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The Future of Air-Ground Integration: Linking Sensor to Shooter in the Deep Fight

By Captain Pablo Kruger, USAF, Captain Michael Molinari, USAF, and Captain Benjamin "TOD" Baumann, USAF

Victory in future combat will depend less on individual capabilities and more on the integrated strengths of a connected network available for coalition leaders to employ…What I'm talking about is a fully networked force where each platforms sensors and operators are connected.

– General David Goldfein

Background

As the National Defense Strategy guides the Joint Force towards an environment of great power competition and defending the nation against near-peer adversaries, the concept of joint all-domain command and control (JADC2) has become the cornerstone to unifying networks, sensors, and weapon systems to distribute information across services, commands, decision makers and warfighters. JADC2's core aim of rapidly translating decisions into action to achieve operational and information advantage in conflict applies to all the warfighting functions, and it is particularly prescient to joint fires.[1] The Joint Force's ability to move, maneuver, and control territory will continue to rely heavily on joint fires to create conditions that provide the supported commander freedom of action.[2] However, in order to keep pace in an operational environment, where adversary weapon systems present advanced capabilities and ephemeral windows of targetable vulnerability, joint fires must maximize connectivity across the Services and across disparate platforms to achieve that goal. On the modern battlefield, it is increasingly crucial to arm weapon systems with actionable data to achieve effects in a constrained amount of time.

The key to achieving actionable JADC2 in the nearest term is by leveraging existing command-and-control (C2) structures and linking key systems across Services. The protracted acquisitions processes of yesteryear, often fragmented along Service-specific initiatives, are not nimble enough to meet the timeline requirements or scale necessary to unify established weapon systems across the Department of Defense (DoD). Here's the good news -- the solutions needed to achieve interoperability across

disparate systems and waveforms are in development by warfighters at the tactical edge of the fight; indeed, where this innovation is most in need. Multi-domain solutions such as the *Automated Tactical Targeting and Counter-fire Kill-chain System* (ATTACKS) link sensors to shooters by transforming the speed and manner in which information can reach a fires platform to deliver effects. These proven technical successes are the way forward in realizing JADC2 for joint fires, and the Air Force's Tactical Air Control Party (TACP) is uniquely situated to maximize this advancement. As the principal air liaison element collocated with United States Army ground maneuver units, the TACP have the capability and connectivity to leverage air-component and ground-component networks, sensors, and weapon systems to inform decisions, shorten the kill-chain, and increase the lethality of joint fires.[3]

The Automated Tactical Targeting and Counter-fire Kill-chain System: **Linking Sensor to Shooter**

Linking sensors to shooters to expedite decisions and maximize lethality is one of the key lines of effort in the DoD's JADC2 initiative.[4] The idea of linking sensors to shooters is a broad concept in an enterprise as large and technologically diverse as the DoD. Yet, the joint fires team of United States Forces Korea have developed a concrete solution that meets the challenges of that particular operational environment. Pioneered by the 25th Fighter Squadron (FS) and 210th Field Artillery Brigade (FAB), ATTACKS originated as a solution to a shared tactical problem within the Korean Theater of Operations – the significant and elusive long-range artillery (LRA) threat aimed at the greater Seoul metropolitan area.

Both units are tasked by their respective components with finding and neutralizing the LRA threat, and each do so utilizing their respective Service's C2 architectures. On the Army side of the counter-fire mission, 210th FAB will rely on the Advanced Field Artillery Tactical Data System (AFATDS) to receive actionable targeting data generated by the Q-53 Counter-fire Target Acquisition Radar to disseminate fire missions down to the firing units. On the Air Force side of the counter-fire mission, aircraft will fly missions utilizing tactical data links (TDL); specifically, Situational Awareness Data Link (SADL) and Link-16, to create a common air picture, communicate among users, and allow for C2. The A-10s of the 25th FS will take off with target areas of interest to search for enemy activity and the Army's Q-53 radar's target point-outs will be relayed to the aircraft during ingress. However, the service-specific C2 architectures in this phase become a speedbump in the overall joint mission execution.

