

Hunter Electromagnetic Spectrum

A Model to Both Train and Advance Modernization Efforts

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The twenty-first-century digital age has revitalized military operational doctrine and the Army's concepts of operations as well as its tactics, techniques, and procedures (TTPs). The contemporary operational environment is evolving rapidly. In part, this evolution is happening because technological innovation continues to accelerate via the use of spectrum-efficient systems, emerging radio frequency hardware, and computer architecture systems for size-, weight-, and power-constrained environments. Importantly, these inventions and advances represent approaches that our adversaries, specifically Iran, Syria, and Iraq, are also adopting. Therefore, historic, large institutional systems and processes struggle to remain relevant and adequately prepare soldiers for the threats and demands they will encounter when deployed in competition, crisis, or conflict. Recognizing the need for a doctrine "lift and shift" to support more complex operations, in recent years, the Department of Defense has introduced new doctrine to address the multidomain battlespace of today and tomorrow. Examples include Joint Publication 3-12, *Joint Cyber Operations*; Joint Publication 3-85, *Joint Electromagnetic Spectrum*

Operations; Field Manual 3-0, *Operations*; Field Manual 3-12, *Cyber and Electromagnetic Activities*; and Army Doctrine Publication 3-13, *Information*.¹ To actualize such doctrine, the 10th Mountain Division is pioneering multidomain training and representing an operational unit that seeks to understand conditions forward and tailor training paths to relevant operational threats. The multidomain environments of the Ukrainian, Syrian, and Israeli theaters of conflict have amplified the importance of understanding the application of the electromagnetic spectrum (EMS) to twenty-first-century conflict. Adversaries use electromagnetic countermeasures to negate our ability to use sensors and exploit technological advantages. This is in stark contrast to the fights in Iraq and Afghanistan where the electromagnetic spectrum had limited application. Creating and exploiting a relative advantage in the contemporary operational environment is impossible without synchronizing and integrating electromagnetic feedback. However, bridging the gap between rhetoric and reality is a difficult quest. Hunter Electromagnetic Spectrum (HEMS) is a story of how a highly deployed, low modernization priority unit prepared and trained



The AN/TPQ-53 radar is staged for premobilization training 7 July 2021 at the Regional Training Center in Salina, Kansas. (Photo courtesy of the U.S. Army)

with emerging technologies for continuous rotations to theaters of conflict. While circumstantially developed, the HEMS model could be replicated to speed the pace of technological iteration while developing unit competency through training.

The Human Dimension

As the division artillery (DIVARTY) commander, I started HEMS to enhance radar training. With the intent of incorporating our cyberspace electromagnetic activities (CEMA) and space teammates from throughout the division, the team developed a concept that would sharpen everyone's skill set. Using PR 200 terrestrial-based equipment and spectrum analyzers, the collective team created a scrimmage that competitively pitted radars against electronic signature hunters (a.k.a. a digital opposing force). Essentially, the radars hide, attempt to mask themselves, and use emission control to stay outside of a targetable threshold—in this instance,

using a target location error of three hundred meters. Hunters would analyze terrain and push out dismounted teams to retrieve the radars by acquiring lines of bearing, side lines of bearing, resection, or triangulation. The collective team executed multiple turns per day and the learning curve remained steep through the ability to iterate frequently. Our radar operators understood their vulnerabilities better and refined their TTPs to become harder to kill. Our 17-series soldiers (electronic signature hunters) learned how to employ their equipment better and work as a team to acquire targetable information and input it into the targeting apparatus.

For our soldiers, understanding how someone will hunt them underpins the motivation and intelligently informs means to prevent exposure and better anticipate adversary actions. Additionally, detailed knowledge in TTPs comes from pushing equipment and personal limits in training. When technical and physical thresholds are achieved, soldiers' trust in the process

grows while confidence and morale increases, indicating an advantage in the human domain. Furthermore, the foundation of unit collective training is individual soldier proficiency. Advanced levels of unit proficiency are built on each individual human in the formation.

