



HIGH-FREQUENCY COMMUNICATIONS:

OBSERVATIONS AND RECOMMENDATIONS  
FROM PROJECT CONVERGENCE

(DVIDS photo by John Budnik, U.S. Army  
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Ground-based artillery can provide close fires, and they can also provide deep shaping fires. These fire support systems must be able to shoot tens to hundreds of kilometers during each fire mission from locations close enough to range the target but far enough from enemy fire systems to maintain survivability. To ensure an effective balance between these competing requirements for positioning, United States (U.S.) long-range precision fires must be able to shoot far distances and effectively communicate one-third of their maximum range. With the emergence of extended range Field Artillery (FA) systems, that becomes a tall order.

*Consider the following vignette:*

*9th Battalion, 99th Field Artillery Regiment (FAR) has been in the Indo-Pacific Command (INDO-PACOM) theater for a few months. Its subordinate firing batteries are spread across an island chain, providing fire support to suppress or destroy enemy anti-access/area denial capabilities which enables freedom of navigation in the region. The unit, with its extended range precision systems, offers the equivalent of four Arleigh Burke-class guided-missile destroyers (DDGs) to augment naval capability. Due to the expansive area of responsibility, the use of line-of-sight (LOS) communications has very limited utility. Aircraft overhead is sparse. The threat of air defense artillery and other anti-access/area denial weapons poses a severe risk to aircraft and limits the freedom of maneuver in the skies. Far above, what appears to be a daytime star is becoming visible. The remnants of a large communication satellite have just been pulled out of orbit, compounding degradation of communication capabilities available in the theater and globally. Many U.S. platforms and capabilities, such as communications and the Global Positioning System (GPS), are space-*

*based. Without reliable communications, 9-99 FAR is unable to provide long-range precision fires to eliminate land and maritime threats. Consequently, the joint force commander will have to risk the force's joint strike capability or naval DDGs on a target that could otherwise be reached from long-range surface-to-surface fires.*

As a fighting force, the U.S. Army must improve its ability to function in a contested cyber environment, in which the use of satellite communications providing the backbone of upper tactical internet (UTI) is degraded or entirely unavailable. One solution is greater tactical expertise in high-frequency (HF) radio communication. Future Large-Scale Combat Operations (LSCO) demand consistent, reliable communications, even in disrupted and degraded environments. The U.S. Army has developed an overreliance on UTI, allowing its proficiency with tactical communications systems to atrophy. The reintegration of HF communication skills as a core competency starts with understanding its necessity in combat operations. Building competency requires a focused effort to identify and validate requirements, prioritize resources to acquire material solutions, modernize doctrine and conduct focused dedicated training.

### **OBSERVATIONS FROM PROJECT CONVERGENCE AND NTC 24-03**

National Training Center (NTC) rotation 24-03 and Project Convergence are part of the Army's approach to building on lessons learned to continue developing lethal response options in a crisis. How can the Army maintain the same capability it has in Syria while adding the complexity of distance, reception/staging/onward movement/integration (RSOI), sustainment and communications? Project Convergence is taking the sensor-command and control (C2)-effector framework and adding a processor (sensor-process-C2-effector) to enable commanders to have immediate refined information across the warfighting functions for mission command and execution. Communications underpin the entire sensor to effector architecture. Critical communications platforms make or break the chain and friendly forces' ability to transition from deep sensing to long-range precision fires.

A participating rocket artillery battalion played an integral part in the "effector" component. The

Multiple Launch Rocket System (MLRS), as an individual component, is a highly capable platform for providing operational shaping fires. The MLRS launcher is the final effector component in the system from sensor to shooter. It can provide truly extraordinary effects; however, if the firing batteries or launcher sections cannot receive fire missions, they are useless. NTC 24-03 and Project Convergence identified just such a vulnerability. When denied the use of tactical satellite (TACSAT) communications and UTI, they were unable to receive fire missions and deliver timely, effective fires. While this became obvious during the exercise, it also identified a fact that units across the Army are having similar challenges. These challenges constitute a capability gap that requires resolution and integration in the development of future long-range weapon systems.

