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SUPPRESSION OF ENEMY AIR DEFENSES (SEAD) BATTLE TRACKING CHALLENGES IN CONTESTED ENVIRONMENTS

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THE EXERCISE-EXPERIMENT (E-E): A NEW REALITY

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LESS IS MORE

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THE FUTURE OF AIR-GROUND INTEGRATION: LINKING SENSOR TO SHOOTER

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Air Land Sea Application Center

BATTLESPACE JOURNAL

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DIRECTOR'S COMMENTS

For over 46 years, the Air Land Sea Application (ALSA) Center has synchronized the capabilities of all Services to provide fast, credible, and effective tactical doctrinal solutions to meet the needs of the warfighter. Today, as we leverage the opportunities born from the challenges of executing our mission under pandemic conditions, our team demonstrates that positive change is possible under the most trying of environments.

The Battlespace Journal (BSJ) you're reading is proof of that change. Previously, this publication was referred to as the Air Land Sea Bulletin (ALSB). However, as the joint force expands domain interoperability efforts, we found it necessary to change the name to something that encapsulates the totality of the joint operational and tactical fight that reflects the academic quality of articles submitted for publication. As far as the traditional ALSB is concerned, we decided to return it to its origins—as an update to the Services concerning ongoing events/publications—and have included it in the last pages of the Battlespace Journal.

In this inaugural edition of BSJ, you will find new articles on the suppression of enemy air defenses, close-air-support game plans, multi-Service coordination for the deep fight, and the use of exercises to enable future modernization and readiness. Additionally, we have included two articles from our archives that remain relevant today. One discusses the direct air support center and the other provides some background on the development of the kill box concept.

As we tackle changes and challenges to our global operating environment, we rely on your experience, ideas, and insights to keep our warfighting edge honed. Please help us by representing your Service and the joint community by preparing relevant articles for viewing on our website and in Battlespace Journals. Your unique perspectives shape the innovation of current and future joint tactics, techniques, and procedures—making us all better.

Habilis, Credibilis, Celeritas!

IAN S. BENNETT, Colonel, USA

Director

AARON W. CLARK, Colonel, USAF

Deputy Director

New Team Members: We welcome LTC Adam Stine (USA) as the new chief of our Command and Control (C2), Cyber, and Space Branch; and, LTC Andy Brown (USA) and Maj Jared Towles (USMC), who will join our Air and Sea Branch this summer.

Farewells: We extend a special farewell and thank you to our Editor, Ms. Patricia Radcliffe, who retired after over 41 years of faithful civilian service. Also, we say farewell to LTC Ethan Loeffert (USA), who takes command of the US Army Priority Air Transport Battalion at Andrews Air Force Base (AFB), Maryland; and Maj John Bradley (USMC), who will serve as the Operations Officer of the 2nd Air Naval Gunfire Liaison Company (ANGLICO) at Camp Lejeune, North Carolina.

SUPPRESSION OF ENEMY AIR DEFENSES (SEAD) BATTLE TRACKING CHALLENGES IN CONTESTED ENVIRONMENTS

A U.S. Air Force B-2A Spirit assigned to the 509th Bomb Wing at Whiteman Air Force Base, Mo., and a Royal Netherlands Air Force F-35A Lightning II conduct aerial operations in support of Bomber Task Force Europe 20-2 over the North Sea, March 18, 2020. Low Observable aircraft like the B-2A and F-35A are critical in Suppression of Enemy Air Defense (SEAD) operations. Photo by MSgt Matthew Plew, USAF.

By Maj Evan G. Fillman, USAF

INTRODUCTION

The offensive counterair-SEAD campaign is central to joint air forces achieving effects in the contested and degraded operations (CDO) environment.[1] (For brevity, offensive counterair-SEAD will be referred to as SEAD hereafter.)

SEAD efforts create localized air superiority through avoiding, suppressing, or destroying the enemy's integrated air defense system (IADS). The ability to achieve effective SEAD grows in complexity with the advancement of enemy systems and countertactics. The next evolution of automated battle tracking systems offers an opportunity to aid warfighters in tackling these evolving SEAD tactical problems.

This article aims to identify tactical challenges in SEAD and suggests potential remedies for inclusion in next-generation, battle-tracking software suites.

There is a groundswell in ideation and development of automated battle-tracking systems backing the move to Joint All-Domain Command and Control (JADC2) and acquiring the Advanced Battle Management System.[2] Some use artificial intelligence and machine learning as panaceas for complicated data fusion problems. However, current paradigms require humans to design automation software solutions based on concrete problem sets. Hence, the warfighter must continue to deliver concrete requirements to defense contractors to produce software that aids warfighters in achieving desired effects by optimizing decision quality.

This article focuses mainly on SEAD against surface-to-air threats in a CDO environment. This focus is not meant to ignore other aspects of SEAD (such as air-to-air engagements) but to provide anecdotes in a familiar context. The theory backing many of these concepts applies across various mission sets, throughout the all-domain spectrum, including the primary mission SEAD may be supporting. This article begins by reviewing the SEAD battle tracking process and identifying SEAD battle tracking challenges. Then, it distills each challenge into an area where automation could aid the warfighter. Finally, it suggests solutions that may assist in rethinking SEAD battle tracking with automated human-machine teaming.

THE SEAD TACTICAL PROBLEM

The core tactical problem in SEAD is opposing observe, orient, decide, and act (OODA) loops described in joint doctrine and multi-service tactics, techniques, and procedures. Opposing forces compete to identify, locate, intercept, and relegate the opponent forces as quickly as possible.[3] The friendly SEAD forces attempt to render the enemy IADS ineffective to enable a reduced-risk environment for friendly operations. The dynamic targeting loop of find, fix, track, target, engage, and assess (F2T2EA) drives this process.[4]

Each entity in the IADS receives an instance of the F2T2EA process. The sum of all entities, in an IADS, results in the battle tracking, common operating picture (COP) of the enemy's IADS.[5] SEAD battle tracking, in this context, tracks target entity progression throughout the F2T2EA process. Then, effective SEAD battle tracking enables forces to make decisions to avoid, suppress, or destroy the enemy IADS in concert with multiple F2T2EA loops.

The enemy acts to complicate the friendly SEAD solution by using countertactics. The enemy learned to employ countertactics (such as limiting radiation, or employing mobile or passive shot doctrine, or using camouflage and deception) to increase their effectiveness. This implies, these tactics aim to reduce the effectiveness of friendly SEAD efforts.[6] Each of these countertactics increases the complexity of effective battle tracking thereby increasing the risk to mission objectives.

The complex nature of SEAD battle tracking leads joint forces to create a COP of the enemy IADS to share across the force. The central problem becomes keeping the COP as accurate as possible to enable friendly operations and effective follow-on SEAD. Friendly forces will attempt to use all available sensors to maintain accuracy of the enemy IADS threat picture from mission planning through engagement and assessment. Many tactical challenges associated with IADS updates arise from the concurrent dynamic targeting and battle tracking processes.

Many tactical challenges associated with IADS updates arise from the concurrent dynamic targeting and battle tracking processes.

The battle tracking COP is, simultaneously, a powerful and a dangerous tool for SEAD operations. Any COP, inherently, contains errors associated with limitations on how data is presented for interpretation. An air COP creates the potential illusion of truth data and, inevitably, leads to a confirmation bias from its users. Virtually all COPs contain issues associated with data concurrency, including false positives, false negatives, and inaccurate or missing data. A false positive, showing a threat is present that is not, forces resource allocation and incorrectly raises the risk to force for friendly forces. A false negative, not showing a threat that is present, incorrectly lowers the risk to force and, possibly, allows the enemy an asymmetric advantage. Any threat COP is probabilistically correct. There is a chance that the data displayed on the COP is correct, or the real world has changed, the COP has not been updated, and the COP is incorrect. The seams between COP (battle tracking) truth and reality truth are the places to identify the root causes of many of the tactical challenges for SEAD battle tracking.

The IADS battle tracking COP begins with an intelligence estimate of the enemy IADS. The intelligence estimate products are known as the electronic order of battle (EOB), the defensive missile order of battle (DMOB), and the air order of battle.[7] These orders of battle are used for mission planning and as starting points from which informed updates can occur. Friendly forces also use intelligence estimates to assess the pre-mission risk to force.

A proactive approach to battle tracking and managing the F2T2EA process for each entity on the orders of battle can address many of the following tactical challenges and lead to more effective SEAD.

The enemy will act to complicate the friendly SEAD solution using countertactics, which manifests as tactical challenges to friendly SEAD forces.

The enemy will act to complicate the friendly SEAD solution using countertactics, which manifests as tactical challenges to friendly SEAD forces. These challenges may occur at any point in the F2T2EA process. Additionally, these challenges point to prospective functional areas for automation and human-machine teaming.

FALSE NEGATIVES

Tactical Challenge 1: A lack of emissions does not equal "killed" or "off".

The core challenge is the enemy has learned radar emissions can give away their position. SEAD forces must ensure they do not translate a lack of emissions into being killed or powered off (for a threat system). A system that is off, but not dead, still presents a potential threat because it can turn on at any moment. However, for systems requiring active radiation to function, being off achieves partial SEAD success. Furthermore, friendly sensors may not be in an adequate position or have the capability to collect a particular type of emission even if the system is emitting. Therefore, time since last emissions may be misleading. Removing a threat based on a lack of emissions may lead to a false negative.

Tactical Challenge 2: IADS stimulation does not equal 100% stimulation.

There is a danger in assuming efforts to stimulate an IADS (get the enemy to turn on their radars) will be 100% effective. This means, when threatened, enemy air defense operators will want to radiate in self-defense. SEAD forces must not rely on an assumption that their efforts to stimulate the IADSs have succeeded to a certain threshold. Tactics used to encourage stimulation may not succeed. Assuming a threat is not present based on a lack of emission, may lead to a false negative.

Tactical Challenge 3: The engagement does not equal killed (yet, may appear so, temporarily).

If a threat is engaged, how does the SEAD package know it had a successful engagement? A weapon's timeout does not equal a kill. Forces must be cautious to ensure they do not translate an engagement into a kill until the assessment process is sufficiently complete and meets the commander's risk threshold. Using standoff weapons in situations where the employer is unable to observe impact is an example of the need for a deliberate assessment step on employment effectiveness. A bomb hit assessment (BHA) by tactical units may provide initial indicators of effects, but a further battle damage assessment by intelligence personnel takes time.[8] Further complicating matters is whether forces employ a temporary effect. Removing a threat that has only been engaged but not assessed, or temporarily engaged, may lead to a false negative. An inaccurate assessment can lead to a false positive if BHA assessed a miss but effects were achieved.

FALSE POSITIVES

Tactical Challenge 4: Is there a new (surprise) threat?

Once operations commence, it is difficult to decide if there is a new threat that was not previously known or forecasted. A certain threshold of data must be met to add a new threat to battle tracking. Not adding a threat or adding a threat too quickly can negatively affect friendly planning and execution accuracy. Adding a threat without sufficient confirmation can lead to a false positive.

Tactical Challenge 5: Has a threat moved?

Extending from the last challenge is determining if a threat is new or has moved. Data precision must correlate to some change-reporting threshold. If a threat has moved a small distance, the battle tracking may correlate the data to a previously estimated position when, in reality, the threat has moved. A threat that moved but was correlated to its forecasted position would lead to invalid precision targeting information. Correlating a threat too quickly may lead to a false positive.

Tactical Challenge 6: Is the threat a deception?

Increasingly, the enemy may be able to deploy deception during the SEAD fight, which increases the complexity of any of the aforementioned complex scenarios.[9] Knowledge of potential deception should drive an appropriate adjustment in collection tactics and awareness during analyses. Warfighters should also keep in mind the enemy may deploy previously unknown or unexpected IADS deception techniques.

SECTION CONCLUSION

Given these challenges, the Services should aim to create the next generation of battle tracking software that can aid in mitigating these challenges. Asking for software that helps with SEAD or connects the force is too vague. Just as the Services aim to create a specific missile for a specific purpose, they should be specific in outlining the capabilities complex software should achieve for purposes of battle management and command and control.

THEORETICAL METHODS TO ADDRESS SEAD TACTICAL CHALLENGES

There are several avenues for addressing battle tracking tactical challenges. To provide design requirements for automation, consider the optimal solution algorithm. These recommendations, at their root, are improvements addressing the tricky business of tracking and data fusion that need to occur for modern SEAD battle tracking. Many of the following solutions are overly cumbersome to humans, so the Services should use automation to implement the algorithm and provide actionable data to operators. The advantage lies in compressing the OODA loop for decisions using an emerging data fusion technology enabled by JADC2.[10]

None of the following ideas entirely solve the problem but, instead, attempt to represent the battle tracking situation more thoroughly. Each solution has far-reaching implications in terms of obtaining the solution (from data science, computer science, and interconnectivity aspects) but are not beyond feasibility. Together, these improvement ideas set the stage for possible SEAD innovations, including those in JADC2 systems.

F2T2EA STATE CYCLE TRACKING AND CUEING

The first area for improvement is to aid forces in tracking the F2T2EA process per emitter. Several of the challenges result from skipping a step in the F2T2EA process or accidentally assuming a step was completed. Automation solutions should track where

TSgt Skyler McCloyn loads a Miniature Air-Launched Decoy (MALD) ADM 160X onto a B-52 Stratofortress July 13, 2020 at Barksdale AFB, Louisiana. MALD’s electronic warfare capabilities are useful in Suppression of Enemy Air Defense (SEAD) operations. Photo by A1C Celeste Zuniga, USAF.

each IADS entity is in the dynamic targeting process. Furthermore, this data is then shared throughout the forces and used to cue and queue the next platform as required and available. Additionally, tracking the state enables the battle tracking system to prompt for human in/on the loop decision making when needed.

Also, state cycle tracking IADS entities represent the temporary aspects of the SEAD fight. Applied effects may be temporary (such as electronic attack jamming) or kinetic. In each case, the assess step provides information that may quickly cycle the target entity to a different step in the F2T2EA process. The depth of required data quickly approaches a limit where automation is needed to aid operators. Extending from this solution is how to discern IADS battle tracking in a probabilistic fashion.