The Information Dimension

The information dimension introduces the human to the battlespace around them. The twenty-first-century fight includes sifting through mountains of data to efficiently find actionable information. Exploiting the information dimension requires many iterations at deciphering the wheat—usable (sometimes perishable) information from the chaff—discardable information.

EMS often acts as the first form of contact via radio frequency site survey. Transitioning the knowledge of EMS to other intelligence disciplines remains key to maintaining a faster processing and decision cycle than the adversary. HEMS is a venue where 10th Mountain leaders communicate the importance of seizing, retaining, and exploiting the initiative within a tactical scenario. The pursuit of objectives in the information dimension is twofold. First, soldiers must understand and use all available information to advance the targeting and striking of targets. Second, soldiers must practice the employment of all-source intelligence efforts to confirm target locations (positive identification). These two key takeaways have been an enduring HEMS success story.

The Physical Dimension

The EMS crosses all domains. The joint force relies upon EMS-enabled communications and weapons systems.² EMS plays a key role in the ability to detect enemy forces and to establish an organization's electronic orders of battle. EMS equally acts as a vulnerability because adversaries pursue the identification of friendly emissions. Advantages gained in EMS complement the human and information dimensions in speeding staff processes, mobility, and lethality. The side that can turn information into intelligence, and subsequently strike a target based on that intelligence, maintains a distinct advantage.

Developing the skills to identify EMS emissions quickly and accurately and to hide in the EMS are foundational to HEMS. As HEMS matured, it also grew in complexity. Success in terrestrial hunting

naturally led to the incorporation of a third dimension, significantly reducing a ground hunter's time to acquire and target location error. An MQ-9 from the New York Air National Guard's 174th Attack Wing provided aerial hunting input in the form of full-motion video and synthetic aperture radar. These multiple-intelligence platforms quickly overwhelmed dismounted ground operators and their rudimentary systems. The need for large bandwidth pipes and a central command-and-control node distilled quickly. Future iterations will incorporate this feedback but also expand the scope and complexity of the exercises.

Upstate New York in February provided a perfect opportunity to exercise field craft and equipment. Operating in temperatures as low as 0°F caused cables to crack, connections to degrade, and entire systems to freeze. Again, the practitioner's lessons stemmed from operators' understanding the limitations of their equipment and taking the necessary steps to safeguard, protect, and mitigate disruption.

Cold weather is one important consideration for the alpine division; another is the unique EMS capability that resides on Fort Drum in the form of joint threat emitters (JTE). Originally designed for the combat aviation brigade (CAB) to practice evasive maneuvers, the JTE is one of only two systems on the U.S. East Coast that can replicate up to forty adver-

sary target acquisition threats. These sensors emit powerful signals that all organic electronic signature sensors

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can acquire, and they provide attractive training stimulus for aerial platforms supporting HEMS events.

DIVARTY Approach

The DIVARTY team initially invested in HEMS to sharpen its sensor-to-shooter linkages and develop TTPs to make its sensors harder to kill. Once leadership realized the value of this training for subordinates, technical investments increased and diversified. While building human capital on all fronts, lessons learned from forward-deployed units generated future experimentation ideas and accelerated the incorporation of many division enablers. Every brigade combat team in the 10th Mountain Division is either deployed or has a deployment on the horizon. Therefore, efforts to incorporate emerging technology or replicate the current threat environment must be done in the immediate term—the 10th Mountain Division cannot wait until 2030. With DIVARTY's key assets deployed to the Europe, sensors and enablers from across the division supported HEMS in 2023 by spreading lessons learned and sharing knowledge between formations. 10th Mountain's pursuit of technical capabilities naturally led to industry partners who provide emerging technological solutions to active theaters of conflict.

Industry Equities

Industry partners naturally look for operational partners to pair with their highly educated and technically savvy engineers. The second iteration of HEMS saw the incorporation of a naval sensor that showed great promise when included in the scrimmage. 10th Mountain soldiers appreciated the opportunity to learn and understand the technology behind the system and enjoyed exploiting it to “win the game,” while industry partners realized that with minor modifications, there was a land application to their ready-made maritime product.