During NTC rotation 24-03, the method to train and develop expertise on the fire support network as a system was incremental. First, the unit conducted a simple inventory to ensure it had all the necessary communication system components. It performed maintenance and installation procedures for all the elements. Following that, it worked on individual systems—identifying, validating and testing the Advanced Field Artillery Tactical Data System (AFATDS) software and radio settings, incrementally building the systems and developing their connections. Ultimately, the unit concluded that fire missions communicated through HF radios in a manpack configuration were a viable solution in situations where the environment's conditions precluded the use of LOS systems (VHF FM). The unit's greatest challenge was troubleshooting and employing the AN/PRC-104(V)6 vehicle system, which consists of a vehicle mount and a man-portable AN/PRC-150 HF radio. Some of that challenge was due to exercise time constraints and resident expertise, but some of that challenge also appeared to be due to deeper system integration problems between the AN/PRC-104(v)6 mount and the AN/PRC-150 HF radio. Regardless, the FA unit's average for operational HF systems with technical and tactical expertise to employ the systems was at or below 25%.

### **WHAT IS THE REQUIREMENT?**

FA organizations have recognized that they must be able to communicate over extended distances to provide timely and accurate fires to the

supported force. Operations in the mountainous terrain of Afghanistan provided communications challenges for which LOS frequency modulation (FM) communications were unsuited. FA units must anticipate operating over extended ranges in the future, especially in LSCO; two factors drive this conclusion. First, artillery firing units must disperse to improve survivability on the battlefield. The effects of massed fires will be accomplished by massing on the target, not at the firing points. Second, the range of artillery systems has increased dramatically, as has the range of target detection. This means the distance between the sensor, fire direction and the shooter has also increased significantly. Communication between these three nodes in the fire system must be responsive, reliable, secure, mobile and able to communicate at very long ranges—certainly beyond the line-of-sight (BLOS).

### **POTENTIAL SOLUTIONS AND THEIR CHARACTERISTICS**

**VHF FM.** For many years, very high frequency (VHF, 30 to 300 MHz) FM radios have been the backbone of tactical communications for the ground forces, including FA forces. FM is the primary communications platform for all FA training at the Field Artillery School in Fort Sill, Oklahoma. VHF FM provides excellent clarity, precise tuning and many usable channels. It functions well with simple, mobile antennas and packages compactly in highly mobile units that can be optimized for mounted or dismounted use. The main drawback with VHF FM is its limited range; it is a LOS system. One of the physical characteristics of the band is that its signals do not bend with the earth's curvature or reliably bounce off predictable atmospheric layers. There are exceptional circumstances when VHF FM signals "skip" and enable communication over extended distances (thousands of miles), but these conditions are rare, unreliable and difficult to predict. There are ways to get around this LOS limitation: taller antennas, retransmission stations and airborne repeaters, for example. Each of these solutions entails drawbacks in mobility, signature and vulnerability.

**UHF SATELLITE COMMUNICATIONS.** There are existing technological solutions to the LOS challenge. One of these is using space-based communications links. TACSAT communications were frequently used in Afghanistan's Operation

Enduring Freedom (OEF). These systems were available, reliable, simple to use and operated in the ultra-high frequency (UHF) portion of the electromagnetic spectrum (300 MHz to 3 GHz). They enabled what amounted to an asymmetric advantage against enemy forces in Afghanistan. Enemy forces could not intercept, jam or disable TACSAT communications, primarily because they lacked the means to interfere with the satellites in orbit. Operations in the future may not enjoy the luxury of such an asymmetric advantage. Peer and near-peer adversaries have demonstrated the capability to extend conflict into space, so it is reasonable to anticipate that the ability to use space-based communication systems will be contested.

