U.S. Army Staff Sgt. David Jones, a paratrooper assigned to 54th Brigade Engineer Battalion, 173rd Airborne Brigade, processes data in collaboration with Sgt. 1st Class Daniel Matchett of the 3rd Infantry Division during the development of a new training module for counter-electronic warfare at Grafenwoehr Training Area, Germany, July 28, 2020. (U.S. Army photo by Spc. Mathew Pous)

Radio Silence: Preparing for Future Electronic Warfare

By Asymmetric Warfare Group Personnel

Recent observations and lessons learned from training exercises focused on the *electromagnetic spectrum* (EMS) have exposed vulnerabilities in current operational tactics against potential near-peer adversaries (Thorn, 2020). Successful maneuvering against these forces will require proficiency working within the EMS. This article will discuss how Soldiers and their organizations can effectively train, fight, and win within the EMS.

The Importance

The EMS is the range of frequencies of electromagnetic radiation from zero to infinity. It is divided into designated bands covering specific frequencies and energy to include what you can hear (conversation or radio communications) and see (visible light or nonvisual such as infrared) (Department of the Army, 2019).

Recently, Asymmetric Warfare Group (AWG) ran a contested micro experiment at Fort AP Hill, Virginia (Thorn, 2020). The goal was to place a trained and equipped reconnaissance troop into an operational environment simulating Eastern Europe.

A U.S. Army reconnaissance troop reported their line of departure (LD) to conduct area reconnaissance and locate possible forces near a critical host nation city. They moved tactically, always using ground cover, carefully camouflaged themselves, and worked well together as teams.

As they moved towards their objectives, despite disciplined movement formations and techniques, the enemy followed them closely. An enemy electronic warfare (EW) operator monitored their communications and troop frequencies. Using that information, the enemy jammed the troop command frequency, causing confusion and disruption of mission command.

The enemy then pinpointed the troop's location and shared it with unmanned aerial systems operators and targeting forces. The troop was then fired upon, rendering 75% of the unit ineffective. If this were actual combat, a majority of that troop would have never reached the objective.

Training Soldiers in EW

Training for the future fight must include understanding of the EMS. Much like Soldiers are taught the basic principles of ballistics: internal (inside the weapon), external (outside the weapon/flight), and terminal (reaching the target), these concepts can also be taught as EMS theory, especially as radio usage concepts.

"Internal" radio ballistics can be considered anything the radio does while not transmitting. "External" radio ballistics can be considered anything taking place during a transmission. And "terminal" radio ballistics would apply to radio waves after leaving the antennae, making them visible/susceptible to EW systems. Soldiers should also be aware that radios operating on a mesh network may be transmitting without operator input.

Visualizing Terminal Radio Ballistics

Soldiers should have a basic understanding of how their systems operate on the EMS and how they appear on EW systems. Noncommissioned officers can coordinate with a spectrum manager or EW Soldier to run a spectrum analyzer (like the PR-100) while Soldiers actively use their communications systems. As systems radiate, the EW Soldier or spectrum manager can show Soldiers what the signal looks like on the analyzer. They can also show Soldiers the difference between short (3-5 seconds) and long (6 seconds or longer) transmissions; longer transmissions being the most susceptible to detection.

Soldiers should do this for single channel, frequency hop, and all parts of the spectrum utilized by a particular system. Soldiers visualizing their signals and recognizing the difference between frequencies will better understand which frequencies and transmissions are most visible and vulnerable to EW adversaries.

Establish Individual Proficiency

Once Soldiers are familiar with the basics of the EMS and EW, they can develop control measures to reduce their transmission visibility. These could include:

1. Reducing radio power as power reduction limits signal strength, making direction finding and signal identification more difficult. (Department of the Army, 2017a).
2. Increasing distance or standoff from EW threats while maintaining minimal power to reduce signal strength will reduce EMS signature (Department of the Army, 2017a).
3. Putting a hard object like a hill or building between the transmitting system and the enemy can help degrade an EW adversary's ability to see and exploit a signal (Department of the Army, 2017a).
4. Increasing or extending antennas. Directional antennas can be used to send signals to a desired recipient while avoiding enemy sensors. Antennas with better efficiency, which includes not having "whip" antennas folded and using proper antennas for assigned frequencies, makes signals more effective at lower power which decreases the probability of detection (Department of the Army, 2020).