PROBABILISTIC THINKING

The second technique is thinking in a probabilistic fashion about the emitter state. Essentially, warfighters will associate a probability of correctness with an emitter tracking state. This probability represents the certainty or uncertainty of truth relating to the tracked entity. Suppose a known, forecasted emitter is on, which might equal one (100% chance for on and located/0% chance for dead). A known, forecasted emitter that has been verified killed is zero (0% chance on/100% chance for dead). There exists many states between one and zero as a decimal state between the two bounding end-states.

For instance, an emitter status might be .7 or (70% on and located/30% killed), upon which the final vote would make it (0% on/100% killed) or 0. Additionally, if a threat is emitting at a known site, there may be less than 100% chance the emitter is where the operator thinks it is located. Therefore, a threat may be on 80%, or accurate. If operators begin to associate probabilities with tracked entity threat systems, it will allow more accurate risk-to-force calculations.

Probabilistic thinking may seem cumbersome, but it mirrors closely what a friendly battle tracking expert believes is the truth about the enemy's IADS. As Nate Silver wrote in his best-selling work, *The Signal and The Noise*, probabilistic thinking "represents the most honest expression of the uncertainty in the real world."[11] Applying probabilistic thinking and processes in battle tracking lowers the chance for a false positive or negative and limits confirmation bias in the presentation to the warfighter. Furthermore, it enables efficiencies (such as the ability to switch from a precision effect to an area effect) if the certainty of coordinates is low.

FUSION VOTE SYSTEM

The two preceding recommendations lead to creating a confidence-based vote system on threat emitter tracking modifications. The probabilistic vision of the enemy IADS battle tracking enables a voting system to adjust probabilities. For example, after mission planning is complete, the likelihood of accuracy for each emitter location and state might be around 50%. The confidence of the emitter may move up and down during the battle using various data and correlations. The data fusion automation may need additional inputs from operators based on the tactical environment as well, not solely machine-to-machine inputs.

INCREASING TRACKING FIDELITY OF THREAT EMITTERS

Determining whether a threat is on or off is insufficient fidelity in SEAD battle tracking. From a friendly-force perspective, a threat's battle tracking state cycles through over the duration of the air battle and as the F2T2EA process iterates. The nature of intelligence forecasting EOB and DMOB combined with mission planning often leads operators to limit the fidelity of emitter states to on or off. However, there is an opportunity to increase the fidelity of information beyond just on or off. There are at least three significant determinants of emitter state: emissions state, physical state, and whether the threat was forecast in the given location. Each combination of these determiners creates a different state, where logically possible. Moving between the tracking states occurs due to new intelligence or a sub-F2T2EA process completing.

Probabilistic thinking may seem cumbersome, but it mirrors closely what a friendly battle tracking expert believes is the truth about the enemy's IADS.

Table 1. Proposed Emitter State Chart						
State	**Emmisions State**	**Physical State**	**Fore-cast**	**Plain English**	**Delta Planned Risk**	**Confidence/ Probability in Data**
1	On	Present	No	Surprise emitter, actively emitting, surprise location	Increase	(0.0 to 1.0)
2	On	Present	Yes	Known emitter, actively emitting, forecast location	No change	(0.0 to 1.0)
3	Off	Present	Yes	Known emitter, not emitting, forecast location	No change	(0.0 to 1.0)
4	Off	Present	No	Surprise emitter, not emitting, surprise location	Increase	(0.0 to 1.0)
5	Off	Not Present	Yes	Known emitter, not emitting, missing from location	Decrease	(0.0 to 1.0)
6	Off	Killed (F/K/M)	Yes	Known emitter, not emitting, killed in forecast location	Decrease	(0.0 to 1.0)
7	Off	Killed (F/K/M)	No	Surprise emitter, not emitting, killed in surprise location	Negates prior increase	(0.0 to 1.0)

Legend:
F—Firepower Kill
M—Mobility Kill
K—Catastrophic Kill

Table 1 represents the range of potential end states for a given emitter. Additionally, actions that may transition between states are the portions of the F2T2EA process. By increasing threat tracking fidelity, the warfighter can glean important insights into enemy intent and also adjust risks to friendly forces. A surprise threat is more serious than a known threat, and warfighters need a methodology to annotate that information.

Together, individual entity state tracking, probabilistic thinking, implementing a fusion vote system, and increasing tracking fidelity of threat emitters would improve battle tracking capabilities for warfighters. The process of achieving many of these effects requires far-reaching modifications to equipment, networks, and protocols in the joint force. Leaders must, however, provide concrete goals to work toward and not just settle for robust interconnectivity.

THE PROMISE OF JADC2 FOR CONTESTED BATTLE TRACKING

The goal of JADC2 is to "connect every sensor to every shooter."[12] Inevitably, this leads to JADC2 solutions containing a massive amount of incoming data from players on the battlefield, in all domains. With the help of advanced automation algorithms and, possibly, artificial intelligence, the stage is set for massive data fusion to occur. JADC2 systems can, and should, specifically address the previously discussed battle tracking challenges.

In the interconnected vision of JADC2, data move between players so quickly that the battle tracking COP is the actual battle, and the battle is the COP.[13] If every sensor is linked to every shooter, the limit of effectiveness is the battle tracking fusion that happens in between the two endpoints. The battle tracking solution generated by JADC2 will never be 100% correct, but its software must, at least, account for these known challenges. It would be a terrible loss of capability and opportunity to acquire the JADC2 systems only to address legacy SEAD challenges.

The JADC2 acquisitions enterprise and engineers must consider specific SEAD challenges in designing JADC2 battle tracking systems and algorithms. Each false positive and negative scenario represents a difficult challenge for data engineers. Each tactical challenge presents a subprocess with many iterations for JADC2 to address. The acquisitions process should address these inherent SEAD challenges, specifically, in the requirements document for JADC2 subprocesses. During the JADC2 acquisition processes, leaders must require defense contractors to win the base scenario and not hide from the most challenging scenario.

Additional challenges for the JADC2 enterprise are accurate developmental and operational tests during the JADC2 system fielding process. The test architecture, real or simulated, must demonstrate and test the tactical challenges discussed in this article. Warfighters must have confidence in their systems when they go to war, and operational test and evaluation is critical to establish this trust. Test personnel should not limit test orchestration and experiment design on these important SEAD issues.

CONCLUSION

Tactical challenges in SEAD battle tracking are prime areas to focus on for improving tactics and technology for any SEAD fight. Many of the challenges in SEAD battle tracking are simple to understand, yet complex to address. Any new SEAD battle tracking system should provide the capability to track entities throughout the F2T2EA process. Additionally, these systems should think in a probabilistic fashion about threat emitters that is enabled by a confidence vote system on their status. Furthermore, systems should increase the fidelity to SEAD battle tracking by considering more states per emitter than just on or off. Many of the challenges presented herein are known and logical challenges of the modern SEAD fight. JADC2 systems personnel must account for these tactical challenges during acquisitions, engineering, and testing. Improving SEAD battle tracking is one step on the way to winning the SEAD fight.

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END NOTES

[1] I would like to thank Col Andrew Beitz for his valuable input on this article.

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THE EXERCISE-EXPERIMENT (E-E): A NEW REALITY

Left to right, US Army Sgt Cody Conklin of the 4th Infantry Division from Fort Carson, Colorado, and Sgt Carl Higgins of the Intelligence, Information, Cyber, Electronic Warfare and Space (I2CEWS), formation from Joint Base Lewis-McCord, Washington, detect and mitigate adversarial radio signals during Cyber Blitz 19 on September 14, 2019. Led by the US Army Combat Capabilities Development Command's C5ISR (Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance) Center and the US Army Training and Doctrine Command's Cyber Center of Excellence, Cyber Blitz is an experiment that informs the Army regarding how to perform evolving cyber electromagnetic activities across the full spectrum of operations. Photo by Edric Thompson.

By LTC Zachary Vogt, USA; Dr. Jeffrey Huisingh, PhD, LTC, USA (R); and Dr. Randal Zimmerman, PhD, LTC, USA (R)

INTRODUCTION

Traditionally, operational forces have conducted readiness training independently from research and development efforts. The result of this approach allows commanders and researchers to tailor individual events to meet their objectives. This conventional approach produced the results each group needed and worked in the fiscally permissive environment. In the early 2000's, the Army used an integrated approach when it combined experimentation with the Task Force XXI and Future Combat Systems concepts during unit rotations at National Training Center and Mission Command Training Program exercises. Many of those early E-E events were focused on emerging command and control concepts and equipment used at the brigade and division levels.

In 2018, the Department of the Army (DA) identified an exercise, ORIENT SHIELD 19 (OS19), and an experiment, CYBER BLITZ 19 (CB19), as candidates for a pilot program to assess the efficacy of the E-E concept in the current and anticipated modernization and readiness environments. OS19 was a United States (US) Army, Pacific Command (USARPAC)-sponsored, bilateral exercise; while CB19 was an experiment, co-sponsored by the US Army Combat Capabilities Development Command's (CCDC's) Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center and US Army Cyber Center of Excellence (CCoE).

Figure 1 highlights the relationships of the units. USARPAC tasked US Army Japan (USARJ) to plan and execute OS19, which had been a relatively small scale, company and below, bilateral training exercise with US Army National Guard forces and Japan Ground Self-Defense Force (JGSDF) counterparts.

As the operational headquarters responsible for the Multi-Domain Task Force (MDTF) pilot program that includes the Intelligence, Information, Cyberspace, Electronic Warfare and Space Detachment (I2CEWS), USARPAC identified two main training objectives for the OS19 and CB19 E-E. They are: for the I2CEWS to train as a unit and to integrate the I2CEWS into OS19 as much as possible.

Parallel with the OS19 planning efforts, the CCDC C5ISR Center and the CCoE (the organizations responsible for leading the CB19 event) identified 17 unique experimental objectives that spanned the operational, institutional, and research and development communities of interest. Each of the experimental objectives was aligned against the multi-domain problem set. Each of the objectives for OS19 and CB19 was considered part of the E-E design.

As seen in figure 1, the three main organizations planning and preparing for OS19 and CB19 execution were operating in a collegial manner and following USARJ's overarching plan. This relationship enabled additional input to USARJ staff planning efforts.

Combining this training exercise with a discovery experiment represents a nontraditional execution model that created challenges and opportunities for the leaders of both efforts. The blended experiment and training objective approach allowed the participating units time to work on specific, mission-essential tasks while accomplishing experiment objectives; including evaluating technologies. The remainder of this article highlights the differences between exercises and experiments, identifies planning and execution challenges during OS19 and CB19, and provides recommendations for the planning and executing subsequent E-Es to maximize the benefits for the Soldier, the joint warfighter, the US Army, and the multi-Service force.

The blended experiment and training objective approach allowed the participating units time to work on specific, mission-essential tasks while accomplishing experiment objectives

BACKGROUND

The Army is organized along operational and institutional lines of effort with the institutional mission supporting the operational mission. To support these missions, the Army developed tailored organizational frameworks for each domain. These organizations and missions differ significant-

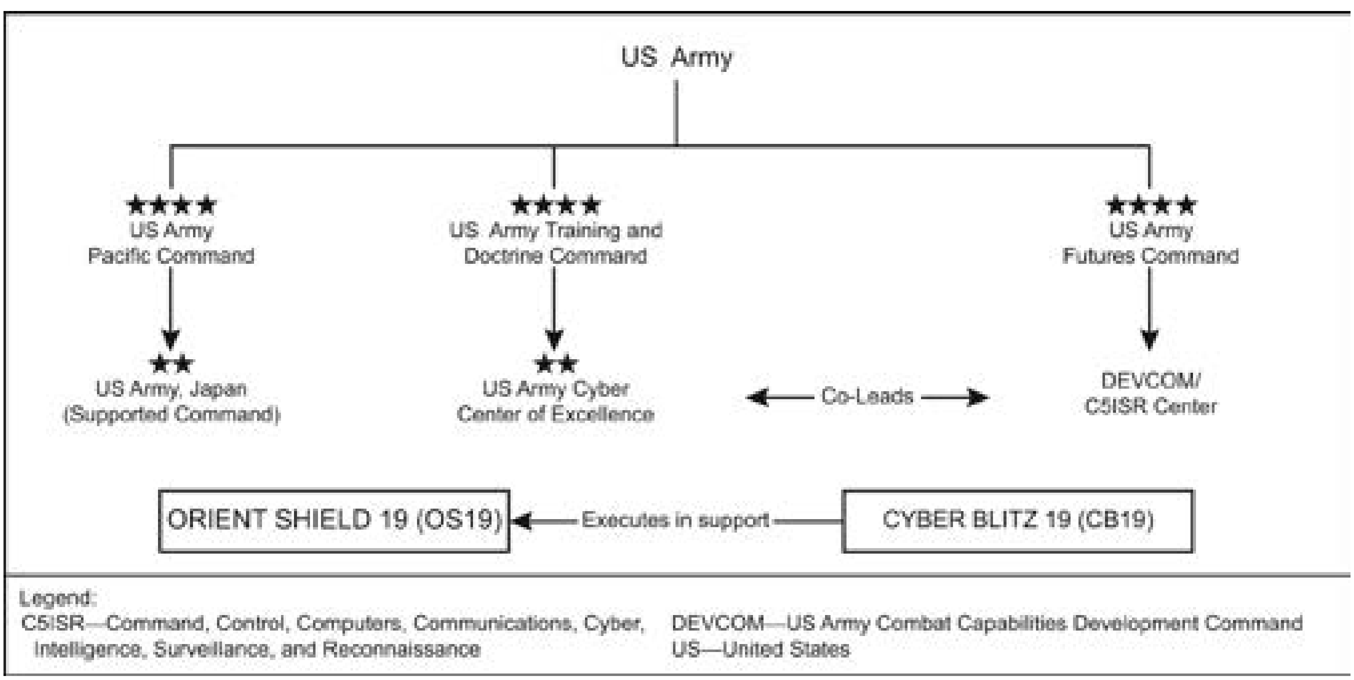

Figure 1. Organizational Relationships

Table 1. Experimentation vs. Exercise Comparison		
Characteristic	**Experimentation**	**Exercise**
Army Mission Category	**Institutional**	**Operational**
Organization	Laboratory, technology development center, center of excellence	Combatant commands, numbered armies, and echelons corps and below
Leadership	Civilian or military study lead operating under a directive	Military commander operating under the authority of AR 600-20, *Army Command Policy*
Participants	Military, civilian, and contractor	Largely military
Analysis and Memorialization	Data-rich environment; a holistic, detailed analysis process; a comprehensive final report	Individual observations equal: Green Book AARs, Joint Lessons Learned Information System entries/AAR Slides
Immediacy	Prepare for "war in the future"	Prepare to "fight tonight"
Success Philosophy	Safe to fail	Must not fail
Legend: AAR—after action report	AR—Army regulation	

ly enough to create potential friction points when the institutional mission that requires experimentation is run concurrently with the operational mission of conducting exercises and training units. Table 1 highlights some of the differences between experiments and exercises.

