Document created: 10 October 00

Transforming Warfare with Effects-Based Joint Operations

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The Quadrennial Defense Review can transform warfare and dramatically increase strategic options across a range of threats from theater war to stability operations by recommending that the Services train and equip their forces to conduct effects-based joint operations. Effects-based joint operations would transform warfare by using a theater team of airborne Command, Control, Intelligence, Surveillance, and Reconnaissance (C2ISR) systems to manage the decentralized execution of U.S. aerospace sorties (Air Force, Navy, Marine Corps, and Army) targeting enemy land forces. Key to the transformation would be the use of friendly (not necessarily U.S.) land maneuver to support this asymmetrical engagement of enemy land forces. The transformation is possible because advances in wide-area, real-time airborne ground surveillance and battle management systems make it feasible for air attacks to create physical and psychological "effects" that in combination can quickly prevent a fielded land force from being able to function well enough to achieve desired objectives. Effects-based joint operations would increase strategic options by making it possible to achieve success faster and more efficiently with less risk for U.S. personnel than is possible in operations that depend on primarily on physical attrition and the close battle to defeat enemy land forces.

The Importance of the C2ISR Team

The unprecedented airborne surveillance and battle management capabilities provided by a theater C2ISR team of consisting of the Joint Surveillance Target Attack Radar System, Airborne Warning And Control System, and Rivet Joint make effects-based joint operations possible. The team possesses the advantages of powerful, wide-area sensors; line-of-sight communications with most combatants; and, most importantly, the large crews needed for the real-time management of both surveillance and target attacks. The C2ISR team's combination of surveillance and surveillance management capabilities are the key to achieving dominant battlespace awareness. The team's battle management capabilities make it feasible to exploit this dominant battlespace awareness in real-time to achieve the functional effect of paralysis by targeting air attacks against those enemy machines that are being operated.

The C2ISR team enhances U.S. expeditionary capabilities because the team and the aircraft it targets (fighters, bombers, and armed helicopters) can quickly self-deploy to a distant theater. But this is not the only way. The team also enhances the expeditionary capabilities of U.S. land forces by dramatically reducing and, in some scenarios, even eliminating their need to engage powerful enemy army units in close combat. Reducing or eliminating close combat requirements complements the Army's "medium-weight" combat unit transformation initiative by allowing U.S. land forces to be much easier to deploy quickly and maneuver rapidly once in theater.

The C2ISR team reduces or eliminates close combat requirements in several ways. The air attacks the team manages make it possible to halt powerful enemy units before they can move close enough to friendly land forces to effectively employ their organic weapons. These attacks also create an important maneuver advantage for friendly land forces by allowing them to avoid close combat except under ideal conditions because enemy forces subject to air attack would be unable to move as quickly. By causing enemy forces to be unable or unwilling to move, the attacks would enhance the maneuver of U.S. land forces. Plus, the C2ISR team provides the real-time information U.S. commanders need to maneuver their land forces most effectively.

Achieving and Exploiting Dominant Battlespace Awareness

The C2ISR team achieves dominant battlespace awareness by making it possible to exploit the reality that an army is a system whose ability to function effectively depends on movement and machines. Throughout the history of warfare effective army commanders have been masters at orchestrating the movement of their forces to create the advantages of superior force ratios, favorable positions, surprise, and protection. During the twentieth century technology in the form of motorized vehicles transformed the conduct of land warfare at both the operational (campaign) and tactical (battlefield) levels by greatly enhancing the ability of armies to move combat forces and their logistical support. Today, all but the most primitive armies rely heavily on vehicles to perform a variety of critically important military functions such as maneuvering, targeting (e.g., with radar equipped vans), delivering heavy firepower, protecting (through armor and movement), constructing, communicating (e.g. carrying heavy radios), and re-supplying.