By incorporating these control measures, units can reduce their EMS signature, increasing the probability of mission success.

Build Navigational Redundancy

In the future fight, enemy forces will jam (deny grids, throw off radio timing) or spoof (give false grids) unencrypted GPS, especially if the satellite signal is weak. Conducting basic land navigation regularly without electronics will ensure Soldiers can navigate in any terrain, and under any conditions, like a degraded EMS (Waxler, 2019).

U.S. Army Spc. Elizabeth Rodriguez, assigned to 3rd Infantry Brigade Combat Team, 25th Infantry Division, conducts radio communication checks using a Tactical Satellite Radio at Schofield Barracks, Hawaii, Oct. 16, 2020. The (U.S. Army photo by Staff Sgt. Alan Brutus)

Incorporating Individual Skills to Collective Tasks

After Soldiers have become proficient at signature reduction, they can work towards collective emission control (EMCON) tactics, techniques, and procedures (TTPs). However, TTPs for EMCON cannot necessarily be standardized across the board since they must be adapted to the individual threat and terrain considerations (Department of the Army, 2016).

Current direct fire control measures such as weapon-ready posture, along with weapon control statuses like weapons *hold*, *tight*, and *free* are all examples of control measures that can be adapted to EMCON to create transmission *hold*, *tight*, and *free* statuses.

EMCON Example: Radio Control Status and Radio Ready Posture

Between check point alpha and check point bravo, radio control status is hold and radio ready posture is single channel ground and airborne radio system (SINCGARS) only, networked radios off. Critical to this phase is battalion (BN) and brigade (BDE) echelon of indirect fires against known and likely enemy EW systems. BN and BDE use high frequency radios because of the low probability of intercept/low probability of detection and better control of the indirect fire process. Forces will not pass check point bravo until SINCGARS confirmation that EW threats are neutralized. Once neutralized, forces can transition from radio hold to tight and move to check point charlie.

An exception to radio control status and radio ready posture is only if units are in decisive contact that cannot be handled organically within the unit in contact. Ground force commander, or an appointed representative, can temporarily use control status free, with no change in ready posture, to fight that engagement. Upon a cease in contact, units will conduct a survivability move to an alternate position and resume posture and status.

Once in position to support the attack, Soldiers will stand by for a time trigger to transition from hold to tight and will also change to a status of SINCGARS and networked radios (Department of the Army, 2016). After the attack, and assuming there are no contingencies, the unit will withdraw off the objective. Once accountability of Soldiers, weapons, and equipment is confirmed, the unit will transition back to hold and SINCGARS only, network radios off.

A U.S. Army electronic warfare specialist with the 1st Armored Division inspects components for the VMAX dismounted electronic warfare system at Fort Bliss, Texas, June 19, 2020. (U.S. Army photo by Jean S. Han)

Establishing Standard Operating Procedures

Once Soldiers understand how their systems operate on the EMS, reduce their transmission visibility, and incorporate EW collective tasks and TTPs, they can develop their unit's standard operating procedures (SOPs). These SOPs should include: basic threat EW capability; basic Soldier tasks for EMCON and jamming protection/detection prevention; formulas and required supplies for custom antennas; a code word list for common terms (SP = road trip, security halt = pit stop, ORP = parking lot, etc); modified table of organization and equipment signature-producing systems propagation characteristics; descriptions of indicators and warnings during radio frequency and GPS jamming and how to report it; communication security (COMSEC) procedures; map reading, land navigation, and orienteering techniques and fundamentals; and descriptions of critical friendly forces who can help with a contested environment (Department of the Army, 2017c).

Conclusion

Warfare is constantly evolving and the U.S. must adapt to remain successful. Understanding EMS, reducing transmission visibility, developing unit TTPS and SOPs, and being able to perform essential tasks and operate in a degraded EMS environment will ensure that Soldiers are prepared for the next conflict on any terrain and under any conditions. ■

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