With no effective solution to seamlessly bridge information across the TDLs and AFATDS, targeting information generated by the Q-53 radars is relayed up the communications chain to the first headquarters echelon that has both air and ground component C2 nodes. After traversing multiple wickets via digital data, chat, and voice, the information is finally reported to the aircraft flying the mission with substantial delay. Even with the optimistic assumptions of connectivity at each C2 element and the

undivided, error-free attentiveness of the C2 operator, all those manual actions – chat transfers, voice relays, and cockpit inputs – require time. Time is the most significant constraint when targeting enemy systems that train to employ and displace to a covered position as quickly as possible. The longer it takes for targeting information to reach the tasked aircraft, the more the efficacy of that information degrades.

Understanding the targeting information already exists on one C2 domain and the need to get it onto another to expedite the kill-chain is the foundation of ATTACKS. At the heart of ATTACKS is Sierra Nevada Corporation's (SNC) Tactical Radio Application Extension (TRAX) software. TRAX is able to bridge information across domains and waveforms though its ability to understand and communicate across multiple military standard communications protocols. In the case of the Korean counter-fire fight, TRAX is able to take the Q-53 radar's variable message format (VMF) K-series targeting data messages and broadcast J-series messages on the TDLs so that aircraft may receive them. A terminal loaded with TRAX, with a connection to an AFATDS terminal and TDL connectivity, is able to bridge information from machine-to-machine on its respective waveforms much quicker and with greater volume than any current manual relay procedure.

Expanding on that capability, the collaboration by the 25 FS, 210 FAB and SNC resulted in what makes ATTACKS so effective – its ability to automate the process. Through continuous refinement, the ATTACKS team has automated the handoff of the targeting information from the Q-53 radar to the A-10, while providing analysis in order to confirm target selection standards and not over saturate the link. In a nutshell, the ATTACKS terminal recognizes each Q-53 radar K02.9 target data message, filters out messages that do not meet the established targeting parameters and generates a J3.5 message that populates in the A-10 pilot's display. This provides the pilot with the fastest real-time targeting data and increases the probability of completing the kill-chain before the enemy LRA can displace in to reinforced underground facilities.

In addition to significantly shortening the kill-chain compared to the current standard, ATTACKS also a demonstrated capability that would not be possible with the established C2 procedures. Similar to other air-ground kill-chain tests conducted around the DoD[5], the A-10s sent digital fire missions to the 210th FAB's Fires Cell. More than just a proof of concept, this particular technique could prove useful in the counter-fire fight. A flight of A-10s, out of ordnance, could identify and nominate a large target set ideal for artillery as the flight egresses the battlespace. Moreover, this provides surface fires with a sensor that can identify targets prior to enemy actions. Whereas, the Q-53 radar can only provide reactive targeting data once the enemy has started shooting; ATTACKS affords commanders pro-active options in opposing enemy freedom of action. In this inverse target handoff, the ATTACKS terminal would recognize the J12.0 mission assignment message from the A-10 and send it as a K02.4 fire mission

message to the appropriate AFATDS terminal for approval by the fires cell. Again, this automation eliminates the need for manual actions such as voice call-for-fires and manual data inputs.

Beyond automating target handoff, ATTACKS provides ground users with a great deal of situational awareness. Most notably, ATTACKS is capable of presenting information in cursor on target (COT) protocol, allowing the widely utilized Windows Tactical Assault Kit (WinTAK) to display a common tactical picture. This gives users the ability integrate imagery, KMZ files, and battlefield graphics to the TDL picture in a familiar user interface. Link user information, such as precise participant location and identification, sensor points of interest, and J12.6 target sorting messages give the ground user an understanding of where aircraft are within the airspace and what action the aircraft is currently taking. Additionally, call-for-fire, close air support (CAS) 9-Line and free text WinTAK plug-in tools allow the ground user to provide the fires team with additional targeting information and/or correlation. All these features build upon the automation of ATTACKS and allow for a “man on the loop”[6] to build situational awareness amongst all fires players and provide additional fidelity to the automated information transfer.