**HF RADIO.** There is an older, less frequently used technology that provides many of the desired characteristics of long-range, simple use and reasonable mobility. High-frequency radio (HF, 3 to 30 MHz) is not limited to LOS, which is its most significant advantage. It is also robust, resistant to adverse weather effects, has low power requirements and is suitable for data transmission. HF signals can "bend" with the curvature of the earth to achieve BLOS communications, alleviating reliance on space-based support. It is not without disadvantages, however; the lower frequency inherently limits the volume of data transmitted in each increment of time due to the relatively limited bandwidth at the lower frequency, compared to VHF or UHF.

All these solutions are available now. The technology is well-developed, and viable products are immediately available as commercial off-the-shelf (COTS) or government off-the-shelf (GOTS) solutions.

### **COMPARING POSSIBLE SOLUTIONS**

The U.S. Army has relied on UTI and FM radios for decades without much scrutiny. However, the Russia-Ukraine (RUS-UKR) war has ushered in a new era; one that Soldiers are still grappling to comprehend fully. The impact of technology in this war has been profound. A lesson learned is that combatants face a scenario where the communications they have taken for granted are unreliable or unavailable. Adversaries will seek to degrade and deny friendly capabilities in the space domain. They endeavor to employ electronic warfare means to disrupt communications and,

when possible, target fire support systems. The FM radios used in Iraq and Afghanistan are vulnerable to peers' electronic warfare (EW) capabilities and provide a signature that is relatively easy to target. The same is true throughout the VHF frequencies (30–300 MHz) and UHF frequencies (300 MHz – 3 GHz). VHF and UHF are LOS signals generally unimpeded by geomagnetic storms but generate signals with a high probability of detection and interception.

Adversaries can deny, degrade and disrupt space-based communications platforms by creating a denied, degraded and disrupted space operating environment (D3SOE). FM is also susceptible to electronic warfare jamming in disrupted, disconnected, intermittent and low-bandwidth (DDIL) environments. The enemy aims to achieve effects in both UHF/UTI and FM areas of the electromagnetic spectrum. The enemy's goals are:

- 1) *TASK: Degrade communications platforms to combat ineffective.*
- 2) *PURPOSE: Frustrate friendly force elements and force them to use unsecured networks.*

**SATELLITE COMMUNICATIONS.** Many modern technical systems rely on space-based platforms and have replaced legacy technology viewed as obsolete and unsuited for “modern” wars. TACSAT is a UHF LOS system that develops a BLOS capability when paired with a space-based platform. Using the UHF spectrum gives resilience to communications in varying atmospheric conditions and ensures a firm communications platform for LOS conditions.

Some additional satellite-dependent or enhanced systems are the positional navigation unit (PNU), which augments GPS, and the Enhanced Position Location Reporting System (EPLRS), which has been replaced by the Joint Battle Command-Platform (JBC-P). FM radios could not communicate across distances and terrain obstacles encountered in Iraq and Afghanistan and were replaced by TACSAT radios for their ease of use and employment. The satellite transportable trailer (STT) and command post node (CPN), initially fielded in ~2006, were the most significant shift of tactical communications to satellite-based platforms and are the primary means of UTI for units at the tactical edge.

The PNU provides valuable location information for FA units to meet requirements for accurate and predictive fires. The PNU uses accelerometers and gyroscopes to analyze vehicle movement and provide updated survey information as a vehicle maneuvers across the battlefield. It is a mechanical component of the FA MLRS with equivalent systems in other platforms. Various GPS instruments now augment the PNU to provide more reliable and accurate survey information; these GPS instruments are required to shoot precision-guided munitions. Adversaries of the late 1990s and early 2000s could not degrade GPS, and thus, the U.S. Army had a significant capability advantage over those adversaries. The Army transitioned to space-based capabilities to build resistance from adversary interference, build battlefield resilience and create more excellent reliability for tactical units. At the time, in that environment, that was all positive, virtually without negative side effects. Operations in a D3SOE face a direct, credible threat to precision-guided munitions capability vital to U.S. forces.<sup>1</sup>