Practitioner feedback is invaluable to the industry. HEMS provides senior NCO and warrant officer expert feedback, far exceeding the industry's routine soldier feedback. Furthermore, feedback is part of the training and is not seen as an additional requirement. 10th Mountain units conduct the training regardless of industry involvement. Industry can enhance training, and the interaction between the two parties can be mutually beneficial. The scrimmage-like format of HEMS enables quick iteration, allowing all parties to

fine-tune their approach multiple times in a day. This quick iteration format provides opportunities for robust data collection that industry partners take back to the laboratory and continue improvements. Minor details in coding, software, interfaces, or displays distill quickly and would not otherwise be seen. Industry partners view HEMS as a risk reduction event—essentially a safe place to take their technology and experiment with a group of knowledgeable practitioners before being tested at their next acquisition milestone. Industry representatives experience a high learning curve and participate on their own dime owing to the rich feedback and mutually supportive relationship that has been established.

Program Executive Offices

The Army acquisition program executive offices (PEO) and their down-trace project managers have been overwhelmingly supportive of HEMS training and often act as the connective tissue between operational units and industry partners. Modern technology advances too quickly for our acquisition process to leverage in near real time. Exercises like HEMS may be a new model to accelerate technological development while enhancing unit training and give acquisition an opportunity to adopt or adapt emerging technology in an operationally relevant environment. Over the last twenty-three years, while there have been several attempts to reform the laborious and painstaking modernization process, they have all been top-down driven (see figure 1). HEMS generated from an operational unit and grew from the bottom up using mutual interest as the magnetizing force. To reinforce this point, 10th Mountain Division has paid exactly \$0 to industry partners for their participation; the symbiotic partnership has been done through communication, relationship building, and investing time in crafting experimentation objectives that satisfy unit and industry equities. Finally, the missing link to the established HEMS triad is the Army capability managers (ACMs)—the organization that writes the capabilities requirements derived from the doctrine. Some ACMs have attended HEMS, but a more complete model would prioritize ACMs' participation (see figure 2).

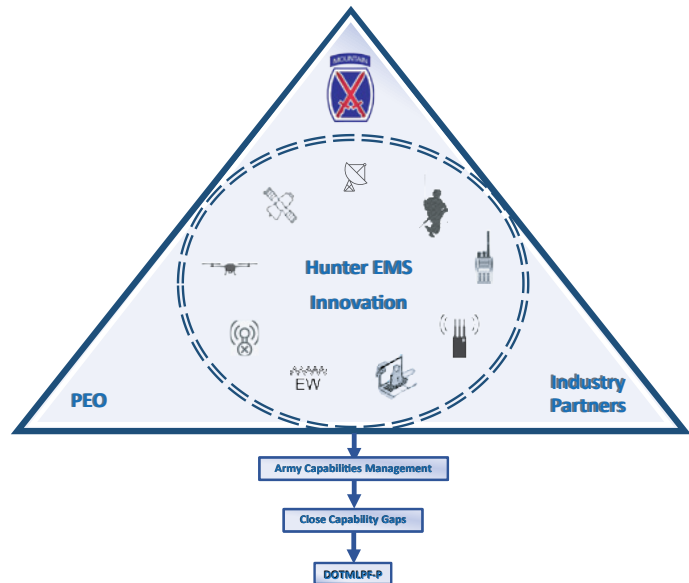
Debunking Common Myths

The act of protecting a unit's training schedule is nearly an hour-by-hour challenge, and I know this because I was a division G-3. Army Forces Command,

corps, and division echelons rightly protect operational units from industry partners who need soldier touchpoints and feedback. This zero-sum game approach focuses on tasking units to provide soldiers with the opportunity to deliver X feedback on Y equipment during a given period. It is a task that must be managed and impacts a unit's training schedule. The industry partner gains while the unit loses soldier availability. The zero-sum game is one of time and where it is spent. HEMS is an example where both soldiers and industry partners benefit from voluntary interaction with each other to pursue aligned objectives. The soldier gains competency, problem context, and technical skill. The industry partner gains soldier feedback from trained and interested parties who will exceed feedback expectations. As HEMS matured, strong relationships developed as each side benefited from the interaction. Soldiers better understood technical components, experienced equipment limitations, and revised their tactical application or adaptation based on emerging capabilities. Industry received feedback from the same NCOs or warrant officers, advancing the depth and technical quality of feedback. Assessment of HEMS progress against objectives was accomplished via soldier hot washes, industry data collection/reduction/analysis, and formal after-action reporting. Collectively, HEMS has completed over 85 percent of its total objectives to date.