ATTACKS is a capability. ATTACKS is JADC2. It introduces connectivity to the systems, networks, and waveforms that host the information that drives our kill-chains and pulls the slack out of our unintentionally convoluted C2 structures. Its ability to facilitate machine-to-machine transfer of information maximizes speed and minimizes the potential for operator error. The next step is taking its core capabilities and applying them to other sensors and shooters in different contexts in order to continue the effort towards a fully networked force.

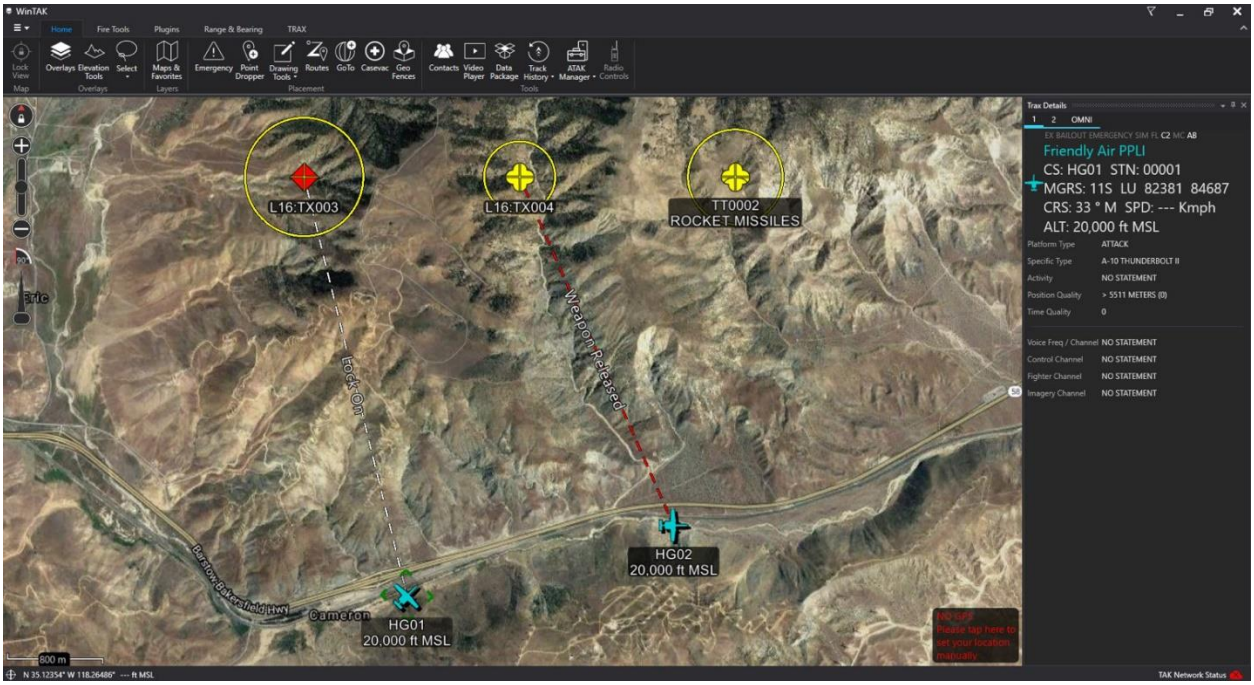

Figure 1. ATTACKS WinTAK plugin displaying hostile and suspect J3.5 land tracks and 2xA-10's J12.6 targeting messages. Photo by Ryan Romanowski.

Shaping the Deep Fight

Much like our service-specific datalink architectures, the services have their own enclaves of operational culture, language and tempo. Providing the connective tissue which allows the air component to synchronize counterland operations with the land component's objectives and maneuver forces, the Air Force's TACP have developed into leading air-to-ground integrators and joint fires experts. From the initial stages of the planning process to providing terminal attack control, the TACP advise the targeting team and drive the kill-chain. The TACP are uniquely situated to leverage air component and ground component networks, sensors, and weapon systems to inform decisions, shorten the kill-chain and increase the lethality of joint fires.