The STT and CPN (UTI system) were the largest shifts in tactical unit communications to capitalize on the asymmetric advantage of satellite-based communications. These systems provided communications to units in austere environments with secure connections and bandwidth that maximized the opportunity for file sharing. They were great in Afghanistan and Iraq for large, centralized command posts without requiring quick displacement. Recently, at NTC, a unit found that the reliance on UTI created mission command posts that were 75% larger than command posts operating on radio-based communications and had limited survivability. The system provided significant advantages and minimized weaknesses in historic conflicts but prohibits tactical unit tasks and lacks resilience in key capabilities when weighed against the future LSCO.

**VHF FM.** As VHF systems, FM radios provide a wide, targetable signature due to the specific frequencies and waveform that U.S. forces operate on. The enemy can use that targetable signature for disruption, passive monitoring or attack on friendly troops with few warnings and indicators. The risk associated with FM comms is high, and the reward is considerably low due to LOS and resilience. It is best suited for contingency and emergency use within the primary/alternate/contingency/emergency (PACE) communications.

These systems are susceptible to interference due to their various weaknesses from enemy forces and lack distinct features that enable FA systems to perform missions in areas of operations over great distances with the necessary characteristics to be resilient and survivable for our units.

FM and TACSAT radios have been viable options for maintaining voice and data communications and will remain in the position of primary and alternate systems in the PACE plan. However, a complete PACE plan requires more than primary and alternate means.

**HIGH FREQUENCY.** As a frequency and a wavelength, HF has unique characteristics that enable communication over great distances, BLOS communication. The wavelength is refracted off the ionosphere back towards Earth through skywave propagation. HF can also be propagated as a groundwave reflecting off the Earth's surface for long-distance communication. These wavelengths can travel over the horizon through various propagation methods. Unlike other wavelengths, Earth's topography has little impact on these communication signals due to propagation. However, HF is relatively fragile and can be impeded by solar flares and other atmospheric conditions that users cannot control. Modern technology can mitigate but not entirely eliminate these susceptibilities. Like all other radio signals, it is possible to detect and locate the origin of HF signals, so HF communications are not immune to detection and targeting.

Modern HF radios operate on upper and lower sidebands (USB/LSB) to efficiently transmit information and reduce noise output. Using sideband waveforms enables freedom of communication while generating a low probability of intercept and detection (LPI/LPD). Additionally, MIL-STD-188-148B establishes Department of Defense (DoD) interoperability standards for anti-jamming technology. The standard creates a common baseline for the joint force HF capability of electronic countermeasures (ECM) and electronic counter-countermeasures (ECCM). The technology found in modern HF radios makes a compelling argument for greater application during operations and within the fire support network.

To standardize HF communications platforms and mitigate the effects of atmospheric conditions, the DoD developed interoperability

and performance standards for medium frequency (MF) and HF radios through MIL-STD-188-141A (1988) and is currently using MIL-STD-188-141D (2017) for automatic link establishment (ALE). A vital characteristic of the military standard is ALE, designed to assess the link quality for both sending and receiving stations and automatically select the channel with the best quality to enable two-way communication. The enhancement mitigates environmental effects on the connection to enable communication. The most recent development in ALE is the 3rd generation ALE, which provides a time synchronization protocol and GPS lock to decrease link establishment time while optimizing.

For now, HF is the organization's most effective contingency communication system in D3SOE or DDIL environments. It offers a reliable means of mission command, enabling fire support execution during operations over extended distances, and can be implemented while presenting a reduced targetable signature.

