide to propagate ULF and VLF due to their extremely long wavelengths, according to Olsson.

"If we are successful, scuba divers would be able to use a ULF channel for low bit-rate communications, like text messages, to communicate with each other or with nearby submarines, ships, relay buoys, UAVs, and ground-based assets, through-ground communication with people in deep bunkers, mines, or caves could also become possible," he said.

Frequency and wavelength are inversely proportional, which means that as frequency lowers the wavelength becomes much longer. This fundamental concept of radio frequency theory has been a bane for military communications for ages.

The problem arises out of antenna construction for ULF and VLF frequencies. Because an antenna must be resonant with the selected frequency, that means antenna size is directly related to frequency, Olsson explained to Military Times. To put that into perspective, a 10 Hz transmitter would require a 1,500-kilometer -- or a more than 930-mile -- antenna at half wavelength.

Antenna construction of that magnitude makes operating in the ULF and VLF bands impractical for the average war fighter and highly inefficient for submarine and navy vessels. On top of the gargantuan size of the antenna, the power needed to transmit a signal would be in the megawatt range. The standard military man-packable PRC-117 Harris SATCOM radio consumesless than 60 watts of power.

AMEBA is designed to develop new transmitters that will allow for handheld or man-packable devices, while exploiting the benefits of ULF and VLF frequency band.

"Rather than relying on electronic circuitsand power amplifiers to create oscillating electric currents that, when driven into antennas, initiate radio signals, the new low-frequency VLF and ULF antennas sought in the AMEBA program would generate the signals by mechanically moving materials harboring strong electric or magnetic fields," Olsson explained.

ULF and VLF communications have great potential for military applications. ULF communications would allow for direct communications between manned or unmanned submarines operating underwater and the ability to transmit data and text. That translates into longer underwater operations and less of a need for submarines to surface, where they are most vulnerable, because traditional communications bands don't travel well in salt water.

Also, because GPS doesn't work underwater, ULF can be utilized for triangulation and locating other submarines. This application will be especially helpful as the Navy continues to develop its unmanned submarine program, expected to be operational by 2020.

For the Army and Marine Corps, ULF and VLF communications allow for over-the-horizon long distance communications.

Currently in the U.S. arsenal, ground forces employ PRC 117 SATCOM and PRC-150 high frequency radios. These systems provide over-the-horizon communications but with substantial drawbacks, according to Olsson. High frequency radios require the transmitter to know the precise location of the receiver, and the operator must change antenna construction for night and day operations to match the lowered ionosphere.

SATCOM radios are vulnerable to attacks by sophisticated state agents such as China and Russia, who both employ satellite-killing missile systems. In a satellite or GPS constrained environment, ULF and VLF transmitters could provide war fighters with handheld devices capable of data and voice communications, Olsson explained.

ULF and VLF can also be utilized as a search and rescue tool for buried miners or victims trapped in earthquake rubble because of its ability to penetrate rocks and building materials.

The AMEBA program was announced this December and currently is in the early stages of discussion with no researchers under contract. DARPA has scheduled a Proposers Day on Jan. 6 at the Booz Allen Hamilton Conference Center in northern Virginia to further describe the project in detail.