This access to the joint fires assets makes TACP's interface between the U.S. Army and Air Force a natural setting to expand the use of ATTACKS. More specifically, given the benefit of speed granted by the automation, the application of ATTACKS to shaping the deep fight is arguably where it is most advantageous. The automated linking of sensors to long-range surface-to-surface fires and air-delivered fires might be the best way to disrupt the enemy's movement in depth, destroy HPTs, and disrupt enemy C2at range,[7] before the enemy can employ effectively.[8] In fact, the A-10s LRA fixated counter-fire mission in the Korean Theater of Operations is a hyper-focused type of air interdiction (AI).

Key to capitalizing on this capability will be proper fire support coordination measures (FSCMs) and airspace management to ensure safety of flight for aircraft and facilitate the responsive fires that the automation allows. Without these details, the speed advantage of ATTACKS will be negated by having to clear blue air before each fire mission. Also, still applicable is the cross-component coordination needed to ensure air interdiction sorties are requested and/or available when needed to support an ATTACKS-enabled fires cell or if shooting long-range surface fires beyond the fires support coordination line (FSCL) in support of an air component target.

The application of ATTACKS is scalable to the needs of the users. The specific Korean Theater mission has been successful in bridging the A-10s and 210 FABs fires assets as previously detailed, and in early 2021, the XVII Airborne Corps conducted a live-fire demo supported by A-10s, F-35s, M142 High Mobility Artillery Rocket System (HIMARS) and AH-64s. This flexibility informs how to think about its applicability when it comes to use with TACP.

Maximizing the JAGIC

The natural place to start thinking about how TACPs can utilize ATTACKS is within the TACP's traditional army-aligned employment. At command posts from corps to battalion, the TACP are a vital cross-component link that advises and assists ground commanders. With CAS in support of maneuver forces being the more likely mission set at lower echelons, the division is where the TACP can have an impact on the deep fight by leveraging access to the sensors and weapons systems available to an Army division.

As the senior tactical echelon, the division has the highest degree of connectivity to fires assets operating within its battlespace; especially, when its joint fires team is organized into a Joint Air Ground Integration Center (JAGIC). Through digital, voice, and TDL communications capabilities to include beyond line of sight (BLOS) reach, the Air Support Operations Center (ASOC) allows for the distribution of a common tactical picture up the chain to the Joint Air Operations Center (JAOC) and down to the air assets executing the mission. Likewise, the Division Fires Cell has the ability to employ the division's organic fires systems, receive information from counter-fire radars, and monitor AFATDS to supervise the status of fire support assets. Combined with the additional airspace situational awareness provided by the Tactical Airspace Integration System and the Air Defense Systems Integrator, all these systems provide the JAGIC's joint fires supporters access to the principal sensors and weapon systems at the division's disposal.

Yet, despite containing these many **digital systems**, the JAGIC relies on **manual actions** by its members – either through tactical chat or vocal call outs to execute its many processes. In most instances, these actions are beneficial for quickly building situational awareness across the JAGIC staff and for initiating critical battle drills that

require parallel actions from multiple participants. However, when considering the wealth of sensors and shooters available to the JAGIC, lack of interconnectivity between systems makes manual data transfer the default method for target handoff, ultimately slowing down the kill-chain. To be clear, ATTACKS is not going to solve or sort the chaos of a fully engaged JAGIC managing a division fight. There are, however, efficiencies to be gained in some aspects of the JAGIC's operation.