It is difficult to conceive of an opposing army attempting a powerful, high-tempo land offensive that does not use thousands of vehicles because of the many important functions vehicles perform in the conduct of land warfare. And given the vulnerability of fixed facilities, the anti-access capabilities that would be employed to protect such an offensive are also likely to make extensive use of vehicles. Even internal oppression operations are likely to rely heavily on the use of vehicles. For example, as was the case with Iraqi internal oppression operations, Serbia's operations in the Balkans were characterized by the use of large numbers of vehicles with army artillery and tank support providing protection for their paramilitary forces.

The C2ISR team's unprecedented surveillance and surveillance management capabilities take advantage of the central role that movement and machines play in modern land warfare to provide and exploit dominant battlespace awareness. It is the role of machines that makes it so difficult for an enemy to counter effects-based joint operations. For example, if an enemy avoids using his machines, he loses all the advantages they provide, rendering his forces much less capable of aggression and making them extremely vulnerable to defeat by forces possessing the advantages their own machines provide. Those familiar with the advantages machines provide understand why the North Vietnamese increased their reliance on machines throughout the war in Southeast Asia and why mechanized units were among the last U.S. Army forces withdrawn. Contrary to the myth that the North Vietnamese effort was sustained by bicycles, the reality was that they devoted huge efforts to making the Ho Chi Minh Trail capable of sustaining increasingly large amounts of truck traffic.

The C2ISR team's combination of sensors make it possible for them to "see" machines in real-time whenever they are being operated (moving or emitting) within a wide area, even in darkness and adverse weather. By cross-cueing each other's sensors, as well as those on Unmanned Aerial Vehicles (UAVs) and other surveillance platforms, and then correlating the information that is collected, the team can quickly and reliably detect, precisely locate, and accurately characterize an enemy's machines. (This information could be further enhanced by giving the team the ability to subscribe to geo-filtered and identification-filtered friendly location and status information to create a composite display of forces essential for reducing the risk of fratricide.) The team can then quickly and securely disseminate its information to a Joint Force Commander (JFC), his component commanders, and their subordinate echelons to ensure that all share the same real-time situational awareness.

The C2ISR team's Ground Moving Target Indicator (GMTI) radar surveillance performance plays an especially important role in achieving and then exploiting dominant battlespace awareness. This performance makes it possible to collect persistent, real-time information on both enemy and friendly vehicular movement occurring within a large area, even during adverse weather and darkness. In many cases GMTI information would be the key to cueing when and where to employ smaller field-of-view, but higher resolution sensors, such as those carried by UAVs and U-2s, that are needed to provide positive target identification.

Experience in Kosovo and exercises shows that GMTI cueing enhances battlespace awareness by making a UAV's much more efficient, effective, and survivable. Cueing UAVs when and where to look for enemy activity can significantly reduce wasted surveillance time. Cueing can increase UAV effectiveness as well by providing targets with less warning time to employ countermeasures like smoke. And cueing decreases UAV exposure to point air defenses, making UAVs more survivable, by reducing their need to loiter in an area searching for targets.

Why Dominant Battlespace Awareness Makes Transformation Possible

Dominant battlespace awareness makes transformation possible by rendering obsolete an assumption that previously made it necessary for close combat to play the major role in the defeat of enemy land forces. Without dominant battlespace awareness commanders (and warfighting models) were forced to assume that information on the location and strength of individual enemy army units would not be reliable or precise. The validity of this assumption was the result of major limitations in the ability to collect and process data on an enemy's mobile land forces, exploit that data into information, and then disseminate that information to warfighters fast enough to support dynamic targeting and land maneuver.

The information problem was caused by most ground surveillance systems having to be very close to their coverage area; sensor fields-of-view that were often very restricted; sensor requirements for daylight and/or good visibility; and a system's inability to provide persistent coverage. Those systems that were adverse weather capable could not see, let alone precisely track, slow moving land vehicles; and many of these systems were very susceptible to having their effectiveness significantly degraded by camouflage, concealment and deception (CCD) measures. Then, after collecting data, many systems had to return to base so their data could be processed and exploited into useful information. When the surveillance information was finally available, it still had to be disseminated. All this took precious time during which movement would make a commander's information on enemy mobile forces collected by these systems increasingly unreliable.