Hunter EMS Training and Experimentation Path

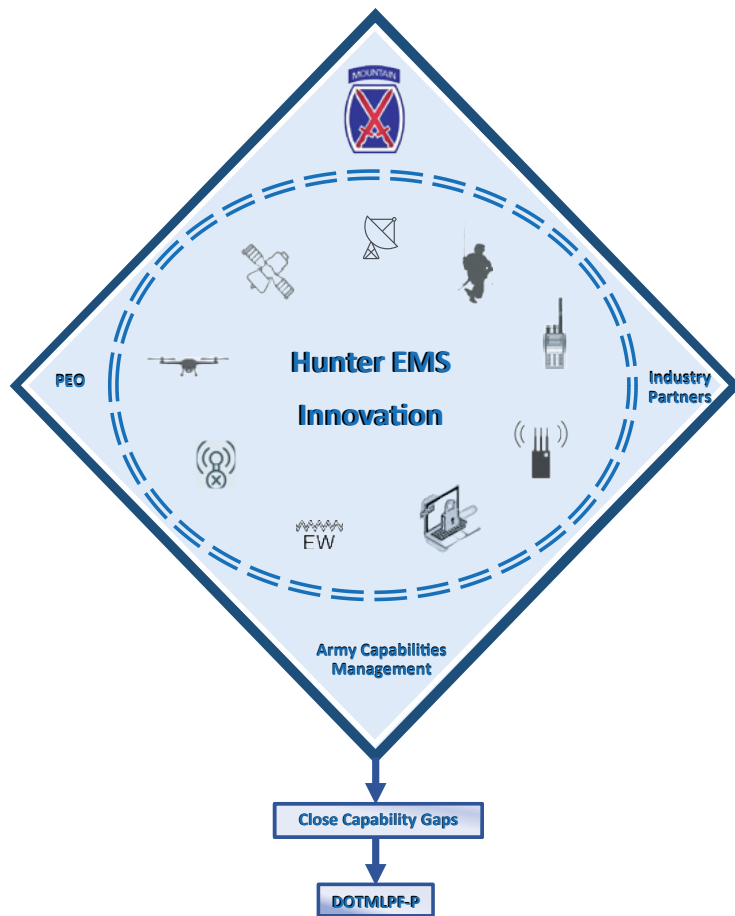
While anchored on organic radars and EMS, the training and experimentation objectives associated with HEMS have taken a circuitous path. Foundationally, operational units inside the 10th Mountain Division identify problem sets or friction points they are struggling to solve, then leaders craft training objectives to pursue solutions to identified problems. Incorporating a mobile all-domain operations center prompted the team to pursue bandwidth solutions for receiving data collected by multiple disparate sensors. Logically, this led to the incorporation



(Figure by authors)

Figure 1. Current Hunter EMS Innovation Structure

of mobile broadband kits in the form of Kymeta and Starlink terminals. Once the team received the data, the next step was to make sense of it, leading the HEMS team to find a platform that could consolidate all electronic warfare feeds into a common operational picture. The solution of utilizing the Maven Smart System showed the most promise, and several industry partners expressed interest in assisting with the project. For nearly twelve weeks, software engineers from private industry, 10th Mountain systems integrators, and 10th Mountain communications technicians surged on creating an electronic warfare common operational picture in Maven. Using organic equipment, emerging programs of record such as the electronic warfare planning and management tool, and commercial off-the-shelf technology, the team successfully analyzed the trade-space among many types of messaging formats and cross-domain solutions to create appropriate and realizable paths for data to be displayed in the Maven Smart System (see figure 3). In the end, the collective team successfully built three separate paths using disparate programs of record and commercial off-the-shelf equipment to make a usable common operational picture. The event was HEMS IV, and it showed the incredible potential that resides in the nexus of the operational unit, PEO, and industry.