The division TACP will support the JAGIC with a joint terminal attack controller to facilitate CAS engagements and an interdiction coordinator (IC) to track the execution of AI missions inside the division area of operations[9]. The latter is where ATTACKS makes it money at the division level. By automating counter-fire acquisitions handoff from the JAGIC's AFATDS to the TDLs, the JAGIC is able to push real-time targeting information to the aircraft flying AI or strike coordination and reconnaissance (SCAR) in or near the division's airspace. It is important to note that AI and SCAR tasked aircraft will have assigned joint integrated prioritized target list priorities tasked to each mission by the air tasking order.[10]. The automated J3.5 land track is not a tasking to the AI/SCAR aircraft, rather it is an assist in starting the kill-chain in line with the assigned mission. When establishing parameters for the message forwarding automation in ATTACKS, it is possible to create analysis filters so that forwarded J3.5 land tracks fall in accordance with already established target priorities. Combining this capability with the IC's ability to establish and manage kill boxes[11] in the division's battlespace and air asset management provides the JAGIC with a more responsive and effective way to employ AI in support of the division.

ATTACKS also enhances the division's ability to service surface fires beyond the FSCL. With the capability to understand aircraft-derived fire missions and forward them to the AFATDS in the corresponding format, the JAGIC can receive Joint Force Air Component Commander acquired fire missions for HIMARS from sensors well past the FSCL. Of course, the necessary cross-boundary and airspace coordination will apply, but if those details are deliberately coordinated prior, the execution of the kill-chain could potentially be as fast as the machine-to-machine target handoff allows.

The synergistic qualities of ATTACKS maximize the existing capabilities already present in the JAGIC. It allows for quicker dissemination of targeting information and speeds how responsive joint fires can be in the division fight. By incorporating ATTACKS into its arsenal of systems, the JAGIC has the potential to be a more lethal clearinghouse for joint fires.

Modular Deterrence

Figure 2. A U.S. Tactical Air Control Party Airman assigned to the 2nd Air Support Operations Squadron, Vilseck, Germany, jumps out of a C-130J Super Hercules over Kiruna, Sweden, prior to Exercise Cold Response 20, Feb. 27, 2020. Photo by Staff Sgt. Devin Boyer.

As combatant commands look to approach a near-peer operational environment with a more agile and flexible force,[12] it's astute to think of ways in which TACP can utilize its joint fires and communications capabilities in a less-than-traditional construct. Short of large-scale combat operations in Phase III of a joint operation,[13] perhaps mobilizing an entire a division headquarters and/or multiple brigade combat teams in not the posture most suited to resiliently deter or rapidly seize the initiative.[14] A modular force, comprised of maneuver, fires, sustainment, etc., tailored to meet the challenges of a contested, hybrid operational environment could be the answer that meet combatant commanders' needs.

Given the advancements in communications capabilities and precision-strike expertise, the TACP are, again, uniquely situated to meet the challenges in this context. In addition to an established package that allows for secure line of sight (LOS) and BLOS comms, the fielding of hand-held Link-16 (HHL16/PRC-161) and Move-Out Jump-Out (MOJO) gateways among others will exponentially increase the TACPs ability to integrate with link users and expand situational awareness across the chain of

command from the edge of the battlefield. All the capabilities previously described as available to the JAGIC will become scalable and employable in a more agile construct with the fielding of these capabilities. This is in large part due to newer equipment's scaled down form factors providing a much smaller footprint than previous equipment. The HHL16 radio is man-portable and allows for dismounted maneuver forces to communicate on Link-16. Similarly, the MOJO variants are small enough to be easily mounted in the back of tactical vehicle and enable BLOS, Link-16, and SADL TDL options. Previously, this type of connectivity was only available to the TACP at the ASOC; now that connectivity is available at the tactical edge of the battlefield. This opens the possibilities to how TACP can be organized to support a tasking and increases their utility on the battlefield.

The highly mobile nature of these capabilities provide the TACP the agility and reduced footprint required in contested battlespaces and austere conditions such as the Arctic. Employed in support of a modular force construct, a team of TACPs could create an overlapping network that extends the TDL across hundreds of miles and is able to extend that common tactical picture back to JAOC through joint range extension application protocol-C. The flexibility to facilitate joint fires close and deep while maintaining situational awareness of the friendly ground and air pictures is a distinct benefit of these communications advancements. Targeting information could be relayed to inbound fighters well outside of LOS communications prior to checking-in to conduct CAS missions and to higher authorities for targeting.