Organization. Army organizations charged to conduct experiments are structured with civilian leadership/involvement, equipped with laboratory and range facilities, and staffed by DA civilians and contractors to design, execute, collect and analyze data, and report results to enable acquisition decisions. Combatant commands, numbered armies, and echelons at corps and below levels are led by a commander with reporting responsibility to a higher-level commander and are staffed and equipped to deliver combat power. The effectiveness of combat power is gained through training and exercises designed to improve individual and collective skills.

Leadership. Civilian directors of institutional organizations may report to other civilians or military leaders while operational units are commanded by officers under the authority of Army Regulation (AR) 600-20, Army Command Policy. Commanders operate under an unambiguous chain of command and report to other commanders also governed by either AR 600-20, or comparable authorities, issued by the Departments of the Navy or Air Force.

Participants. Experiment participants can include commissioned officers, noncommissioned officers, enlisted members, and civilians from every Service and are often supported by contractors for the experiment's planning and execution, including data collection and analysis. Exercise participants are predominantly military who plan, execute, and evaluate training and exercise events.

Analysis and Memorialization. Experiments follow a detailed data collection and analysis plan that takes a holistic look at data collected over the period of the experiment, gathered from multiple data streams. For exercises, observers compare what they are seeing to their perceptions of a standard and report on it in an after-action review (AAR). Experiments produce reports published after the experiment while the informal (Green Book) AAR, PowerPoint presentation, or entries into the Joint Lessons Learned Information System are immediately produced following an exercise.

Immediacy. The US Army Training and Doctrine Command (TRADOC) is modernizing the Army by developing and testing new organizational structures and technologies with the implication that this effort will take time. Conversely, the Army places a requirement on commanders to train to a level of credible collective readiness (DA, 2017) to respond to global contingency operations (Milley, 2016). This "fight tonight" mindset requires commanders to collectively train their units with organic equipment and manpower. This difference in immediacy is a fundamental difference between experiments and exercises and represents significantly different mission sets for experiment directors and troop commanders.

Success Philosophy. In a discovery experiment, technologies; tactics, techniques, and procedures (TTP); concepts of employment (CONEMP); and concepts of operations (CONOP) are iteratively attempted and modified to produce the best possible outcome. In exercises, established battle drills are rehearsed continuously and perfected based on a foundation of institutional training and doctrine and evaluated against standards or best practices. Experiments are conducted with the understanding that systems or TTP, CONEMPs, and CONOPs will not work as intended and require refinement or, in some cases, wholesale change. In contrast, exercises are conducted to prepare units to execute combat operations for which failure is not an option.

Army Chief of Staff, General James C. McConville emphasized this fact in the following statement. "Winning Matters. When we send the US Army somewhere, we don't go to participate, we don't go to try hard, we go to win. There is no second place or honorable mention in combat."

Two characteristics, immediacy and success philosophy, represent significant potential friction points between experimentation and exercise objectives and leaders' perceptions of success and failure. All of the identified characteristics and their potential impacts are described in the following paragraphs.

LESSONS LEARNED FROM OS19 AND CB19

ORGANIZATION

Discussion. Traditional OS19 exercises were small, tactical, bilateral events focused on company- and platoon-level operations. Once the decision was made by Headquarters, Department of the Army (HQDA) to combine CB19 with OS19, the two planning teams initiated a series of video teleconferences (VTCs), conference calls, and in-person meetings hosted by USARPAC, the OS19 sponsor. The USARPAC vision for OS19 was significantly more expansive in scope than previous exercises. A number of challenges occurred early in the planning process. For example, separate orders were issued for OS19 and CB19 execution, rather than having both combined in an initial order and addressing the questions of primacy or parity. This led to an inefficient start in identifying relationships and expectations.

Recommendation. HQDA issue a single order to all involved organizations before planning and preparations begin, that establishes the roles and responsibilities for all participants and defines the scope and objectives for the effort.

LEADERSHIP

Discussion. Unity of command is an essential principle of military operations. The US Army Field Manual 3-0, Operations, defines it as one of nine "Principles of War", and reads: "For every objective, ensure unity of command [is] under one responsible commander". This guarantees one person has ultimate responsibility for the objectives (and people) that fall under his or her purview, and at the same time, makes clear to everyone who is ultimately responsible.[1]

Two characteristics, immediacy and success philosophy, represent significant potential friction points between experimentation and exercise objectives and leaders' perceptions of success and failure. All of the identified characteristics and their potential impacts are described in the following paragraphs.

Unity of effort implies a lack of responsibility because one person is not ultimately in charge; however, unity of effort requires significant coordination. The joint, multinational, and interagency nature of unified action creates situations where the military commander does not directly control all elements in the area of operations. In the absence of command authority, commanders cooperate, negotiate, and build consensus to achieve unity of effort."[2]

The OS19 and CB19 organizational structures (illustrated in figure 2) highlight the principle of unity of effort for the E-E pilot. The OS19 and CB19 teams established exercise/experiment control teams (EXCON) and used twice-daily meetings to coordinate activities of both operations. During execution, the EXCON synchronization meetings, at the beginning and end of each day, proved crucial when expected actions did not take place within the training unit. When that occurred, the CB19 EXCON had to stimulate the training audience again to achieve an experiment objective.

Recommendation. Communicate with the designated lead and partners early and often.

PARTICIPANTS

Discussion. Representatives from the following organizations participated in the CB19 portion of OS19/CB19.

- The USARPAC.
- The C5ISR Center.
- The CCoE.
- The Intelligence Center of Excellence.
- The Intelligence Capability Development Integration Directorate.
- The US Army Cyber Command.
- The 151st Theater Information Operations Group.
- The US Army Cyber Protection Brigade.
- The JGSDF.
- The USARJ.
- The I Corps.
- The 25th Infantry Division.
- The 4th Infantry Division.
- The 335th Theater Signal Command.
- The 359th Signal Brigade.
- The 500th Military Intelligence Brigade.
- The US Army Special Operations Command.
- The 1st Special Forces Group (Airborne).
- The New Jersey Army National Guard.
- The Network Cross-Functional Team.

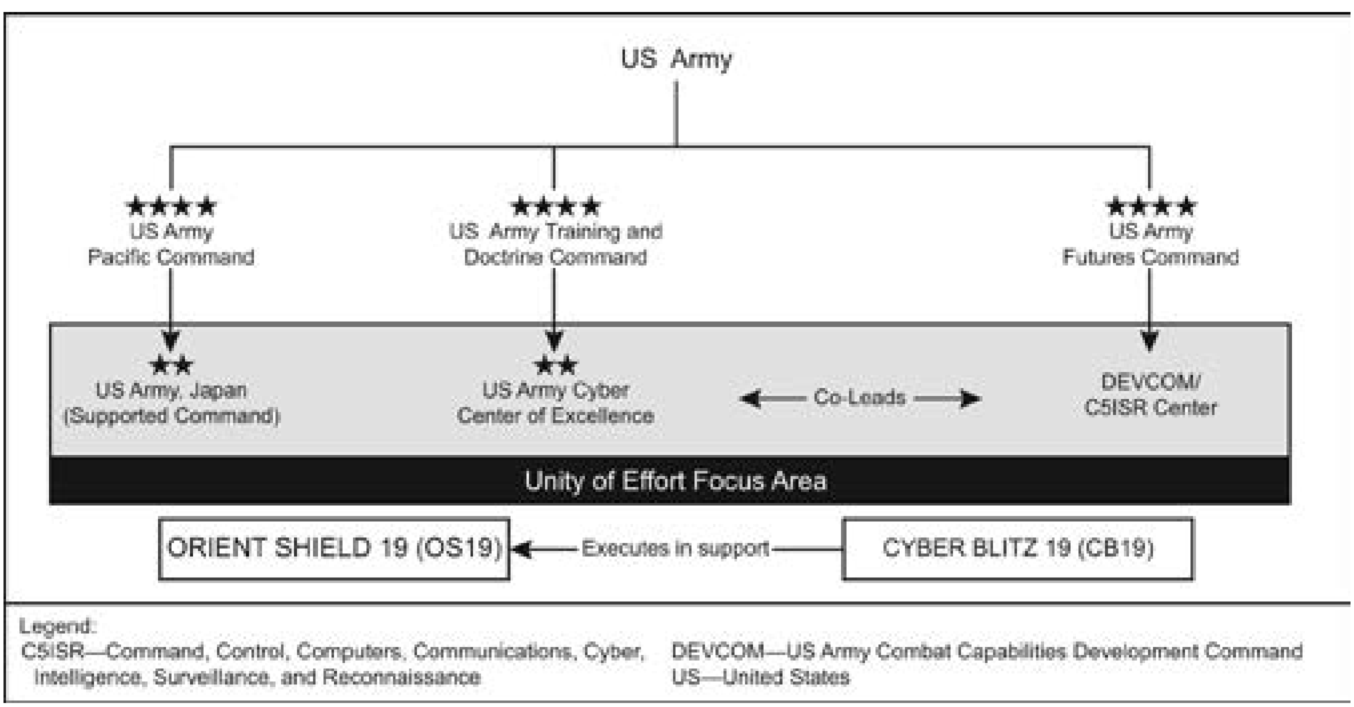

Figure 2. Unity of Effort

- The John F. Kennedy Special Warfare Center and School.
- The US Army Civil Affairs and Psychological Operations Command.
- The US Army Acquisition Support Center.
- The US Army Cryptologic Office.
- The US Army Cyber Institute.
- The 25th Air Force.
- The 780th Military Intelligence Brigade.
- The 1st Information Operations Command (Land).
- The Army Service Forces.
- The 75th Innovations Command.
- The Air Force Space and Missile Systems Center.
- Numerous technology providers.

CB19 required this large coalition of organizations to execute the experiment for a variety of reasons. One of the most significant challenges for the 2019 I2CEWS formation was manning and equipment availability. The unit was manned at ~50% of its Table of Distribution and Allowances (TDA) and had almost none of its assigned equipment. To address these shortfalls, the CB19 planning team worked with HQDA, and units from across the Army, to provide the necessary personnel and equipment for the I2CEWS to have a full complement to conduct its operations.

To support the Multi-Domain Task Force (MDTF) and Intelligence, Information, Cyberspace, Electronic Warfare and Space Detachment training objectives; E-E planners developed an overarching joint task force scenario that consisted of a three-phase operation. The overall intent of the scenario was to provide the MDTF and I2CEWS regional peer challenges from competition, through conflict, in all domains. For the I2CEWS, this resulted in the five master scenario events list (MSEL) highlighted in figure 3. These events were coordinated and synchronized between the CB19 and OS19 E-E controllers to ensure training and experiment objectives were stimulated appropriately.

In an exercise, the training audience plans and reacts to the provided stimulus and continues its mission. If the training unit made an unexpected reaction, a future MSEL is planned to ensure training objectives are achieved. Most training exercises are designed using contemporary equipment and doctrine and follow a sequential progression of actions that result in a US or coalition force victory at the end of the exercise.

During experiments, deliberate attempts are made to control variables and identify changes in outcomes.

During experiments, deliberate attempts are made to control variables and identify changes in outcomes. Frequently, comparisons between technologies, new doctrine, or planned capabilities are required to achieve experimental objectives. This results in the experimental unit "losing" engagements with the threat forces. While this approach can be

Master Scenario Events List	
M1	React to signal of interest.
M2	React to electromagnetic interference.
M3	React to cyber attack.
M4	Conduct active cyber defense of identified host nation critical infrastructure.
M5	React to information warfare.

Figure 3. Operational Phases

A US Army Soldier from the 33rd Infantry Brigade Combat Team, Illinois National Guard, engages a target with his rifle at Oyanohara Training Area, Japan, on September 12th, 2019, during Orient Shield 19. Orient Shield 19 is a premier US Army and Japan Ground Self-Defense Force bilateral field training exercise that is meant to increase interoperability by testing and refining multi-domain and cross-domain concepts. Photo by US Army Staff Sgt. Jacob Kohrs.

"unsettling" for US forces, it affords the experiment staff the opportunity to create measurement space for the experiment objectives. Reconciling the need for measurement space to achieve experiment objectives with training objectives can be challenging in the E-E construct.

In contrast to an experiment, troops conducting a field training or command post exercise finish their scenario and are adjusted, by the EXCON, to get them back on track, rather than stop during the event and redoing it. To redo actions during an exercise would not make sense to most training audiences because they operate from the Army aphorism, "train like you fight and fight like you train". Continually stopping or adjusting variables in an exercise (if the troops did not reach the expected outcome) would violate that aphorism and become a negative training value for the force.

... exercises rely, primarily, on qualitative observations made by subject matter experts ...

Recommendation. Establish, in the base order, the E-E the priority of effort. The priority of effort will provide a framework for subordinate units when making decisions regarding resources or E-E design.

ANALYSIS

Discussion. Experiments like CB19, develop detailed analysis and data collection plans that account for all the stakeholder objectives. Experiments collect quantitative and qualitative data from multiple data streams. Each of the experiment objectives is addressed through an experiment design that focuses on creating the conditions necessary for answering the stated objectives.