Without reliable information on opposing army forces, commanders often depended on actual contact (close combat) to determine an enemy's location, strength, and intentions. The British military theorist B.H. Liddell Hart explained the role of close combat in locating an enemy with his "man-in-the-dark" theory of infantry tactics that compared land combat to two men fighting hand-to-hand in a dark room. Given the problems finding enemy forces, it was not surprising that success often depended on fielding large, powerful, heavy land forces and fighting a campaign whose tempo was restricted by the immense logistical problems associated with the use of such forces.

The Role of Danger and Jointness in Effects-Based Joint Operations

To conduct effects-based joint operations the campaign guidance of a Joint Force Commander (JFC) to his Joint Force Air Component Commander (JFACC) would be to employ precision engagement to paralyze the enemy land force and minimize its ability to engage friendly land forces in close combat. The JFACC would design his counterland operations to apply deterrence theory at the tactical and operational levels. His objective would be to target vehicular movement in order to create such "shock and awe" that surviving enemy soldiers quickly perceive that vehicular movement and the massing of forces, especially vehicles, is extremely dangerous.

The attacks would be designed to communicate clearly to enemy soldiers that movement makes them visible and very vulnerable to deadly air attacks that will soon follow if they attempt to move. Creating an enemy perception of extreme danger is very important because of the tendency for soldiers perceiving great danger to behave in a way that they believe will minimize their exposure to that danger. In this case the desired "effect" is an enemy force whose soldiers will not risk vehicular movement. Causing this behavior explains how the effect of militarily significant vehicular paralysis can be achieved faster and with much less resources than could be explained solely by the amount of physical destruction inflicted.

As the Suppression of Enemy Air Defenses operation in the Gulf War demonstrated, the ability to quickly create a sufficient perception of danger to achieve the desired effect of paralysis (or suppression) is enhanced when a campaign begins with large numbers of sudden and extremely lethal air attacks. Once an enemy soldier's perception of great danger is achieved, it can be maintained by conducting prompt, lethal attacks against any attempts to operate his machines (move, mass or emit). Making *persistent* vehicular paralysis a desired effect has the additional advantage of allowing the component commanders and their staffs to assess quickly and reliably the success of precision engagements targeting this movement. The theater C2ISR team aids in this assessment with its ability to see in real-time the location and amount of vehicular movement. And with continuous coverage, the team's assessments will be even less subject to being distorted by enemy CCD measures.

Ideally, the JFC's campaign guidance to his Joint Force Land Component Commander (JFLCC) would be to support the JFACC's precision engagement with maneuver while also using maneuver to avoid close combat to the maximum extent possible. Under this guidance, the JFLCC would orchestrate his maneuver to present such a threat or opportunity that he creates the "effect" of causing enemy forces to attempt rapid and massive vehicular movement. Closely coordinated with the JFACC, such an effect would greatly increase enemy vulnerability to air attack. The resulting destruction of enemy forces attempting to move would, in turn, complement friendly land maneuver by quickly causing more long lasting and widespread enemy vehicular paralysis and dispersal.

Once the combination of precision engagement and maneuver achieves the degree of paralysis and dispersal of enemy forces that the JFC determines will provide his land forces with maneuver dominance, enemy units would be vulnerable to being by-passed or defeated in detail. Thus, regardless of whether an enemy commander chooses to move or disperse and conceal his forces, the JFC's conduct of effects-based joint operations would dramatically reduce the role of close combat while ensuring that enemy land forces face certain, quick defeat with minimum risk for civilians and friendly forces. Presented with an inability to fight effectively, organized enemy resistance would be likely to collapse rapidly, allowing U.S. forces to quickly achieve the campaign's objective.

Airborne Battle Management and Effects-Based Joint Operations

The success of effects-based joint operations depends on airborne battle management. The JFACC would use the C2ISR team to manage the decentralized execution of counterland operations targeting mobile forces within the team's coverage area. The JFACC would do this by using his Air Tasking Order (ATO) to assign objectives, forces (fighters, bombers, armed helicopters, UAVs, and, in the future, Unmanned Combat Air Vehicles), and coverage areas to subordinate commanders located with their battle staffs onboard the C2ISR team's systems. It is important to emphasize that the JFACC's use of the C2ISR team's airborne battle management would be integrated into his exercise of centralized control over theater air operations. The JFACC would remain responsible for developing the air portion of the theater campaign plan based on JFC guidance and coordinating that plan and its dynamic execution with the JFLCC.