### *COMPLEX ORGANIZATIONAL TERRAIN*

The U.S. military has used HF communications for BLOS communication since the 1930s – almost 100 years since well before satellite communications became widespread.<sup>2</sup> The required operational capability (ROC) from 1982 that established the improved high-frequency radio (IHFR) system is still in effect, outlining Army HF requirements for the acquisitions community. A key component from this 1982 ROC is the AN/PRC 104 HF radio system, managed by Program Executive Office, Command and Control Communications – Tactical (PEO-C3T) and Life Cycle Management Command (LCMC) Communications-Electronics Command (CECOM). The AN/PRC-104 is still in the inventory, but it should not be confused with the AN/VRC-104(v)6. The AN/PRC -104 was a product of the Hughes Aircraft Company and could be mounted in a vehicle. Harris acquired the tactical radio line from Hughes Electronics, including the AN/PRC 104 program in the early 1990s. The AN/PRC-104 remains a legacy Army program of record with full sustainment requirements.

As the military shifted focus to satellite communications, HF systems like the AN/PRC-104 were maintained but with limited fielding until renewed interest in BLOS systems emerged in 2008. The Harris HF Falcon II AN/PRC 150, a

dismounted manpack radio that fits into the AN/VRC 104 vehicle system, was acquired as part of the 2008 Army Modernization Strategy. Unlike the AN/PRC 104, the AN/PRC 150 is not an Army program of record and has minimal identified or supported sustainment requirements. It was purchased as a COTS solution to meet immediate modernization needs without updating the ROC. The COTS contract is managed by the U.S. Navy's project manager for portable communications. Current plans are to replace the AN/PRC-150 radio with the AN/PRC-160 radio because the AN/PRC-160 can comply with emerging security and encryption standards.

The Army has been using two products—the legacy vehicle mount and the Falcon II radio—to create a complete vehicle-mounted HF system. This reduced acquisition requirements, sped up fielding and kept costs low. While the radio is a COTS item, it met the immediate needs until the ROC could be updated. However, sustainment has been challenging due to contract limitations, and the radios are maintained under a five-year warranty with L3 Harris. As these radios begin to fail, the Army incurs additional costs for repairs.

The joint force has recognized the vulnerability created by over-reliance on SATCOM and underutilization of the HF spectrum. Military HF capabilities and programs of record have not significantly changed since 1982, except for COTS purchases. In February 2024, the DoD designated the Navy as the lead service for the high-frequency communications enterprise. The Navy is now providing the first ROC update since 1982 with the Army's Project Manager-Tactical Radio (PM-TR) under PEO-C3T representing Army interests. This update will ensure the development of HF voice and data communications systems in man-pack, command post and vehicle configurations for 2035 and beyond.

Through product development and system evolution, HF radios and AFATDS have gradually integrated; thanks to the deliberate analysis of system requirements and the foresight of technical leaders within the defense acquisition system. The FA tactical network relies on coordination between PEO-C3T, which manages the AFATDS and L3 Harris Falcon Radios (HF), and Program Executive Office Missiles and Space (PEO M&S), through Project Manager Strategic & Operational Rockets and Missiles (PM STORM), to ensure proper data

connection between AFATDS and rocket launchers (MLRS or HIMARS). This process also involves three other organizations for material support: CECOM for radio maintenance, Development Command (DEVCOM) for software solutions and Network Enterprise Technology Command (NETCOM) for troubleshooting and training.

At the tactical level, FA units using HF radios rely on support from CECOM, DEVCOM and NETCOM. Each provides specific expertise:

- *CECOM handles technical support for radio systems, assisting when radios or mounting systems malfunction.*
- *DEVCOM supports the connection between AFATDS and the radios, as well as the network setup.*
- *NETCOM provides HF training and troubleshooting, helping units develop institutional knowledge beyond initial training.*

These organizations are essential for maintaining strong HF capabilities in the field, and leaders must engage with their Soldiers during technical troubleshooting to understand the issues and coordinate external resources as needed.