By comparison, exercises rely, primarily, on qualitative observations made by subject matter experts (e.g., observer/coach trainers at the National Training Center or in the mission command training program) who are informed by Mission Essential

Task Lists (METL), Army Training and Evaluation Program (ARTEP) standards, and experience. Those observations are aggregated, compared to the doctrinal norms, and provided to training units as part of an AAR process. Experiments produce reports (published after the experiment) while the Green Book AAR, PowerPoint presentation, or entries into the Joint Lessons Learned Information System are immediately produced following an exercise.

During CB19, multiple pieces of experimental equipment and software were provided to the I2CEWS Soldiers for training and conducting their operations. Each piece of equipment had specific measures and analysis objectives that required constant monitoring and assessments. At the conclusion of CB19, the Soldiers provided direct feedback to the developers of each piece of software and equipment for them to use for making additional improvements. By comparison, during training events, the emphasis is on using the equipment that is provided to the unit, in addition to mission success. There is no mechanism for the Soldiers to provide direct improvement feedback to the equipment developers.

Recommendation. Continue to populate E-E events with experimental equipment to facilitate developing new equipment and concepts. This is even more important regarding electronic warfare equipment since the force is using quick-reaction capabilities and not using programs of record that will not be fielded for a significant amount of time.

A unified effort is required for the experiment and exercise to succeed as a linked Exercise-Experiment.

IMMEDIACY

Discussion. The Army requires commanders to train to a level of credible collective readiness (DA, 2017) and be prepared to respond to global contingency operations (Milley, 2016). This fight tonight mindset compels commanders to train their units with existing, organic equipment and manpower. Parallel with the fight tonight training mindset, the TRADOC is tasked with modernizing the Army by developing and testing new organizational structures and technologies with an eye toward Army requirements that are five years beyond the present. These juxtaposed missions frame different challenges for Army leaders.

Recommendation. Specify a balanced objective approach in the E-E order to the participating organizations.

SUCCESS PHILOSOPHY

Discussion. US Army experiments are designed to test unit capabilities and emerging doctrine, and to push units and equipment to their breaking point. In other words, cause them to fail. In contrast, exercises increase the challenges of the threat force in response to the performance of the training audience and, ultimately, end when the US forces have achieved their training objectives. The perception that commanders have "failed" in preparing and training their units must be overcome for experiments to have meaningful results.

Recommendation. Leaders must create a "safe to fail" environment for experimentation to be successful.

SUMMARY: THE RECOMMENDED WAY AHEAD

Since the Army plans to combine exercises and experiments for the foreseeable future, planners may wish to consider the following lessons learned from OS19/CB19:

1. Acknowledge duality of purpose. Without a common commander, Field Manual (FM) 3-0, Operations, suggests the leader of the experimentation effort and the commander of the unit being exercised adopt a unity of effort mindset. A unified effort is required for the experiment and exercise to succeed as a linked E-E. This mindset is one of a partnership of equals that promotes a non-hierarchical relationship similar to multinational operations with coalition partners. To ensure a common understanding, primary and secondary objectives for each organization should be recorded in a memorandum of understanding and signed by organizational leaders with rank or positional parity.
2. Conduct a concept development meeting that results in a common understanding of how both organizations intend to meet their objectives and support the other.
3. Conduct full-scale systems tests prior to the E-E to ensure interoperability.

4. Convene a common E-E control cell to coordinate all events and establish priorities.

5. Schedule regular coordination meetings prior to the E-E to ensure leaders from both organizations know each other prior to execution.

6. Plan for face-to-face or VTC meetings at regular intervals to share information relevant to E-E objectives.

7. Establish priorities early in the planning process to shape events leading up to the E-E and during it.

8. Designate staff functional leads for planning (i.e., Personnel (G/S1), Intelligence (G/S2), Operations and Training (G/S37), Signal Operations (G/S6), Financial Management (G/S8), or Civil Affairs Operations (G/S9).

9. Integrate the E-E participating units into the planning process early so they understand the intent of the E-E and can identify their training objectives and get them integrated into the overall plan. This process could start with a warning order and a unit back brief.

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END NOTES

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[2] Ibid.

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LESS IS MORE

An A-10C Thunderbolt II flies over a group of tactical air control party specialists. Photo by A1C Kenneth Boyton, USAF.

By Lt Col Aaron Brady, USAF

INTRODUCTION

The Joint Staff first published Joint Publication (JP) 3-09.3, *Close Air Support* (CAS) in 1995. Since then, CAS practitioners have refined the procedures, with the most current iteration published in 2019. Technology and tactical problems CAS team members face drove those changes. However, as the United States (US) military transitions its focus from limited to large-scale combat operations, warfighters should assess how well currently accepted best practices meet the desired intent of CAS procedures. This article asserts that some of the techniques used today are unnecessarily rigid. Depending on the experience and skill of the joint terminal attack controller (JTAC), current practices sometimes remove so much initiative from the flight or section leader as to almost make the existence of flights or sections moot (CAS aircraft become a collection of individual planes rather than coherent units). As a result, the techniques miss the tactical intent or they make CAS procedures too inflexible for a dynamic battle against a capable foe.

Although a relatively new tactic, this article focuses on the game plan because it is subjective in execution—leading to a wide variety of techniques across the CAS community. Also, the game plan illustrates the trend toward removing initiative from flight/section leaders, which, inherently, makes CAS tactics less flexible. Table 1 illustrates how poor game plans change the CAS team from a cohesive group, working together to solve tactical problems into a collection of individual aircraft striving to meet sometimes ill-defined requirements. The author received the game plan described on the left several months ago.

The following is a brief history of the CAS Briefing (9-line) including the game plan, the current process for developing a 9-line, and recommendations for balancing control and initiative between the two sides of the CAS team to build cohesion among all CAS team members.

THE CAS TEAM

The number of people a CAS team may comprise depends on the supported ground echelon or mission

Table 1. Game Plan Comparison	
Overly Rigid Game Plan	**Minimal Game Plan**
This will be Type 2, BOT, BDU-33 from number 2 followed by guns from number 1, one minute interval, two targets, two kilometers apart, one tank and one machine gun position, number 2 in the from west, number 1 in from the south, call ready 9-Line.	This will be Type 2, BOT, two target locations, call ready 9-Line.
Legend: BDU—bomb dummy unit	BOT—bombs on target

size. All the team members can be grouped into two categories: JTACs/forward air controllers (airborne) (FAC(A)s) and supporting aircrew. JTACs/FAC(A)s are the ground commander's direct representatives. As such, they receive the ground commander's intent and translate it into orders (or a 9-line) for the aircrew.[1] The aircrew executes actions based on the 9-lines to make the ground commander's intent into reality. The 9-line, then, is the core mechanism by which the JTAC/FAC(A) communicates intent and restrictions to the aircrew, see figure 1.

THE 9-LINE AND THE GAME PLAN

The purpose of the 9-line is to "help aircrew in determining if they have the information required to perform the mission."[2] JP 3-09.3 says the 9-line "does not dictate the CAS aircraft's tactics."[3] The original 1995 JP 3-09.3 included these exact phrases, and they have not changed in 25 years. The doctrinal verbiage emphasizes the basic process described in the CAS team section (in the previous paragraph). The 9-line is a standardized format for a JTAC/FAC(A) to communicate the ground commander's intent, targeting information, and restrictions to aircrew so they can deliver the desired effect. CAS procedures intend for the aircrew to have maximum flexibility regarding tactics (as constrained by ground commander's or JTAC's/FAC(A)'s restrictions).

There are few differences between the 1995 and 2019 9-line versions. However, the nuances within each 9-line have undergone numerous revisions for a variety of reasons. The current game plan is the result of a slow evolution which began in 2003.

The 2003 JP 3-09.3 required JTACs/FAC(A)s to "broadcast the type of control in use upon aircraft check-in," and mandated that "Type 1 is the default method of control."[4] The 2009 JP 3-09.3 eliminated this requirement, instead directing that type of control be coordinated during the fires approval process and the 2014 edition added that type of control should be communicated prior to the "In" call.[5] In addition, the 2014 edition introduced the method-of-attack concept (bomb on target [BOT] or bomb on coordinate [BOC]), reflecting the proliferation of GPS-guided munitions and experience gained in Iraq and Afghanistan, and added the game plans—"a concise and SA enhancing tool to inform players of the flow of the following attack"—while setting the minimum information required: type of control and method of attack.[6] In 2019, JP 3-09.3 dropped "SA enhancing" from the game plan's description, suggesting the authors desired to emphasize "concise" rather than the more subjective "SA enhancing."

In a period of 11 years, for a variety of excellent reasons, the CAS team evolved from a fire control methodology focused on a single, area-based type of control that disregarded additional techniques or procedures to a more flexible system.

In a period of 11 years, for a variety of excellent reasons, the CAS team evolved from a fire control methodology focused on a single, area-based type of control that disregarded additional techniques or procedures to a more flexible system. The current system gives a JTAC/FAC(A) six choices for each attack: three types of control and two methods of attack for any target. At the end of this decade-long transition, the game plan was added to ensure the JTAC/FAC(A) and aircrew shared a clear understanding of expectations and standardized game plan passage prior to the 9-line.

The intent of the game plan is to enhance aircrew SA, just as the intent of the 9-line is to allow aircrew to determine if they have sufficient information to attack. In both cases, the aircrew is the target audience. Even though the aircrew are the supporting players in the CAS team, the aircrew are the people who either will or will not achieve the ground commander's desired effects. This means that JTACs/FAC(A)s should construct 9-lines that provide necessary target and engagement information, then design game plans that allow aircrew maximum flexibility in the given situation to achieve the desired effect.

THE LOGIC OF THE GAME PLAN

The game plan's addition to CAS procedures likely stemmed from several factors. First, the elimination of assumptions about control type and the addition of attack methods created a need to standardize when a JTAC/FAC(A) should pass that information for a given attack. Second, the nature of operations in Afghanistan and Iraq coupled with technological change simultaneously decreased the pre-mission detailed integration between aircrew and JTACs/FAC(A)s while rules of engagement demanded increased levels of control by ground commanders to mitigate collateral damage.[8] Finally, differences in the fires approval processes between the US Army and US Marine Corps meant that Marine Corps CAS tended to be more specific about ordnance and timing restrictions. These trends meant that the attack requirements in the 2004 to 2015 period could be unusually specific compared to CAS tactics from earlier years. A game plan could alleviate some of those variables by essentially communicating to the aircrew, "here's what's about to happen, call ready for the details."

The game plan is a reasonable solution to these issues and serves a needed purpose but, as with any tool, misuse can hinder rather than help progress. The point of the game plan, beyond simply control type and attack method, is for a JTAC/FAC(A) to recognize a potentially confusing 9-line and preempt that confusion by clearly articulating the conceptual attack before going into details. In this author's experience, when game plans do not achieve this purpose, it is typically because the game plan is unnecessarily complicated and/or overly controlling.

THE GAME PLAN AS A CONCEPT BRIEFING

Discussions of the game plan often focus on required items: type and method per the JP 3-09.3, or type, method, ordnance, and interval (TMOI) per the US Marine Corps' MAWTS-1 TACP TACSOP.[9] The next part of the discussion, then, usually turns to whether certain additional elements of the passed game plan add value or detract from overall SA. Rather than debate which elements should or should not be required in a game plan, JTACs/FAC(A)s should think more about how they develop the "concept of

Table 2. Simplifying Engagement Process

JP 3-09.3 CAS Target Engagement	Simplistic Process
1. Develop targeting data	1. Where is the target?
2. Request air support	2. What do we want to do to the target?
3. Develop game plan	3. How will we engage the target with the resources we have to achieve that effect?
4. Determine target correlation method	4. What is the simplest way to find the target that allows us to engage it as determined in step 3?
5. Develop attack geometry	5. Do we need help to engage the target? If so, what?
6. Determine SEAD requirements	6. How do we put this all together? (complete attack plan/geometry)

Legend:
CAS—close air support
JP—joint publication
SEAD—suppression of enemy air defenses

the attack," with an emphasis on how much control is required by the JTAC/FAC(A), then create a concise statement to prepare aircrew for the attack.

JP 3-09.3 Chapter V, Section 2, provides an excellent description of how JTACs/FAC(A)s should develop a target engagement plan. Table 2, below, lays out the process defined by JP 3-09.3, and relates it to a question-based process used by the author. The doctrine clearly states that "the intent is not to dictate aircraft tactics but to offer a plan that meets the ground commander's intent."[10] However, given the nature of game plan development it is common for JTACs/FAC(A)s to go into greater detail than required.

When addressing how to engage the target, JTACs/FAC(A)s should begin game plan development from the perspective that tactics ... are the aircrew's prerogative.

When addressing how to engage the target, JTACs/FAC(A)s should begin game plan development from the perspective that tactics—which includes aspects like timing—are the aircrew's prerogative. Once JTACs/FAC(A)s pair assets to targets, the JTAC/FAC(A) should provide the task (effect) and build a container of restrictions for the aircrew to operate within, while allowing aircrew as much flexibility as possible. Setting too many unnecessary conditions causes the aircrew to lose tactical flexibility and may put the aircrew into risky positions or cause the aircrew to fail to deliver the desired effect. By providing a simple game plan—an attack concept—the aircrew can match the best tactics to the situation and mitigate the this issue. Perceiving the game plan simply as an attack concept into which the aircrew can fit their tactics helps mitigate this issue.

THE CONCEPT IN PRACTICE

If the JTAC/FAC(A) looks at the game plan as a concept brief and allows the aircrew to select tactics within a set of constraints, the game plan will help build SA and set conditions for an effective attack. The following narrative illustrates how a JTAC/FAC(A) might use a different mindset to come to a better overall game plan and, ultimately, a more effective and efficient result.

The ground commander nominates a machine gun position and single, stationary tank north and northeast from the company's position respectively. The JTAC/FAC(A) has only one flight of

A joint terminal attack controller (JTAC) calls for close air support against opposing forces during Northern Strike 17. Northern Strike 17 is a National Guard Bureau sponsored exercise uniting approximately 5,000 service members from 11 US states and five coalition countries. Photo by TSgt Jason Boyd, USAF.

fixed-wing fighters on station, and the ground commander wants both targets struck as soon as possible. The JTAC/FAC(A) quickly plots both targets, builds a description, and determines the nearest friendly positions. Considering the targets and the aircraft's remaining ordnance, the JTAC/FAC(A) determines that a Type 2 bomb on target attack is the best approach. The JTAC/FAC(A) could pass two 9-Lines, one for each target, but decides that a single 9-Line will be faster and provide sufficient situational awareness. Assessing the friendly and target positions, the JTAC/FAC(A) identifies that different attack restrictions are required for each target (see Figure 2). This is another indication that two 9-Lines may be the best choice, but for argument's sake this JTAC/FAC(A) will proceed with a single 9-Line. With a complete picture built, the JTAC/FAC(A) is ready to pass the game plan.