The C2ISR team's airborne battle staffs would be responsible for dynamically prioritizing targets and pairing weapons with targets based on changing conditions created by vehicular movement and weather. They would be expected to create and then exploit opportunities and neutralize developing threats created by vehicular movement. For example, they might create an opportunity, such as a lucrative vehicle concentration, by targeting route structure just in front of a convoy when it reaches a location where the vehicles would be unable to quickly disperse off-road when under a follow-up attack. The airborne battle staff could also create opportunities by suggesting schemes for friendly land maneuver designed to make enemy forces move in ways that would increase their vulnerability to air attack. The JFACC would closely monitor this decentralized execution of the ATO, coordinating recommendations for land maneuver as necessary with the JFLCC. As he deems necessary, perhaps as the result of new JFC guidance or his dialogue with the JFLCC, the JFACC would make timely adjustments in terms of the objectives, coverage areas, and forces he assigns to the airborne battle staffs.

The C2ISR team's role in effects-based joint operations could be compared to that of a football quarterback who is allowed by the coach (JFACC) to exercise his judgment and change plays (divert sorties and assign targets) at the line of scrimmage to counter developing threats or exploit fleeting opportunities. For example, a coach may instruct his quarterback to call an audible when necessary to counter developing threats or exploit fleeting opportunities that are being created by the location or movement of an opponent's defensive players. Like the quarterback calling an audible, when the C2ISR team detects a developing threat or fleeting opportunity created by enemy vehicular movement, it could be authorized to act quickly and divert aircraft previously identified as potential diverts in the ATO to appropriate targets.

Mobile and Fixed Targeting Differences

The differences between the processes for the precision engagement of mobile and fixed targets help explain why the C2ISR team's decentralized airborne battle management is needed to achieve the "single digit" response time required in effects-based joint operations. In contrast to fixed targets, the precision engagement of mobile army forces requires minimizing the engagement decision timeline because target movement can quickly change one or more factors vital to targeting effectiveness. One obvious factor vital to effectiveness is target movement's ability to rapidly change target location. Movement can also quickly reduce target vulnerability through dispersal, increasing the intervals between vehicles, changing the types of vehicles (armored versus soft skin) in the target area, and decreasing target exposure to attack by using terrain and foliage for protection and concealment. Movement can quickly reduce target size in terms of the numbers of vehicles in the target area. Movement can rapidly increase the risk of collateral damage by adding the presence of civilian vehicles or by putting military vehicles into a populated area. The risk to friendly forces can increase quickly through movement. For example, enemy vehicles can move under the coverage of an air defense system, a missile launcher can reach a firing position, and enemy land forces can move into close enough proximity to friendly land forces to employ their weapons.

Adding to the differences between the processes for the precision engagement of fixed and mobile targets is the way vehicular movement can influence the complexity of the targeting process. One way vehicular movement influences targeting complexity is through the number and types of vehicles that are potential targets. Thousands or even tens of thousands of vehicles can be located within the coverage area of the C2ISR team and these vehicles can be moving in very dense traffic with many different types of vehicles, military and civilian, moving in close proximity to each other. The unpredictable movement of these vehicles adds to targeting complexity. Unlike in the air, vehicles on land can and often do frequently change their direction and speed, making unpredictable stops and starts, while moving over a very short distance. Traffic density can also quickly change. Other reasons for the unpredictability of vehicular movement include the way darkness, adverse weather, traffic density, and changing surface strength (perhaps from weather or damage to a road) affect vehicle speeds. In addition, movement can affect targeting complexity by quickly changing surveillance coverage and visibility because of screening caused by terrain, foliage, and buildings.