The dual management of AFATDS (by Project Manager Mission Command) and HF radios (by Project Manager Tactical Radio) adds complexity to the effort to increase HF knowledge and skills within tactical units. Although efforts were made to synchronize the upgraded AFATDS with the Falcon III AN/PRC-160 radio (successor to the AN/PRC-150), challenges persisted, particularly with the compatibility between the software and port configurations of the AFATDS and the Falcon radios. Despite the capability of the Falcon II and Falcon III radios to communicate via voice and data, they require a deep understanding of the planning applications and network configuration.

Units receiving these systems on different timelines must now overcome the basic technical challenges of integrating two platforms to establish a functional fire support network. While program offices worked to ensure interoperability between new and legacy systems, the technical advancements have further complicated the understanding and use of AFATDS-HF systems.

Unfortunately, Soldiers receive little to no doctrinal training on these upgrades, leaving gaps in practical knowledge.

The acquisition process delivered as intended and rapidly provided a capability that met the emerging needs of units in the field. However, the methods used for integrating these communication capabilities have had mixed results, sometimes creating as many challenges as they solved. To improve sustainment and guide future upgrades or system replacements (during Phase V of the Defense Acquisition System, “Operations and Support”), there needs to be more deliberate collaboration between cross-functional teams (CFTs) and the program executive offices (PEOs).

## RECOMMENDATIONS

### *Preparing For Future Conflict:*

Soldiers train and fight based on the systems knowledge and experience acquired during their service. While the Universal Telecommunications Interface (UTI) is fast, reliable and secure in training environments, it might not offer the same advantages in combat against near-peer adversaries in contested space settings. The Army needs to enhance its understanding of future warfare, where adversaries can deny, degrade and disrupt command and control networks while maintaining the crucial objective of delivering timely and accurate fire support to the maneuver commander. By transitioning from near total reliance on space-based communications to a robust PACE communications plan, the Army can bolster its fire support network for combatant commanders.

The fire support network’s complexity is partly self-imposed, stemming from managing various acquisitions across programs of record (POR) and directed requirements (DR) and involving multiple program executive offices and cross-functional teams. Coordination between CFT-Long Range Precision Fires (LRPF) and CFT-Networks is essential to ensure that the new joint HF requirements document adequately supports the Army’s tactical fire support network.

To move away from legacy systems vulnerable to D3SOE and DDIL environments, institutional knowledge must be developed. Programs at the U.S. Army Training and Doctrine Command

(TRADOC) must sufficiently prepare Forces Command (FORSCOM) units to effectively employ HF radio systems. This is critical when software changes alter operational use, as the system may look the same but function differently. Mastery of HF system software is integral to the PACE plan and essential for sustaining the force’s capability.

NTC serves as the testing ground for electromagnetic spectrum analysis of friendly forces. During training rotations, units must apply HF systems with various software settings for both voice and data communications. Intensive use of different settings allows NTC to analyze electromagnetic emissions and provide crucial feedback on tactics, techniques and procedures for enhancing unit communications in preparation for LSCO.

### *Training Enhancements*

Army organizations must prioritize building readiness through continuous training to ensure units are prepared when called upon. To maintain readiness, units should focus on digital sustainment training to develop and maintain in-depth knowledge of HF systems. Developing expertise in three key areas is essential: radio systems (hardware), fire network operations (software) and system maintenance.

NETCOM conducts an annual high-frequency (HF) competition known as QRPX. This event also includes Army Military Auxiliary Radio System (AMARS) auxiliaries. The event gathers talented amateur radio enthusiasts across the Army, promoting friendly competition and allowing Soldiers to refine their skills and practices. Air Defense Artillery units frequently excel against Signal units, and Field Artillery Soldiers, particularly those in the 13J military occupational specialty (MOS), should be encouraged to learn HF theory and test their skills alongside the Army’s top Signal Soldiers. For more information, see: <https://www.usarmymars.org/home> and <https://oh8stn.org/blog/2021/04/10/qrpq-army-netcom-annual-hf-low-power-competition/>. Additionally, Signal students at advanced individual training (AIT) are briefed on other annual HF events they could participate in. Noble Skywave is sponsored by the Canadian Communications and Electronics branch of its military. It lasts three days during the last full week in October (see <https://nobleskywave.ca/index.php>). NETCOM’s low-power HF competition known as QRPX (always

a Thursday thru Saturday at the end of March) and NETCOM's July X event (at the end of July), a skills challenge event where operators grade themselves on 9-10 basic tasks an HF operator should know how to do.