At this point, the JTAC/FAC(A) passes the full 9-Line, choosing the tank as the target for Lines 4, 5, and 6 since it is slightly closer to friendlies and a higher priority. In the remarks and restrictions, the JTAC/FAC(A) passes the second target description and location, final attack heading restrictions for each target, and desired effects. The JTAC/FAC(A) used the game plan and the remarks/restrictions to build a container within which the aircrew have the flexibility to strike the targets in the best way they see fit. Once read-backs are complete, the JTAC/FAC(A) completes correlation with the aircrew. Then, since the aircrew now understand the restrictions placed upon them and have target SA, they are now in a position to make the best decision on tactics.

> "…That machine gun nest is your second target, call tally."
>
> "Tally."
>
> "Go with tactics when able."
>
> "Number one will be in on the tank from the south with guns, then number two will be in on the machine gun nest from the west with bombs, expect 45 seconds between aircraft."
>
> "Copy all. Push when ready. Call in with direction."

While the tactics the flight/section leader determined were not grossly different from the original game plan, the above attack flow is much simpler for the flight/section leader to lead the fighters through. Additionally, since the JTAC/FAC(A) did not build tight cuffs around the aircrew's actions during the game plan, there was no need for the time-consuming discussion that might have resulted as the flight/section leader tried to turn the unwieldy game plan into something more conducive to the aircrew's training and habit patterns. The game plan the JTAC/FAC(A) passed in this scenario was simply a concept: two targets, quick effects. That is what the ground commander wanted. The JTAC/FAC(A) gave the aircrew the freedom to determine how to deliver those effects.

CONCLUSION

Game plans arose in the last fifteen years to serve a necessary purpose. However, the CAS team must strive not to lose sight of the purpose of game plans—establishing the basic concept for an attack before going into details. If game plans become almost as long as 9-lines, or if they unnecessarily restrict aircrew action, then tactical effectiveness and, potentially, results suffer. JTACs/FAC(A)s should keep game plans as simple as possible—a concise description of what is about to happen.

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THE FUTURE OF AIR-GROUND INTEGRATION: LINKING SENSOR TO SHOOTER IN THE DEEP FIGHT

By Capt Pablo Kruger, USAF, Capt Michael Molinari, USAF, and Capt 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.

> Time is the most significant constraint when targeting enemy systems that train to employ and displace to a covered position as quickly as possible.

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 25th FS, 210th 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 oversaturate 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.

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 US 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

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

fires might be the best way to disrupt the enemy's movement in dep,th, destroy HPTs, and disrupt enemy C2 at 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

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).

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

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 or multiple brigade

A US 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, USAF.

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

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.

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.

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.

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THE FUTURE DIRECT AIR SUPPORT CENTER: IMPLEMENTING TACTICAL DATA LINKS TO ENHANCE COMBAT POWER

Editor Note – Originally published in 2017, "The Future Direct Air Support Center" describes additional capabilities, and the impact those capabilities would have on employment options of the Direct Air Support Center (DASC) within United States Marine Corps Marine air ground task force operations. As Services develop concepts, exercises, and experimentations exploring combined joint all-domain command and control, the evolution of the DASC provides useful lessons for incorporating digital capabilities to improve air-ground integration in tactical, multi-Service execution.

By Capt Earl Gerlach, USMC and Capt Aaron Falk, USMC

BACKGROUND

Common Aviation Command and Control System (CAC2S), Increment I, Phase II, is an aviation command and control system scheduled to be fielded to the to the direct air support center (DASC) from fiscal year 2018 through 2021. The system will be fielded to the rest of the Marine air command and control system (MACCS) on a similar timeline. This new system provides a common, expeditionary, modular and scalable system that enables data fusion throughout the Marine air ground task force (MAGTF). This article informs commanders and their staff, involved in every warfighting function, about the DASC's new capabilities and employment options.

CAC2S is a hardware and software suite that enables the DASC to integrate existing information exchange systems such as Global Command and Control System (GCCS), Command and Control Personal Computer (C2PC), Integrated Broadcast Service (IBS), and Advanced Field Artillery Tactical Data System (AFATDS), using a Multi-source Correlator Tracker to fuse information onto a tactical display. CAC2S enables the DASC to execute the concept of digital interoperability, with organic assets and the joint force, through tactical data links (TDLs) such as radio frequency Link 16 and Joint Range Extension Application Protocol (JREAP). This fusion of data enables the DASC to see near-real-time air, surface, subsurface, land, and space tracks, and integrate modern C2 systems with legacy equipment to provide a true, common tactical picture. The addition of these enhanced capabilities will drive significant change across the DASC community and will improve the MACCS' integration with the theater air-ground system (TAGS).

DASC SUPPORT TO THE MAGTF COMMANDER

The DASC will soon have a plethora of exploitable capabilities that will create better synergy between the aviation combat element and ground combat element (GCE), ultimately increasing lethality and generating combat power for the MAGTF commander. CAC2S fuses the GCE's current GCCS and AFATDS networks with a Link 16 capable system, which utilizes J-Series messages. AFATDS facilitates a GCE fires network utilizing K-Series variable message format messages. CAC2S can process J-Series, K-Series, and M-Series messages (Link 11 is primarily employed by the Navy and uses a 48-bit message compared to a Link 16 J-Series which uses a 75-bit message.[1,2]

Harnessing these new capabilities will allow the use of TDLs to maximize the efficient use of aviation assets in support of the ground scheme of maneuver, thereby enhancing the effectiveness of the MAGTF. The increased speed and accuracy of the processing of immediate air support requests, with the advanced communication functions of digitally aided fire support, digitally aided close air support (CAS), and digital air control, make this a relevant and highly capable system for the MAGTF and its future battlespaces.

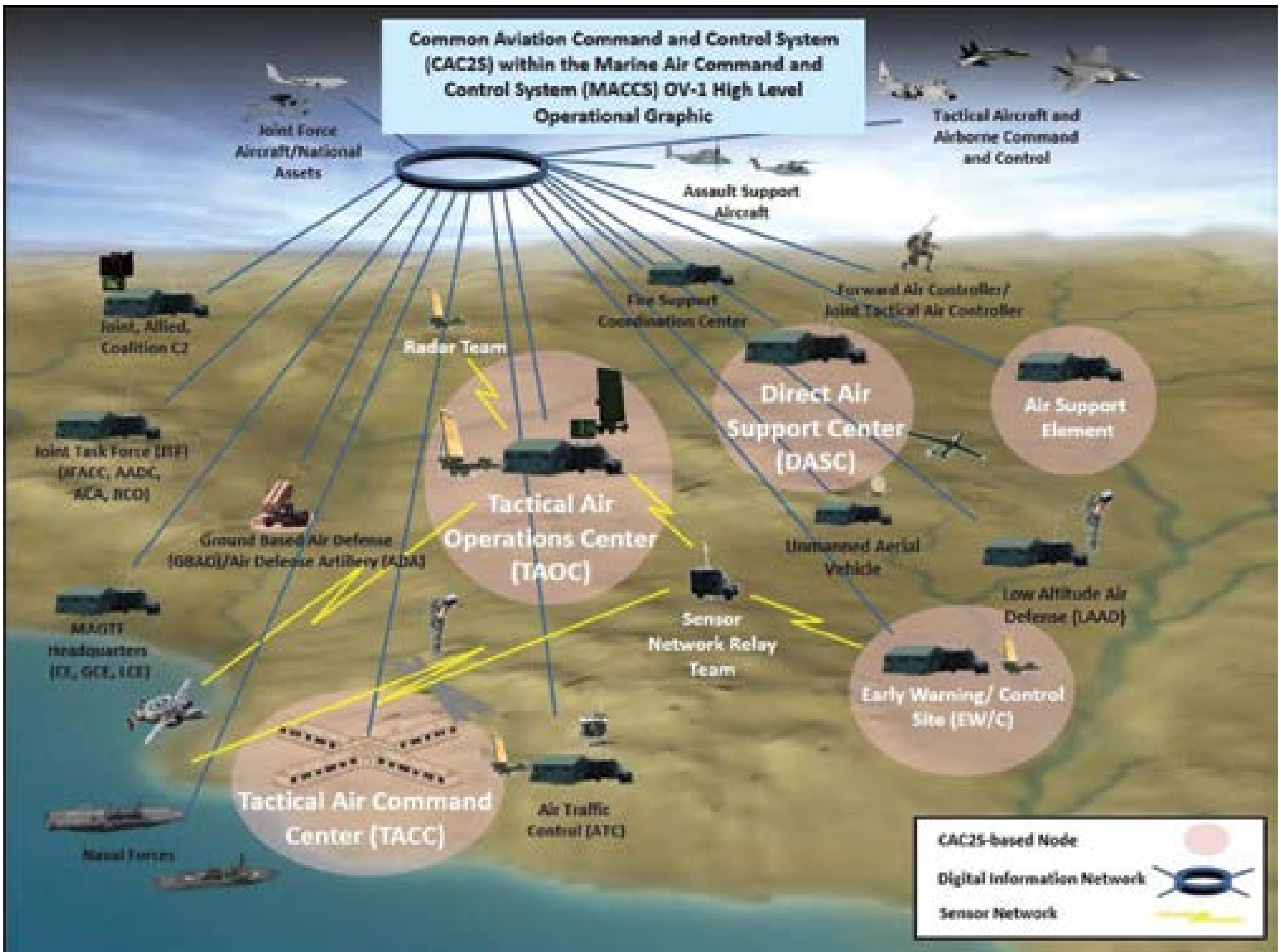
ROLES OF THE DASC

The defined DASC roles, as outlined in Marine Corps Reference Publication 3-20F.5, *Direct Air Support Center Handbook*, need to be discussed and refined. The following paragraphs describe how the DASC is an improved aviation command and control

(AC2) agency through these new capabilities.

IMMEDIATE AIR SUPPORT REQUESTS PROCESSING

The DASC processes immediate air support requests, including joint tactical air strike, assault support, and casualty evacuation requests. The process always begins with the requesting unit. Traditionally, a tactical air control party or air officer would request immediate air support via the battalion combat operations center. The request would be relayed up to an operator in the DASC, with vetting from the division fire support coordination center (FSCC) where the DASC is col-located. This is for mission number assignment, mission number verification, and aircraft sourcing data. CAC2S integrates AFATDS and Target Location, Designation, and Handoff System (commonly known as StrikeLink), on the host system. Thus, units can submit immediate air support requests, via K-Series messages to the DASC digitally. Even though StrikeLink will become obsolete in the coming years, the replacement, Target Handoff System, is interoperable with AFATDS, so this functionality will remain. As C2 becomes more and more digitalized, having this capability will improve timeliness and reduce the possibility for transcription errors. CAC2S will be able to receive requests, plot them to allow the operator to screen them for accuracy, and send mission assignment data back to the requesting unit.



Legend:
AADC—area air defense commander
ACA—airspace coordination area
C2— command and control
CAC2S—common aviation command and control system
CE—critical element
GCE—ground combat element (USMC)
JFACC—joint force air component commander
JICO—joint interface control officer
JTF—joint task force
LCE—logistics combat element (USMC)
MAGTF—Marine air-ground task force
USMC—United States Marine Corps

Figure 1. Common Aviation Command and Control System, Increment I, Phase II, is the epitome of Digital Interoperability – Enabling the DASC to facilitate critical information exchange requirements over a variety of communications pathways.

Furthermore, if the selected aircraft is TDL capable, the DASC can exercise digital air control. The request can be transmitted directly from the DASC, to the aircraft via a J12.0 Mission Assignment and a J28.2 Residual Text message, concluding with a radio call confirming the pilot received the mission assignment. This is similar to StrikeLink operations. The aviator is required to acknowledge the received mission in flight. Simultaneously, the DASC can configure routing paths to forward the data to their senior agency, the tactical air command center, to ensure that situational awareness is maintained throughout the MACCS. By conducting this immediate air support request process via digital means, the aircraft and AC2 agency host systems can populate the request data with minimal user action. This speeds the process and limits operator interaction to confirming the accuracy of the information (the authors anticipate a "read back", similar to that with close air support 9-Lines).[3] This new tasking process, specifically for immediate air support requests, is an emerging joint tactics, techniques and procedures (TTP) the authors believe will be the future of AC2 operations. The ability to quickly and accurately assign mission data to aircraft shortens the kill chain and provides rapid and accurate support to the requesting unit, thus, conserving limited aviation resources.

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CAC2S gives the DASC a link to joint aviation assets. The DASC is the principal MACCS air control agency responsible for directing air operations that directly support ground forces.[4] In a joint or combined environment, C2 of aircraft creates unique challenges. This interoperable system will enable rapid submission of air support requests to joint, combined, coalition, adjacent, and senior AC2 agencies, such as the United States Air Force (USAF) air support operations center (ASOC) or their senior agency, the air operations center.[5,6] The DASC will have the organic capability to see joint air assets' locations, altitudes, and fuel and ordnance statuses via their precise participant location and identification (PPLI) and the associated J13.2 air platform and system status message. It will allow the DASC to receive sensor contacts from adjacent AC2 agencies. CAC2S also provides the capability to plug an AN/TPS-59 or AN/TPS-80 Ground/Air Task Oriented Radar (G/ATOR) directly into the system, providing real-time tracks, allowing the DASC to conduct better asset management and selection thereby, significantly, reducing the time to request 'purple' or joint aviation assets to provide aviation fire support for ground forces engaged with the enemy.