The application of ATTACKS is this context does not change. The capability would continue to provide automated machine-to-machine target handoff. Where this application becomes particularly impactful is in the prosecution of elusive targets deep in a contested battlespace. Given the distance that TDL-enabled TACP can receive J-series targeting messages and the range of Army long-range precision fires as well as air-delivered stand-off munitions, the amount of battlespace in which a modular fires force could facilitate effects provides commanders with an agile deterrence force. Additionally, TACP utilized as a forward reconnaissance element provide an all-weather, low-observable sensor with the ability to leverage joint fires at considerable range through relays and BLOS reach back. At the most recent ADRIATIC STRIKE exercise, TACP from the 2 Air Support Operations Squadron conducted a TDL-only dynamic targeting cycle that resulted in a SMACK tasking from the appropriate authority and a simulated Joint Air-to-Surface Standoff Missile employment on a modern surface-to-air threat[15].

In that same line of thinking, ATTACKS would provide TACP the connectivity and information exchange with modular fires cell's AFATDS and supporting surface-fires weapons. A TACP observer leveraging the TDL's range and ATTACKS ability to automate the message format transfer could at great distance request surface fires from

fire direction center co-located with an ATTACKS terminal. In addition to being a ground sensor, TACP will be able to facilitate target handoff between sensors and shooters at the edge of the battlespace. Airborne sensors searching for priority targets in a contested battlespace could seamlessly send targets through the ATTACKS-enabled TACP to surface-fires assets.

The possibilities in which sensors and shooters are employed are growing continuously as units experiment with solutions to the challenges of the modern battlefield. Recently, Air Mobility Command loaded a HIMARS launcher onto a C-17 Globemaster III, relayed targeting information the launcher mid-flight, and, upon landing, the HIMARS launcher exited the C-17 ready to fire[16]. It is entirely within the realm of possibility that a net-enabled TACP reconnaissance team at the edge of the battlefield could be the source of that HIMARS' targeting information or the relay node through which that message transfer happens. The key to realizing the potential the TACP have as precision-strike experts is leaning into the experimentation that explores modular employment and finding what does/does not work. By capitalizing on the fielding of new equipment, emergent waveforms, and the ability ATTACKS has to connect weapon systems, the TACP are ideally situated to provide a networked joint fires capability to the joint force.

Figure 3. Over-snow reconnaissance vehicles and sleds being loaded onto a C-130 in preparation for deep precision strike operations during COLD RESPONSE 20 in Bardufoss, Norway. Photo by Staff Sgt. Devin Boyer.

Conclusion

Within the scope of the Korean Theater of Operations, the ATTACKS team has significantly shortened the kill-chain and increased the lethality of each sortie looking to extinguish the LRA threat to Seoul. In a broader scope, the ATTACKS team's endeavors have created a joint fires capability that illustrates the path forward in bridging the connectivity gap among sensors and shooters on disparate datalink architectures. As the application of this nascent capability continues to refine and grow, it will begin to incorporate more sensors, more weapon systems and even intel mIRC chats. As the progression happens, it will be important to apply critical thought to where and how this novel capability can improve our connectivity and processes. Through training, deploying, and fighting beside the Army, the TACP have established an ability as an enterprise to translate from Army to Air Force, and vice versa. Incorporating ATTACKS into the TACP's toolbox has the potential to extend ability into the digital realm, while increasing our lethality as joint fires experts in the process.

Captain Pablo Kruger and Captain Michael Molinari are TACP Officers assigned to the 2nd Air Support Operations Squadron and 607th Air Support Operations Group, respectively. Captain Benjamin "TOD" Baumann is an A-10 pilot assigned to the 422nd Test and Evaluation Squadron.

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