If a unit wants to improve its unit's expertise in the use of HF communications, these are great ways to ramp up that skill level. Most units are unable to create the training rigor required to improve HF communications skills. These opportunities, generated by outside organizations with truly specialized expertise, are excellent ways to allow these low-density MOS Soldiers to become true experts in their field.

The AN/PRC-160 radios are coming and will be accompanied by a new equipment training (NET) program. This NET program is essential, but it is a one-time, "fire and forget" event. The program manager only conduct NET once for any unit receiving a new piece of equipment. That means that units must send their very best people to NET—Soldiers who are already highly competent in their specialty, who have the ability to learn quickly and who can pass their lessons learned to other Soldiers. Still, that knowledge is only one PCS away from disappearing. To maintain valuable expertise at the unit level, a knowledge and skills sustainment training program is essential. Otherwise, the radios will sit untouched in a supply room or a CONEX and not work reliably when needed because no one will know how to make them work.

### *Training to Fight Tonight:*

Understanding the interdependence between the S-6 and S-3 shops is crucial. The S-6 shop provides the necessary operational support while the S-3 shop directs missions. This collaboration is vital for effectively employing combat systems. HF communications are covered in the FA or Communications schools but not in great depth. Soldiers in the 13 and 25 series need to train together so they can work effectively during operations. These Soldiers must build expertise through individual training and unit exercises to ensure readiness. Each MLRS and High Mobility Artillery Rocket System (HIMARS) unit should clearly define the roles and responsibilities of the S-6 and S-3 shops to align MOS expertise with their specific skill sets. The aim is to integrate this expertise and maintain a sustainable mission

focus, with section training certifications by echelon to verify and document proficiency levels.

The S-6 team is responsible for providing communication security (COMSEC), HF plans, frequency management and the PACE plan to support adjacent staff sections and subordinate commanders. Within the main command post, they establish mission command systems that coordinate with higher headquarters, provide a mission command standard operating procedure and offer troubleshooting support. If external assistance is required, the CECOM logistics assistance representative (LAR) is the primary resource for the S-6 team while NETCOM can offer additional technical support via phone but supplements CECOM's on-ground capabilities.

The fire direction center takes charge of establishing a fire support network with higher headquarters, delivering a digital fires SOP, meeting the five requirements for accurate fire and ensuring system maintenance. Subordinate batteries carry similar responsibilities at their respective echelons. The U.S. Army Combat Capabilities DEVCOM smart lab team is the primary resource for 13 series Soldiers to maintain the fire support network from the AFATDS to the launcher.

Battalions should integrate command maintenance and digital sustainment training into their routine battle rhythm to maintain critical radio systems. Command maintenance involves performing preventive maintenance checks and services (PMCS), allowing soldiers to verify equipment functionality and request necessary repairs. It also provides an opportunity to inventory and test radio components. During command maintenance, inviting a CECOM representative can aid the S-6 and electronic maintenance (ELM) teams in routine system upkeep.

Digital fire sustainment training (DFST) allows the organization to test the fire support network and validate software necessary for fire mission processing. Due to burn rights, imaging and program updates, both AFATDS and radios must be routinely checked to ensure the installed programs and applications are up to date and validated through fire mission processing. Units can deploy to the field with confidence that the system's hardware and software are fully mission-capable and ready for operational deployment. DFST is an excellent opportunity to coordinate for the



DEVCOM smart lab representatives to be present for training and provide on-the-spot in-person support for fire support network issues.