INTEGRATING AIRCRAFT EMPLOYMENT WITH OTHER SUPPORTING ARMS

CAC2S enhances the DASC's capability to integrate aircraft employment with other supporting arms. TDLs provide DASC air controllers with accurate PPLI, along with the ability to transmit munition flight paths (also known as gun target lines), to aircraft in flight. CAC2S allows AC2 to integrate aviation assets in real time with supporting arms to maximize fire support and minimize airspace restrictions. This key tenet is outlined in Joint Publication (JP) 3-52, *Joint Airspace Control*, "Indirect fire systems are also airspace users and today range higher and farther than ever before. These increased user demands require an integrated airspace control system that facilitates mission accomplishment while reducing the possibility of unintended engagements against friendly, civil, and neutral aircraft."[7] The DASC can accomplish this by digitally building and disseminating formal and informal airspace coordination areas (ACAs) to Link 16 participants. This facilitates a permissive fires environment where surface to surface indirect fires do not require coordination with AC2 agencies. While there may be risk involved in conducting this process entirely digitally, it can be enhanced through voice communications, or agreed to be conducted entirely digitally by the MAGTF commander and joint force commander. PPLI and sensor contact data will, ultimately, allow the DASC to more effectively integrate aircraft with munition flight paths using smaller informal ACAs than procedural means alone.

The DASC, collocated with the senior FSCC, can provide this air picture to its common tactical picture. This enhanced picture provides the air officer and fire support coordinator an accurate tool, resulting in quicker decision making. Furthermore, through a JREAP C (TCP/IP or UDP/IP, which is a secure internet connection), an air picture can be sent from the DASC to a regimental FSCC when a subordinate DASC agency is in direct support of them such as a CAC2S-equipped air support element. This further disseminates common situational awareness to lower levels of the ground combat element.

MANAGE TERMINAL CONTROL ASSETS

The DASC community struggles with managing terminal control assets. According to doctrine, the DASC conducts this role by maintaining communications with the GCE and the supporting aircraft, via the tactical air control party (TACP), which is, according to doctrine, an extension of the MACCS. Managing terminal control assets enables the DASC to use these available assets for other, immediate, air support requests of higher precedence. However, dynamically re-tasking an aircraft that is already working with the GCE can be a difficult endeavor. Most Marine Corps aircraft have only two radios, therefore they cannot continuously monitor the DASC's primary frequencies. With current systems, if the DASC wanted to re-task an aircraft under a TACP's control to support another mission, the operators may have to contact the supported units' air officer who would have to direct the aircraft back to the DASC's primary frequency for coordination, or in the worst-case scenario, the DASC would be forced to transmit on the guard net, which is inefficient and potentially unsafe. The TDL capability that CAC2S provides is a viable solution to this difficult problem. The system will improve the DASC's ability to manage assets that are in their assigned airspace but working in support of terminal controllers on the ground. Information such as battle damage assessments and in flight reports can be disseminated via TDL to the DASC. The DASC can reach out to aircraft (via J28.2 Residual Text Message) and re-task the aircraft, directly. This holds true even if the aircraft are in support of a TACP and not monitoring the DASC's frequencies. This is possible because a J28.2 addressed to a specific aircraft, regardless of who the aircraft crew is talking to on the voice frequency, will still populate the aircrafts host system. This can enable the DASC to divert aircraft working with the TACP, with little required coordination. The time savings can save lives. Also, the DASC will be more efficient in multiplying the commander's combat power.

The enhanced situational awareness air tracks bring to the DASC can produce many-benefits; including shortened radio communications, minimized electronic signature, increased safety of flight for aircraft,more direct routing, and increased information exchange accuracy.

PROCEDURAL CONTROL OF AIRCRAFT IN DASC ASSIGNED AIRSPACE

The procedural control of aircraft is a rapid, expeditionary, secure, and effective means of controlling airspace with limited communication required. However, the capabilities TDLs bring to the fight should not be ignored. The enhanced situational awareness air tracks bring to the DASC can produce many benefits; including shortened radio communications, minimized electronic signature, increased safety of flight for aircraft, more direct routing, and increased information exchange accuracy. Additionally, the DASC can maintain communications with various rotary-wing platforms through a radio frequency (RF) Link 16 network designed to support the relay function of Link 16, thus, vastly increasing the DASC's RF Link 16 range. This can pose network design challenges if voice and imagery are being relayed, but this will be situationally dependent and determined by the joint force commander's information exchange requirements.

The DASC will have the ability to see near-real time aircraft locations. This ensures the DASC's air controllers can quickly see where aircraft are in an environment where it is impractical, or difficult, to manage and control airspace, simply, through procedural means. The ability to receive the radar feed from agencies like the Marine Corps' tactical air operations center or the USAF's control and reporting center, (J3.2 air tracks and PPLIs directly from aircraft to the DASC's RF Link 16 antenna), supports enhanced situational awareness to air controllers and senior decision makers alike. The DASC also will be able to fulfil more responsibility in a MACCS degradation plan, due to enhanced situational awareness enabled by CAC2S.

JOINT OPERATIONS

Modern warfare is almost always a joint endeavor. Combining the strengths of each component gives the joint force commander a unilateral capability. Through standardized joint doctrine and equipment sets, each Service component will be more prepared than ever to work with sister Services throughout a campaign. CAC2S provides the DASC, and, ultimately, the MACCS, a system that is complementary, compatible, and as capable as adjacent C2 agencies. While the specific TDL terminals will vary, the ability to process RF Link 16, and share it through JREAP connections, is the same. Not only will the DASC have a C2 system equal to or greater than other AC2 agencies such as the USAF ASOC or United States army air defense and airspace management cell, but because the DASC is col-located with the Marine Division and the senior FSCC, it will be an essential hub of information in the MAGTF area of operations. This area of operations integrates aviation, maneuver, fires, and intelligence data. This will not only keep the DASC relevant without a sensor, but will also allow rapid coordination with joint and organic aircraft, and surface fires synchronized with targetable intelligence provided through IBS.

Regularly, the Marine Corps operates as a part of a Navy-Marine Corps team (technically, this is not considered joint per JP-1).[8] The DASC will be better able to support amphibious landings and operations in support of a Marine expeditionary unit (MEU) and Navy amphibious ready group (ARG). The worldwide MEU and ARG rotation provides a, nearly, continuous presence in the Middle East. If landward control of aviation assets provided by a MEU/ARG is required for the geographic combatant commander, the MEU would be able to send a DASC element with an expeditionary CAC2S ashore to augment the already established airspace control system which, could provide positive control using their digital data links.[9]

> CAC2S will enhance the MACCS as a whole, and allow a more effective and efficient C2 of joint airoperations across the TAGS.

CAC2S will enhance the MACCS as a whole, and allow a more effective and efficient C2 of joint air operations across the TAGS. The DASC will become a more flexible agency capable of operating within the MAGTF, alongside USAF AC2 agencies, or as a stand-alone AC2 agency, depending on the mission set.

CONCLUSION

CAC2S, Increment I, Phase II, is the materiel future of the MACCS. The roles of the DASC are evolving based on new TTPs developed through enhanced capabilities. The community must notice and capture TTP as soon as CAC2S Phase II is fielded, improve understanding of TDLs in DASC operations, and redefine the role of the DASC in doctrine. There is a consensus in the AC2 community that the DASC needs to adapt to operate with improved technological advances to remain a relevant agency within the MACCS and TAGS. If leaders across the Marine Corps notice and act, the DASC will not only surpass expectations, but will become an AC2 agency capable of excelling in a digital interoperability environment, integrating with new technology such as the AN/TPS-80 G/ATOR radar system and the F-35 joint strike fighter to support the MAGTF commander on the modern battlefield.

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[5] JP 3-30, *Command and Control of Joint Air Operations*, 10 February 2014

[6] JP 3-52, *Joint Airspace Control*, 13 November 2014

[7] Ibid.

[8] JP-1, *Doctrine for the Armed Forces of the United States*, 25 March 2013.

[9] JP 3-52, *Joint Airspace Control*, 13 November 2014.

KILL BOX UPDATE

Editor Note - Originally published in 2008, "Kill Box Update" describes changes proposed and then incorporated into ALSA's *Multi-Service Tactics, Techniques, and Procedures (MTTP) for Kill Box Employment*. As Services develop multi-domain concepts and further evolve all-domain coordination in joint operations, understanding the cross-domain coordination of joint fires will be critical. Revisiting "Kill Box Update" may generate discussion by providing an example of how tactical change drives future doctrine.

By Col (R) David Neuenswander, USAF, Mr. Bo Bielinski, Col Russ Smith, USAF

Although kill boxes have been employed using various procedures since Desert Storm, recent attempts to refine kill box tactics, techniques, and procedures (TTP) may have generated confusion within the Services and the joint community. At the July 2008 Air Land Sea Application (ALSA) Center Joint Working Group (JWG) conducted to revise *Multi-Service Tactics, Techniques, and Procedures (MTTP) for Kill Box Employment*, senior US Army and US Air Force doctrine representatives agreed to write this article to clarify the way ahead for this publication. This discussion outlines a brief history of kill boxes, an explanation of the joint fires area (JFA) concept, and the way forward for the Kill Box MTTP publication revision.

During Desert Storm, the air component employed kill boxes as a way to conduct air interdiction against enemy ground forces and mobile targets beyond the fire support coordination line (FSCL). Kill boxes were defined as 30 degree by 30 degree grids on the map, which translated to 30 NM in latitude and something slightly less in width depending on how far north or south of the equator the kill box was located. Kill boxes primarily served as airspace coordinating measures (ACMs) to deconflict and control aircraft conducting air interdiction. US Air Force killer scouts provided target information and deconflicted aircraft assigned to specific kill boxes. In the absence of a theater-wide area reference system, kill boxes were often employed to expedite aircraft from one area to another beyond the FSCL.

Kill boxes remained 30 by 30 grids during operations in Kosovo and during the initial operations in Afghanistan. In 2002, United States Central Command Air Forces (USCENTAF) created Kill Box Interdiction-Close Air Support (KICAS) procedures prior to Operation Iraqi Freedom (OIF). KICAS procedures labeled all 30 by 30 grids in the joint operations area (JOA) as kill boxes. For the first time, these kill boxes could be further subdivided into nine 10 NM by 10 NM keypads. In the KICAS TTP, air interdiction was conducted in an "open" kill box. When a kill box was "open" the land component would not allow surface-to-surface indirect fires into the area above a previously coordinated altitude. If a kill box was not open, it could be used for any type of activity. Since all 30 by 30 grids were called kill boxes, a kill box became a defacto area reference system.

During numerous post-OIF after-action conferences and reports, the joint community developed a number of recommendations for the future employment of kill boxes. Some of the major recommendations were:

1. A kill box should be defined as a fire support coordination measure (FSCM) rather than an ACM.
2. Kill boxes should only be employed for interdiction and not as an area reference system (e.g., don't send an aircraft to a kill box unless they are supposed to kill something).
3. A separate area reference system should be developed to assist the joint force with FSCMs and ACMs and the reference system should allow areas with smaller divisions than 10 NM by 10 NM.

US Army photo.

4. There should be two types of kill boxes: one which integrates air-to-surface fires with surface-to-surface indirect fires and one which only allows air-to-surface fires.

5. There was discussion that the term "kill box" was too barbaric and that the Department of Defense should develop another term. Ultimately, the subject matter experts attending the kill box JWGs pressed on with kill box as the accepted term.

ALSA sponsored the kill box TTP development process resulting in the initial publication of the Kill Box MTTP in June 2005. This new publication included the following major concepts:

1. For the first time kill boxes were identified as FSCMs.

2. Kill boxes are established and adjusted by component commanders in consultation with superior, subordinate, supporting, and affected commanders, and they are an extension of existing support relationships established by the joint force commander.

3. There were two types of kill boxes, blue and purple.

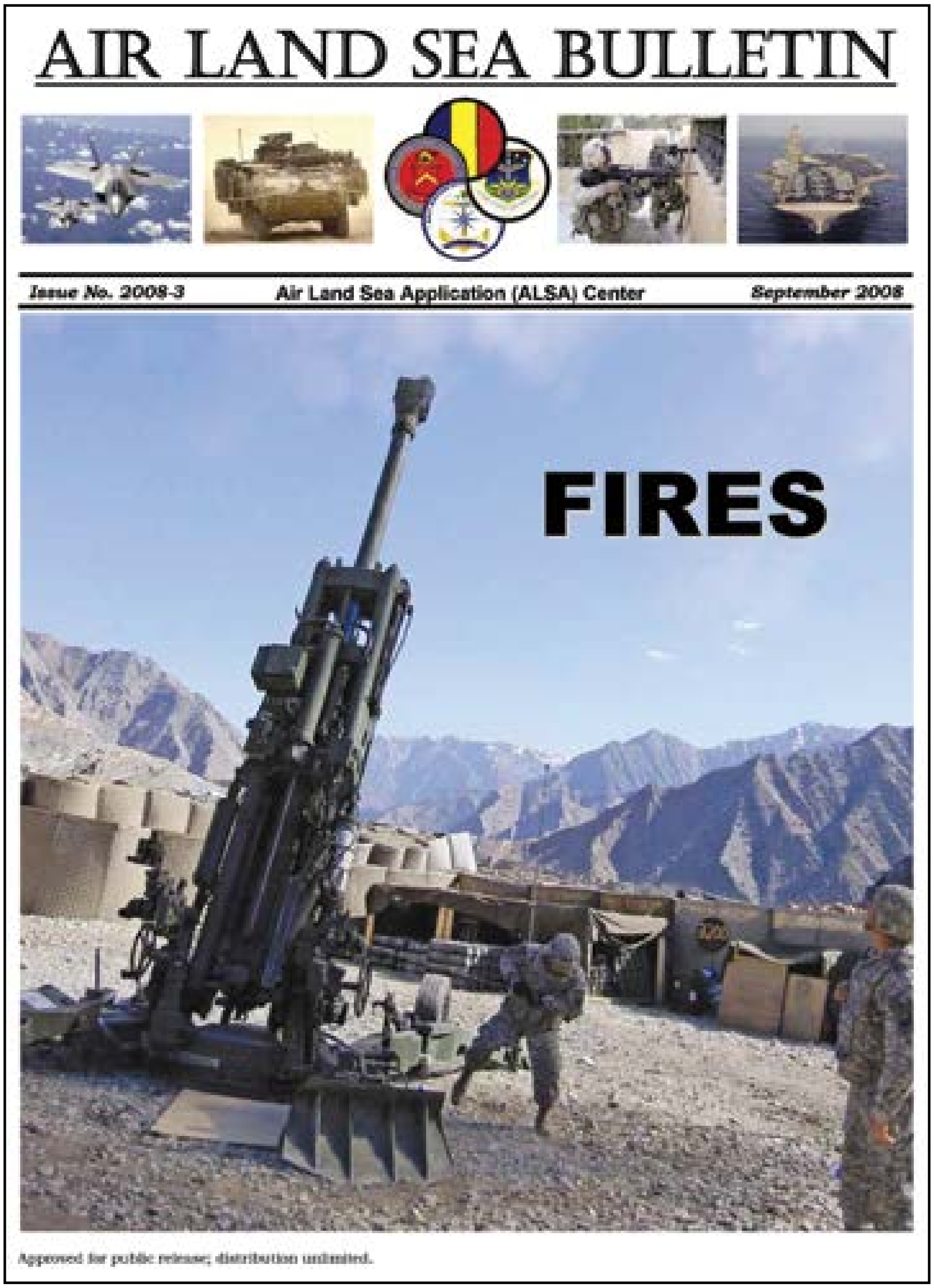
   a. Blue kill boxes permitted air-to-surface fires in the kill box without further coordination with the establishing headquarters.

   b. Purple kill boxes integrated air-to-surface fires in the kill box (usually with an altitude restriction) with surface-to-surface indirect fires (usually with a maximum ordnance defined) without further coordination with the establishing headquarters.