(Figure by authors)

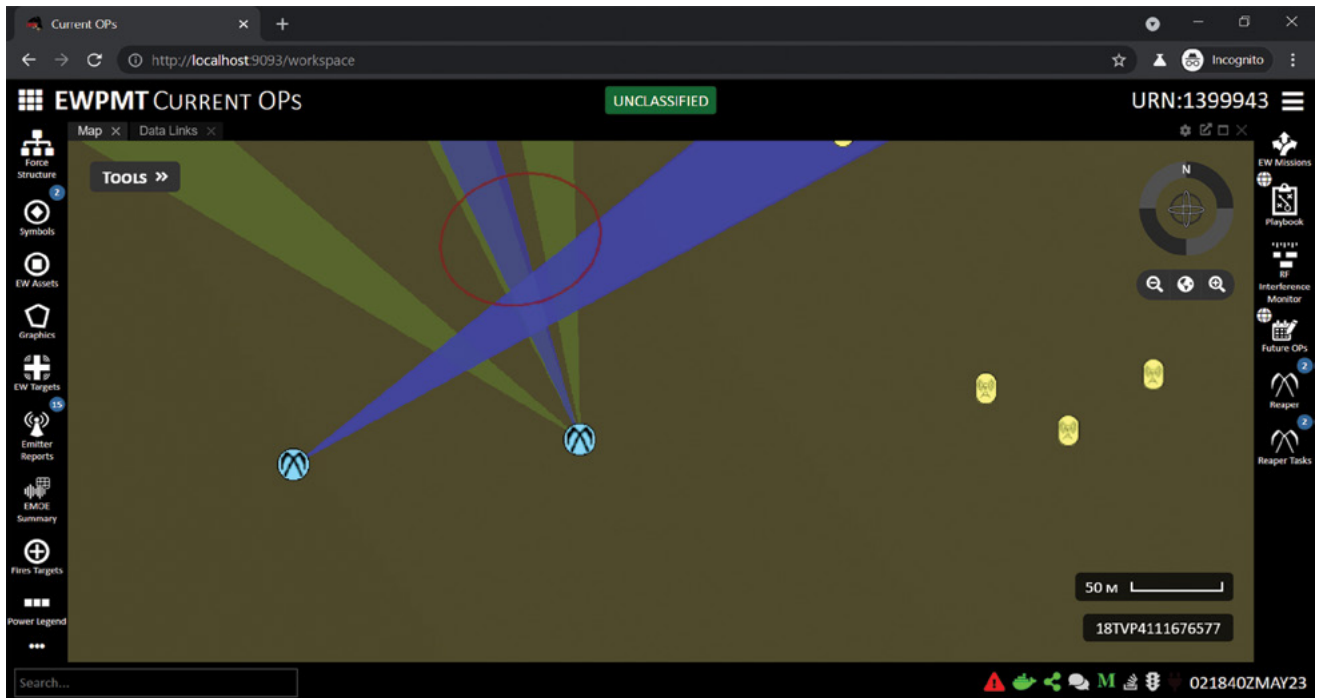
Figure 2. Hunter EMS Innovation Way Forward

As HEMS matured through 2023, one complementary effort was the consolidation of 17- and 14-series soldiers into an air missile defense and electronic warfare (AMDEW) platoon in DIVARTY. The idea behind consolidation grew from 1st Brigade, 10th Mountain's 2022-2023 Iraq and Syria lessons learned that described how leaders rushed to adequately train their base defense operations centers personnel to combat the evolving threat of one-way unmanned aircraft system (UAS) attacks. The consolidation effort aimed to leverage the experience of the senior NCOs who had just returned from a cutting-edge counter-UAS environment. Again, local industry found value in aligning training objectives for experimentation with the AMDEW platoon. Syracuse Research Corporation, an independent, not-for-profit, research and development corporation chartered by the state of New York, brought several passive and ground-based

radars to enhance AMDEW, CEMA, and DIVARTY training. Syracuse Research Corporation also contributed to advancements in the mobile all domain operations center, leading to more efficient consolidation, processing, and exploitation of acquired information. HEMS V reinforced the idea that operational units and industry could find mutually beneficial training and experimentation objectives that together advanced organizational goals.