Go to the field and turn off all FM radios. Bring out representatives from the three support organizations (CECOM LAR, DEVCOM smart lab and ELM team) and troubleshoot the systems until the unit's team is fire mission capable and can certify over HF. As part of training and certification standards, units should verify initial operating capability (IOC) and full operating capability (FOC) about the unit's ability to employ fires in a degraded environment. A suggested standard is that IOC units operate effectively on UTI and FM. FOC units should conduct fire mission processing on HF as well. While in IOC, units would be more susceptible to jamming and targeting compared to FOC units. FOC is the goal, with the ability to operate effectively in contested domains using all the elements of a well-designed and practiced PACE plan.

## CONCLUSIONS

SATCOM remains the most reliable and easy to use communications system from the operator's perspective. UTI on the SATCOM backbone is almost plug and play from the operator's perspective because the complexities are handled by a virtual army of experts in network and satellite communications. Using VHF and LTI require a higher level of local and unit-level skill, but they provide a good alternative to SATCOM/UTI when LOS communication is sufficient. HF communication is an excellent backup, but the level of unit-level and operator expertise to make these systems work reliably requires a quantum leap in unit and operator level expertise. To make HF communications a reliable "C" in the unit's PACE plan will require dedicated effort to focus training to the unit level along with support from NETCOM, DEVCOM and CECOM.

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*Dr. Thomas E. Ward, II, recently retired as a Professor of Practice, after seventeen years on the faculty at the US Army Command*

*& General Staff College. He holds a Bachelor of Science from the University of Oklahoma, an MBA from Florida Institute of Technology, and a PhD in Organization and Management from Capella University. He spent twenty-six years on active duty, in Infantry, Transportation, Ordnance, and Military Police assignments. He will tell you it was a delight to collaborate on this article with MAJ Mehle. "True success as a teacher comes when the student becomes the teacher." (Thanks, Roger, great work.) Researching this article prompted Dr. Ward to earn his Technician and General amateur radio licenses from the Federal Communications Commission (KForWS). New tricks for an old dog; a lifelong learner to the end.*

## References & Research

BING Query results, 20230315

QUERY: What are the advantages of an HF packet? Include references.

1. **Long Range:** HF (High Frequency) signals can travel long distances due to their ability to bounce off the ionosphere. This makes HF packet suitable for global communication, especially in remote or challenging terrains.
2. **Low Power Requirements:** HF packet can operate effectively with relatively low power levels. This is advantageous for portable and emergency communication scenarios.
3. **Robustness:** HF packet is less susceptible to interference from noise, weather conditions, and other factors compared to VHF or UHF frequencies. It remains reliable even in adverse conditions.
4. **Standardization:** The use of standardized protocols (such as AX.25) ensures compatibility across different HF packet systems. This facilitates interoperability among various radio stations.
5. **Data Modes:** HF packet supports various data modes, including text messaging, file transfer, and telemetry. It allows for versatile communication beyond voice.
6. **APRS (Automatic Packet Reporting System):** APRS, a popular application of HF packet, enables real-time tracking, weather reporting, and emergency alerts. It has widespread adoption in amateur radio communities.

While HF packet has its advantages, it also has limitations, such as slower data rates and the need for specialized equipment. However, for certain use cases, it remains a valuable communication mode.

## Above References:

The HF Communications Renaissance | L3Harris® Fast. Forward.

## Learn more

<https://www.l3harris.com/newsroom/editorial/2021/08/hf-communications-renaissance>

## ENDNOTES

<sup>1</sup> CALL Handbook No. 18-28, Operating in a Denied, Degraded, and Disrupted Space Operational Environment. Center for Army Lessons Learned. June 2018.

<sup>2</sup> "HF Radios Make a Comeback and Enable Global Command and Control," The Modern Battlespace, Collins Aerospace. Accessed August 28, 2024 at: <https://modernbattlespace.com/2020/03/05/hf-radios-make-a-comeback-and-enable-global-command-and-control/>