4. For the first time, kill boxes were separated from the area reference system.

   a. Kill boxes would no longer be used as an area reference system.

   b. Kill box boundaries normally would be defined using an area reference system (e.g., Appendix E, Common Geographic Reference System [CGRS]), but could follow well-defined terrain features or may be located by grid coordinates or by a radius from a center point.



This article originally appeared in the 2008 edition of the Air Land Sea Bulletin.

c. The only time aircraft would be sent to a kill box was to perform air interdiction.

d. Air battle management functions that previously used kill boxes as a reference system (e.g., " Lancer 1, proceed to kill box 18I for refueling.") would now use CGRS for ACM functions not involving air interdiction (e.g., "Lancer 1, proceed to cell 18I for air refueling.").

In February 2005, while the Kill Box MTTP publication entered the final stages of development, the Director, Operational Test and Evaluation initiated the joint fires coordination measures (JFCM) Joint Test & Evaluation (JT&E) with the task to investigate, evaluate, and make recommendations to improve the effectiveness of kill boxes by standardizing TTP at the operational level. The JFCM JT&E research effort focus eventually shifted to creating and developing the JFA concept.

After several years of testing, the JFCM JT&E published a draft JFA TTP document. This TTP manual contained approximately 85% of the information from the 2005 Kill Box MTTP publication and it amplified details on coordinator duties, establishing authority, control of assets, and deconfliction requirements relative to each joint force component's command and control responsibilities. In addition, the JFA TTP updated the reference system to include the new Global Area Reference System (GARS). One major point of departure for the JFA TTP involved the absence of colorized containers; JFAs represented only the intended effects area and the airspace needed for deconfliction vice blue and purple designations. Furthermore, the area reference system choice was delineated as a separate ACM function not tied to the establishment of a JFA FSCM.

The JFCM JT&E recommended that JFA TTP be incorporated (in its entirety) into the next revision of the ALSA Kill box MTTP publication and into joint doctrine as appropriate. However, full implementation of the JFA TTP requires the development and fielding of a new software program entitled the JFA manager (JFAM). This software is a specific tool which is planned to reside within the Joint Automated Deep Operations Control System command and control software program. Unfortunately, the JFAM software is not scheduled for release until CY 2009.

Concurrent with the JFCM joint test, US Forces Korea (USFK) modified the draft JFA TTP into the JFA-K (JFA-Korea TTP). The JFA-K was a significant modification of the original JFA TTP, though it worked well for the specific challenges on the Korean Peninsula. JFA-K TTP involves multiple layers of different colored JFAs, with each color corresponding to a specific altitude deconfliction level.

When the first ALSA Kill Box JWG met in May 2008 to revise the publication, they reviewed the JFA TTP for inclusion. Subject matter experts at the JWG contemplated replacing the term kill box with JFA; however, the JFA TTP could not be fully implemented as designed without the JFAM, and the JFAM would not be ready for implementation until well after the Kill Box MTTP revision's release date. Additionally, it was decided to not base the revised TTP on an untried and untested future software version (the JFAM) which may or may not meet the needs of the warfighter. Lastly, it was decided to maintain the original kill box color delineations.

With respect to the JFA TTP concept, the Service subject matter experts attending the May 2008 JWG chose the following courses of action:

1. Implement best practices from the JFA TTP but not use the name JFA until the JFAM software is available (potentially during a future ALSA Kill Box MTTP revision).
2. Retain the purple and blue kill boxes.
3. Recommend GARS rather than CGRS as the reference system of choice.

NOTE: USFK representatives advised the working group that Korea will retain the JFA-K TTP rather than use the term kill box.

To date, ALSA has conducted two kill box JWGs to revise the publications and it will be released early in CY 2009. Thanks to the efforts of the JFCM JT&E and their work on the JFA TTP, the new Kill Box MTTP publication will be much improved over the original.

OVER THE HORIZON

The Air Land Sea Application (ALSA) Center identifies tactical gaps in the joint forces' abilities to integrate combat forces. Once identified, ALSA primarily uses education, through the publication of multi-Service tactics, techniques, and procedures (MTTP) manuals to inform joint warfighters. As future combined joint all-domain command and control (CJADC2) systems grow, ALSA will be instrumental in identifying best practices, common terminology, and key nodes to integrate joint warfighters at the tactical echelon.

Currently, the United States Air Force (USAF) envisions CJADC2 as "kill chain optimization and battle management orchestration"[1] through the Advanced Battle Management Systems (ABMS). ABMS is the replacement to the Theater Battle Management Core Systems (TBMCS). The USAF intends to use artificial intelligence (AI) to aid in filtering massive amounts of both actively and passively gathered intelligence to produce highly reliable and actionable information to leadership.[2]

The United States Army (USA) is developing faster information networks enabling all-domain command and control across the competition continuum. Additionally, USA leadership envisions network-enabled operations linking soldiers within every combat echelon with sensors from joint and combined forces allowing real-time sharing of critical information.[3] Linking joint and combined forces to enable information sharing is critical to effective all-domain operations while limiting fratricide risks.

The United States Navy (USN) and United States Marine Corps (USMC) are driving all-domain operations through AI-enabled networks paired with manned and unmanned systems to share intelligence across the fleet.[4] The USN's approach utilizes parts of the USAF and USA's vision for CJADC2. However, the common thread is AI-enabled networks capable of providing real-time information across the competition continuum to create faster decision times for leaders.

Currently, ALSA sees the link between USAF airpower with USA and USMC warfighters as the likely node for CJADC2 confusion in future operations. As the USA develops weapon systems capable of exceeding traditional boundary lines, the ability to integrate fires from multiple domains becomes extremely important. As the pace of combat quickens, and the geographic size of future battlespace expands, it becomes critical for Services to integrate CJADC2 systems effectively allowing efficient command and control across the joint force.

ALSA asks all joint warfighters to capture CJADC2 lessons learned, to communicate those lessons to ALSA action officers, and to provide links with future CJADC2 exercises so that ALSA can capture best practices and educate joint warfighters through upcoming MTTPs such as Joint Application of Firepower (JFIRE), Strike Coordination and Reconnaissance (SCAR), and Airspace Control.

END NOTES

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MAJOR EVENTS OF INTEREST

Date	Unit/Event	Description	Location	POC
10 Aug-12 Aug	ACC/A3 Joint Airspace Conference	Newly formed for all Services to discuss Airspace concerns	Virtual; Langley AFB, VA	Air/Sea Branch
22 Aug-27 Aug	Nellis and NTC Engagement	MTTP research and SME recruitment/engagement ICW Fighter Integration JWG	Nellis AFB, NV, and National Training Center, CA	Air/Sea Branch
23 Aug-27 Aug	AF IT and Cyberpower Symposium	Cyber Operations	Maxwell AFB, AL	C2, Space, and Cyber Branch
31 Aug-3 Sep	Future Fires Conference	Annual fires conference (JFIRE focus)	Virtual	Land Branch
20 Sep-24 Sep	AF IW WEPTAC	Information Warfare Exercise	Lackland AFB, TX	Air/Sea Branch
20 Sep-24 Sep	Northwest Engagement	MTTP research and MDTF engagement	JB Lewis-McChord and NAS Whidbey Island, WA	Land Branch
20 Sep-24 Sep	Special Operations Joint Interoperability Working Group	Interoperability collabora-tion event with CF and SOF stakeholders	Tampa, FL	Land Branch
20 Sep-24 Sep	Doctrine Developer's Course	US Army Course	Fort Lee, VA	US Army
26 Oct-29 Oct	Army Doctrine Developer's Forum	US Army Course	Fort Leavenworth, KS	US Army
08 Nov-17 Nov	Bold Quest 21.2	Interoperability study for digital CAS/fires and JFIRE research	Camp Atterbury, IN	Air/Sea Branch
15 Nov-18 Nov	Land Branch Research and Outreach TDY	EO and Non-Lethal Weapons	Fort Leonard Wood, MO	Land Branch
11 Dec 13-Dec	Association of the United States Army	Annual symposium which includes forums on wide ranging topics.	Washington, DC	Land Branch

ALSA JOINT WORKING GROUPS

Date	Publication	Location	Point of Contact
23 Aug -27 Aug 21	Fighter Integration	Nellis AFB/561 JTS	Air/Sea Branch
23 Aug-27 Aug 21	Brevity	Joint Base Langley-Eustis, VA/ MS Teams	C2, Space, and Cyber Branch
25 Oct-29 Oct 21	ISR Optimization	TBD	C2, Space, and Cyber Branch
06 Dec-10 Dec 21	ISR Optimization	TBD	C2, Space, and Cyber Branch
24 Jan-28 Jan 22	ATSRSE	TBD	C2, Space, and Cyber Branch
All Dates are Tentative			

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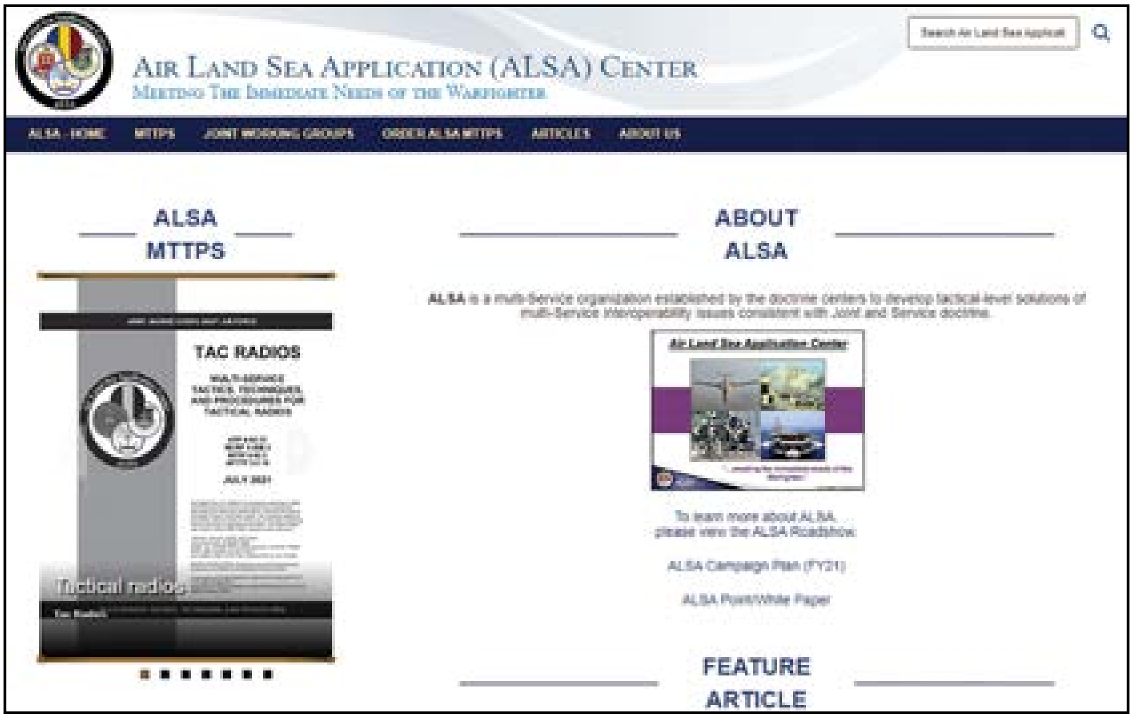

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Navy - https://nwdc.navy.mil/