Next, the Hunter EMS VI concept heavily relied on the PEO Intelligence, Electronic Warfare, and Sensors team and took about eleven months to prepare. One of the Army's 31+4 modernization efforts is the multifunctional electronic warfare (MFEW) 0 that will provide aerial electronic support and attack capability organic to the division level.³ 10th Mountain DIVARTY became interested in the MFEW after their participation in Warfighter 22-05 in June 2022, during which exquisite capabilities such as aerial electronic attack needed to be planned and synchronized with detail. The 10th Mountain Division targeting cell led an integrated air defense system work-

ing group in the aftermath of the Warfighter to gain greater knowledge and generate defeat mechanisms for this threat. The MFEW capability neatly aligned with the integrated air defense system working group's outputs. The MFEW brought the opportunity to bring aerial electronic attack to a lower echelon to utilize more frequently as a risk mitigation measure and as nonlethal shaping fires to extend 10th CAB's access to adversary threat systems. By leveraging the JTEs on Fort Drum, the unit orchestrated a division-level live-fire exercise that initiated with aerial electronic attack and followed with an MQ-9 500 lb. bomb, CAB strike, and M777 fire missions. With the assistance of the explosive ordnance detachment, PEO Intelligence, Electronic Warfare and Sensors provided expendable electronic warfare emitters to place on top of targets in the impact area to broaden the scope of the target array. The triad of industry, PEO, and operational



(Figure from Chief Warrant Officer 2 Brett Melnyk, U.S. Army)

Figure 3. Electronic Warfare Planning and Management Tool Display from a HEMS IV

units converged again to advance the development of one of the Army's key modernization platforms while exercising DIVARTY, CAB, CEMA, and AMDEW essential tasks.

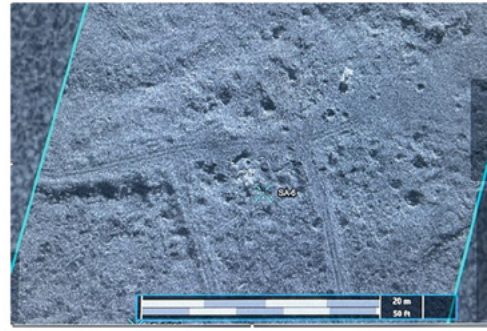
In another application, HEMS VII coincided with an artillery battalion's Table XV battery qualification and AMDEW Table VI certification. HEMS VII proved to be an exercise in multiechelon training management, where one critical event could simultaneously service multiple training objectives. For instance, by adding a Q-50 to a two-gun artillery raid, the team sought to experiment with its effectiveness in a position, navigation, and timing denied environment. Elements from U.S. Army Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) Center brought UASs to identify howitzers attempting to mask themselves in the woodline while industry partners, currently using equipment in a theater of conflict, identified and tracked those systems in support of AMDEW training objectives. Additionally, emerging technology in the form of non-line-of-sight and line-of-sight extended communication systems validated

FM voice and digital communications from Fort Drum to variable height antennas deep in the Adirondack Mountains and Camp Ethan Allen, Vermont. The line-of-sight communications experiment paired three separate industry partners together to effectively achieve an eighty-seven-mile linkage.