Air Force - https://www.airuniversity.af.edu/LeMay/

CURRENT ALSA MTTP PUBLICATIONS

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TITLE	DATE	PUB #	DESCRIPTION/STATUS
ACC *Multi-Service Tactics, Techniques, and Procedures for Air Control Communication* **Public Release**	14 FEB 20	ATP 3-52.4 MCRP 3-20F.10 NTTP 6-02.9 AFTTP 3-2.8	Description: This publication provides MTTP for the control and coordination of air operations in tactical command and control managed areas of responsibility. **Status: Revision**
AMD *Multi-Service Tactics, Techniques, and Procedures for Air and Missile Defense* **Distribution Restricted**	14 MAR 19	ATP 3-01.15 MCTP 10-10B NTTP 3-01.8 AFTTP 3-2.31	Description: This publication provides joint planners a consolidated reference on Service air defense systems, processes, and structures to include integration procedures. **Status: Revision**
AOMSW *Multi-Service Tactics, Techniques, and Procedures for Air Operations in Maritime Surface Warfare* **Distribution Restricted**	18 DEC 20	ATP 3-04.18 MCRP 3-20.2 NTTP 3-20.8 AFTTP 3-2.74	Description: This publication consolidates Service doctrine, TTP, and lessons-learned from current operations and exercises to maximize the effectiveness of air attacks on enemy surface vessels. **Status: Current**
AVIATION URBAN OPERATIONS *Multi-Service Tactics, Techniques, and for Aviation Urban Operations* **Distribution Restricted**	27 APR 16	ATP 3-06.1 MCRP 3-35.3A NTTP 3-01.04 AFTTP 3-2.29	Description: This publication provides MTTP for tactical-level planning and execution of fixed- and rotary-wing aviation urban operations. **Status: Revision**
DYNAMIC TARGETING *Multi-Service Tactics, Techniques, and Procedures for Dynamic Targeting* **Distribution Restricted**	10 SEP 15	ATP 3-60.1 MCRP 3-16D NTTP 3-60.1 AFTTP 3-2.3	Description: This publication provides the JFC, operational staff, and components MTTP to coordinate, de-conflict, synchronize, and prosecute dynamic targets in any AOR. It includes lessons learned, and multinational and other government agency considerations. **Status: Revision**
FIGHTER INTEGRATION *Multi-Service Tactics, Techniques, and Procedures for Fighter Integration* **Classified SECRET**	15 JUN 20	MCRP 3-20.7 NTTP 3-22.6 AFTTP 3-2.89	Description: This publication is a single-source set of integration standards intended to enhance commonality when operating with multiple-mission design series or type, model, and series fighter aircraft during an air-to-air mission. It establishes baseline intercept contracts with the associated communications plan. **Status: Revision**
JFIRE *Multi-Service Tactics, Techniques, and Procedures for the Joint Application of Firepower* **Distribution Restricted**	15 SEP 19	ATP 3-09.32 MCRP 3-16.6A NTTP 3-09.2 AFTTP 3-2.6	Description: This is a pocket-sized guide of procedures for calls for fire, CAS, and naval gunfire. It provides tactics for joint operations between attack helicopters and fixed-wing aircraft performing integrated battlefield operations. **Status: Current**
JSEAD *Multi-Service Tactics, Techniques, and Procedures for the Suppression of Enemy Air Defenses in a Joint Environment* **Distribution Restricted**	15 DEC 15	ATP 3-01.4 MCRP 3-22.2A NTTP 3-01.42 AFTTP 3-2.28	Description: This publication contributes to Service interoperability by providing the JTF and subordinate commanders, their staffs, and SEAD operators a single reference. **Status: Revision**
KILL BOX *Multi-Service Tactics, Techniques, and Procedures for Kill Box Employment* **Distribution Restricted**	18 JUN 18	ATP 3-09.34 MCRP 3-31.4 NTTP 3-09.2.1 AFTTP 3-2.59	Description: This MTTP publication outlines multi-Service kill box planning procedures, coordination requirements, employment methods, and C2 responsibilities. **Status: Revision**
PR *Multi-Service Tactics, Techniques, and Procedures for Personnel Recovery* **Distribution Restricted**	4 JUN 18	ATP 3-50.10 MCRP 3-05.3 NTTP 3-57.6 AFTTP 3-2.90	Description: This MTTP publication for personnel recovery is a single source, descriptive, reference guide for staffs and planners executing the military option of personnel recovery using joint capabilities. **Status: Revision**
SCAR *Multi-Service Tactics, Techniques, and Procedures for Strike Coordination and Reconnaissance* **Distribution Restricted**	31 JAN 18	ATP 3-60.2 MCRP 3-20D.1 NTTP 3-03.4.3 AFTTP 3-2.72	Description: This publication provides strike coordination and reconnaissance MTTP to the military Services for conducting air interdiction against targets of opportunity. **Status: Revision**
SURVIVAL, EVASION, AND RECOVERY *Multi-Service actics, Techniques, and Procedures for Survival, Evasion, and Recovery* **Distribution Restricted**	21 AUG 19	ATP 3-50.3 MCRP 3-02H NTTP 3-50.3 AFTTP 3-2.26	Description: This is a weather-proof, pocket-sized, quick-reference guide of basic information to assist Service members in a survival situation regardless of geographic location. **Status: Project Assessment**

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TITLE	**DATE**	**PUB #**	**DESCRIPTION/STATUS**
UAS *Multi-Service Tactics, Techniques, and Procedures for Tactical Employment of Unmanned Aircraft Systems* **Distribution Restricted**	22 JAN 15	ATP 3-04.64 MCRP 3-42.1A NTTP 3-55.14 AFTTP 3-2.64	Description: This publication establishes MTTP for UAS by addressing tactical and operational considerations, system capabilities, payloads, mission planning, logistics, and multi-Service execution. **Status: FY19 Rescind Approved**

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TITLE	**DATE**	**PUB #**	**DESCRIPTION/STATUS**
ADVISING *Multi-Service Tactics, Techniques, and Procedures for Advising Foreign Forces* **Distribution Restricted**	13 NOV 17	ATP 3-07.10 MCRP 3-33.8A NTTP 3-07.5 AFTTP 3-2.76	Description: This publication discusses how advising fits into security assistance/security cooperation and provides definitions for specific terms as well as listing several examples to facilitate the advising process. **Status: Revision**
AIRFIELD OPENING *Multi-Service Tactics, Techniques, and Procedures for Airfield Opening* **Approved for Public Release**	27 OCT 18	ATP 3-17.2 MCRP 3-20B.1 NTTP 3-02.18 AFTTP 3-2.68	Description: This publication provides guidance for operational commanders and staffs on opening and transferring an airfield. It contains information on Service capabilities, planning considerations, airfield assessment, and establishing operations in all operational environments. **Status: Revision**
BIOMETRICS *Multi-Service Tactics, techniques, and Procedures for Tactical Employment of Biometrics in Support of Operations* **Distribution Restricted**	30 APR 20	ATP 2-22.85 MCRP 3-33.1J NTTP 3-07.16 AFTTP 3-2.85 CGTTP 3-93.6	Description: Fundamental TTP for biometrics collection planning, integration, and employment at the tactical level in support of operations is provided in this publication. **Status: Current**
CF-SOF *Multi-Service Tactics, Techniques, and Procedures for Conventional Forces and Special Operations Forces Integration and Interoperability* **Distribution Restricted**	4 APR 18	FM 6-05 MCRP 3-30.4 NTTP 3-05.19 AFTTP 3-2.73 USSOCOM Pub 3-33	Description: This is a comprehensive reference for commanders and staffs at the operational and tactical levels with standardized techniques and procedures to assist in planning and executing operations requiring synchronization between CF and SOF occupying the same area of operations. **Status: Revision**
DEFENSE SUPPORT OF CIVIL AUTHORITIES (DSCA) *Multi-Service Tactics, Techniques, and Procedures for Defense Suport of Civil Authorities* **Approved for Public Release**	11 FEB 21	ATP 3-28.1 MCRP 3-30.6 NTTP 3-57.2 AFTTP 3-2.67	Description: DSCA sets forth MTTP, at the tactical level, to assist the military planner, commander, and individual Service forces in employing military resources in response to domestic emergencies, in accordance with US law. **Status: Current**
EO *Multi-Service Tactics, Techniques, and Procedures for Unexploded Explosive Ordnance Operations* **Distribution Restricted**	12 MAR 20	ATP 4-32.2 MCRP 3-17.2B NTTP 3-02.4.1 AFTTP 3-2.12	Description: This publication provides commanders and their units guidelines and strategies for planning and operating in an explosive ordnance environment while minimizing the impact of explosive ordnance on friendly operations. **Status: Current**
FORENSICS *Multi-Service Service Tactics, Techniques, and Procedures for Expeditionary Forensics* **Distribution Restricted**	30 Oct 20	ATP 3-39.21 MCRP 10-10F.5 NTTP 3-07.8 AFTTP 3-2.7 CGTTP 3-93.10	Description: This publication ensures succesful planning, integration, and employment of expeditionary forensic capabilities at the tactical level in support of operations. The TTP details the six forensic functions that occur during, or in support of, tactical operations. It is designed for tactical level commanders, staffs, small unit leaders, and collectors so that they may execute the forensic functions successfully. **Status: Current**
MILITARY DIVING OPERATIONS (MDO) *Multi-Service Service Tactics, Techniques, and Procedures for Military Diving Operations* **Approved for Public Release**	2 JAN 19	ATP 3-34.84 MCRP 10-10D.1 NTTP 3-07.7 AFTTP 3-2.75 CGTTP 3-95.17	Description: This publication is a single-source, descriptive-reference guide to ensure effective planning and integration of multi-Service diving operations. It provides combatant command, joint force, joint task force, and operational staffs a comprehensive resource for planning military diving operations, including considerations for each Service's capabilities, limitations, and employment. **Status: Revision**
NONLETHAL WEAPONS (NLW) *Multi-Service Service Tactics, Techniques, and Procedures for the Tactical Employment of Nonlethal Weapons* **Distribution Restricted**	29 MAY 20	ATP 3-22.40 MCTP 10-10A NTTP 3-07.3.2 AFTTP 3-2.45 CGTTP 3-93.2	Description: This publication provides a single-source, consolidated reference on employing nonlethal weapons. Its intent is to make commanders and subordinates aware of using nonlethal weapons in a range of scenarios including security, stability, crowd control, determination of intent, and situations requiring the use of force just short of lethal. **Status: Current**

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OP ASSESSMENT *Multi-Service Tactics, Techniques, and Procedures for Operation Assesment* **Approved for Public Release**	07 FEB 20	ATP 5-0.3 MCRP 5-10.1 NTTP 5-01.3 AFTTP 3-2.87	Description: This publication serves as a commander and staff guide for integrating assessments into the planning and operations processes for operations conducted at any point along the range of military operations. **Status: Current**
PEACE OPS *Multi-Service Tactics, Techniques, and Procedures for Conducting Peace Operations* **Approved for Public Release**	2 MAY 19	ATP 3-07.31 MCTP 3-03B AFTTP 3-2.40	Description: This publication offers a basic understanding of joint and multinational PO, an overview of the nature and fundamentals of PO, and detailed discussion of selected military tasks associated with PO. **Status: Current** **Ownership of this MTTP and responsibility for future revisions has been transferred to the Peacekeeping and Stability Operations Institute**
TACTICAL CONVOY OPERATIONS *Multi-Service Tactics, Techniques, and Procedures for Tactical Convoy Operations* **Distribution Restricted**	26 MAR 21	ATP 4-01.45 MCRP 4-11.3H NTTP 4-01.6 AFTTP 3-2.58	Description: This is a quick-reference guide for convoy commanders operating in support of units tasked with sustainment operations. It includes TTP for troop-leading procedures, gun-truck employment, countering IEDs, and battle drills. **Status: Current**

COMMAND AND CONTROL (C2), CYBER AND SPACE BRANCH–POC: alsaC@us.af.mil			
TITLE	**DATE**	**PUB #**	**DESCRIPTION/STATUS**
AIRSPACE CONTROL *Multi-Service Tactics, Techniques, and Procedures for Airspace Control* **Distribution Restricted**	14 FEB 19	ATP 3-52.1 MCRP 3-20F.4 NTTP 3-56.4 AFTTP 3-2.78	Description: This MTTP publication is a tactical-level document which synchronizes and integrates airspace C2 functions and serves as a single-source reference for planners and commanders at all levels. **Status: Revision**
AIR-TO-SURFACE RADAR SYSTEM EMPLOYMENT *Multi-Service Tactics, Techniques, and Procedures for Air-to-Surface Radar System Employment* **Distribution Restricted**	23 OCT 19	ATP 3-55.6 MCRP 2-10A.4 NTTP 3-55.13 AFTTP 3-2.2	Description: This publication covers theater-level, air-to-surface radar systems and discusses system capabilities and limitations performing airborne command and control; wide area surveillance for near-real-time targeting and target development; and processing, exploiting, and disseminating collected target data. **Status: Current**
BREVITY (Change 1) *Multi-Service Brevity Codes* **Approved for Public Release**	28 MAY 20	ATP 1-02.1 MCRP 3-30B.1 NTTP 6-02.1 AFTTP 3-2.5	Description: This publication defines multi-Service brevity which standardizes air-to-air, air-to-surface, surface-to-air, and surface-to-surface brevity code words in multi-Service operations. **Status: Project Assessment**
ISR OPTIMIZATION *Multi-Service Tactics, Techniques, and Procedures for Intelligence, Surveillance, and Reconnaissance Optimization* **Distribution Restricted**	3 SEP 19	ATP 3-55.3 MCRP 2-10A.8 NTTP 2-01.3 AFTTP 3-2.88	Description: This publication provides a comprehensive resource for planning, executing, and assessing surveillance, reconnaissance, and processing, exploitation, and dissemination operations. **Status: Project Assessment**
TACTICAL RADIOS *Multi-Service Tactics, Techniques, and Procedures for Tactical Radios* **Distribution Restricted**	14 JUL 21	ATP 6-02.72 MCRP 3-30B.3 NTTP 6-02.2 AFTTP 3-2.18	Description: This publication is a single source, descriptive reference guide to ensure tactical level operators and planners have a comprehensive resource for planning, employing, creating, and operating radio networks in a Joint Service Environment. **Status: Current**
TAGS *Multi-Service Tactics, Techniques, and Procedures for the Theater Air-Ground System* **Approved for Public Release**	21 MAY 20	ATP 3-52.2 MCRP 3-20.1 NTTP 3-56.2 AFTTP 3-2.17	Description: This publication promotes Service awareness regarding the role of airpower in support of the JFC's campaign plan, increases understanding of the air-ground system, and provides planning considerations for conducting air-ground ops. **Status: Current**

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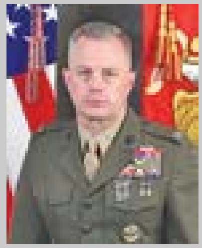

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ALSA is the principal DOD organization charged with synchronizing joint warfighting capabilities at the tactical level. We will accomplish this through professional networking, collaborative tools, digital media and any method that allows us to engage and inform the warfighter. Adaptability, credibility, and speed are the pillars of ALSA's organizational culture. These characteristics ensure we provide timely, relevant, and accessible multi-Service solutions in ways that bolster the interoperability and lethality of the Joint Force.

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