To advance and align with the alpine culture of the 10th Mountain Division, future HEMS iterations will continue EMS and radar experimentation along with position, navigation, and timing denial and navigation warfare in the Adirondacks. The incorporation of Navy and Air Force joint platforms is on the horizon for the second and third quarters of fiscal year 2024 along with other modernization efforts in various stages of development. As the HEMS concept continues to gain traction, PEOs and industry partner collaboration contribute to the pool of experimentation ideas—which are proving to be the incubator of innovation and improving overall soldier competency. 10th Mountain leaders will take the ideas and narrow the scope of training to the right mutually supportive triad nexus. In the coming months, one measure of effectiveness for HEMS will be how many lessons learned and



MITRE Expendable Emitter on Tank Hull in Fort Drum, New York, impact area



MQ-9 Synthetic Aperture Radar (SAR) capture during Hunter EMS VI



C/s-6 FA Fires in Support of Hunter EMS VI

HEMS VI synchronization. ([clockwise from top left] Photos by Sgt. 1st Class Thomas Zebrowski, U.S. Army; Staff Sgt. Christopher Gunter, U.S. Army; and Spc. Kade M. Bowers, U.S. Army. Composite by Michael Lopez, *Military Review*)

developed concepts the collective team can push to 1st Brigade Combat Team for tactical employment in their training progression and subsequent deployment. HEMS is about training our internal 10th Mountain teams but also transforming how the 10th Mountain Division operates based on the knowledge and skills acquired in HEMS training.

A Model to Advance Aligning Interests

Air Force Research Laboratory (AFRL) Information Directorate in Rome, New York, has been an important partner with 10th Mountain Division in advancing Hunter EMS initiatives. AFRL orchestrates a recurring experimentation series dubbed Future Flag that is focused on accelerating the development, demonstration, and fielding of innovative capabilities for Joint All-Domain Command and Control and autonomy and artificial intelligence systems. Recently, AFRL has started the Northeast Multi-Domain Operations Alliance (NEMDOA) with the expressed intent to provide an ecosystem for the experimentation

and characterization of emerging multidomain operations technology immersed in a relevant operational environment. The alliance is regionally focused and includes bringing representatives from the Air Force, Army, Navy, Space Force, New York Air National Guard, and other government partners to share training or experimentation opportunities with each other. NEMDOA shows incredible potential to expand training and experimentation opportunities for all its members, echeloning up ideas from its contributing members like 10th Mountain Division and the HEMS series. Government members will lead the NEMDOA to provide convergence opportunities through an ecosystem for the experimentation of multidomain operations technology while serving as a risk reduction series. Members of the alliance are committed to work together to further HEMS, Future Flag, and other alliance-related activities.

Conclusion

HEMS is a mission-effective and cost-efficient way to advance and mature technological development while



Industry partners combine a tethered drone, a directional antenna, and a radio to achieve a communications solution (HEMS VIIB) to digitally communicate a distance of eighty-seven miles from Fort Drum to the top of Whiteface Mountain (highest peak in New York State) on 5–8 December 2023. (Photo by Chief Warrant Officer 2 Michael [Brett] Melnyk, U.S. Army)

training an operational unit for the contemporary operating environment they will encounter in a theater of conflict. While initially developed as a training venue for organic systems and personnel, the training objectives and experimentation hypotheses developed for HEMS attracted industry partners and the Army's acquisition enterprise. The mutually beneficial partnership that subsequently developed may serve as a model to bring soldier knowledge and competency in line with

the contemporary threat, increase technological innovation and iteration through expert soldier feedback, and advance acquisition milestone achievement by providing more frequent opportunities. Via the NEMDOA, HEMS can serve as a joint interest risk reduction event for service-level capstone experiments and exercises. ■

Many thanks to PEOs, industry partners, and HEMS contributors for their inspiration to publish this article.

Notes

1. Joint Publication (JP) 3-12, *Joint Cyber Operations* (Washington, DC: U.S. Government Publishing Office [GPO], 2022); JP 3-85, *Joint Electromagnetic Spectrum Operations* (Washington, DC: U.S. GPO, 2020); Field Manual (FM) 3-0, *Operations* (Washington, DC: U.S. GPO, 2022); FM 3-12, *Cyber and Electromagnetic Activities* (Washington, DC: U.S. GPO, 2021); Army Doctrine Publication 3-13, *Information* (Washington, DC: U.S. GPO, 2023).

2. FM 3-0, *Operations* (Washington, DC: U.S. GPO, 2022), 1-20–1-22.

3. A POD is a detachable/replaceable attachment that fits on the wing of a Class III unmanned aircraft system or on a fixed-wing aircraft.