Operational Factors and Airborne Battle Management

Timeless operational factors related to human capabilities and limitations provide still more reasons why airborne battle management is essential for effects-based joint operations. Even when battlefields were far smaller and commanders could see and quickly communicate (using horns, drums, and flags) with all their forces, effective commanders learned to organize so they exercised command and control through subordinate echelons, such as through commanders of tens, hundreds, thousands, and ten thousands. The reason was not so much technical as human limits. These commanders knew, as do fighter pilots experienced in air-to-air combat, that their span of surveillance limits the number of dynamic entities and engagements that they can keep track of, especially when the entities are moving in many different and widely separated parts of the battlespace. They also knew that their span of control limited how many units they could effectively manage during a very dynamic engagement. Finally, they knew that the survival of their forces, let alone their ability to achieve success, depended on whether their exercise of command and control would degrade gracefully if there were interruptions in communications with the fighting forces or if they or a key subordinate was disabled.

The magnitude of the span of surveillance problem created by large numbers of mobile land targets has a significant impact on the airborne battle management of counterland operations. This problem makes it necessary for C2ISR systems responsible for the execution of counterland operations to have the internal space to be equipped with large numbers of operator workstations. For example, in the land environment, especially during the initial part of a campaign, there are likely to be more targets (thousands instead of tens or hundreds) to detect, locate, track, and characterize than in the air environment.

As has been noted, the movement of vehicles on land is much more complex than in the air in that they move far more slowly and their movement is significantly more unpredictable, ensuring that they rarely move continuously or relatively directly between their start points and destinations as do aircraft. The ability of vehicles moving across the land's surface to stop moving at any time also creates increased opportunities for effective camouflage, concealment, and deception measures; which makes reliable tracking and characterization far more difficult in the land environment. Additionally, in the land environment vehicles often move in dense traffic and are more subject to screening. Finally, characterizing and prioritizing targets in the land environment is much more difficult because civilian vehicles are much more likely to be intermingled with military vehicles.

Constraints on span of control also contribute to the need for C2ISR systems large enough to support multiple numbers of attack control operators. The much larger number of targets and the complexity of their movement does much to make span of control for the engagement of mobile land targets generally much more constrained than is the case with the engagement of air targets. Given the very large numbers of vehicles that are likely to be moving in the land environment, especially during an enemy offensive or in a defensive reaction to a friendly offensive, effective precision engagement is likely to require controlling a large number of nearly simultaneous attacks.

But target movement is not the only factor constraining span of control in the land environment. Span of control is limited because aircraft targeting moving land vehicles are likely to need more information from off-board sources than is the case with the engagement of targets in the air environment. More information is needed because aircraft attacking mobile land targets do not possess a sensor that allows them to detect and track vehicles from a significant distance, let alone track a vehicle moving during adverse weather. In addition, aircraft attacking land vehicles generally employ munitions that do not possess their own sensors, as do air-to-air missiles, that allow them to guide on a moving target. The need for attacking aircrews to precisely aim their munitions at targets in the land environment can easily increase the amount of targeting information operators must provide to ensure an effective precision engagement.

Other reasons why airborne battle management is needed can be found in the ability of a surface command and control facility, such as the Air Operations Center (AOC), which is usually located deep in friendly territory, to maintain timely contact with large numbers of aircraft operating deep in enemy airspace. Much of the dominant battlespace awareness needed to orchestrate precision engagements against mobile targets depends on being able to monitor the communications of the aircraft operating in enemy airspace.

Deployability and out of area "untethered" operations provide still more reasons for exercising airborne battle management. Increasingly, countering threats posed by land forces will require quickly deploying forces to areas where surface facilities for exercising command and control are limited or even unavailable. Even if such facilities are available, they and their communications are likely to be more vulnerable to attack, especially to attacks with ballistic or cruise missiles delivering Weapons of Mass Destruction, than an airborne system. An airborne system can, if necessary, be based at a significant distance from the area of operations and can maintain an orbit beyond the reach of enemy surface-based air defenses.

The Requirement for Advanced Distributed Simulation

The success of effects-based joint operations depends greatly on whether JFCs, their component commanders, and their subordinates, including the commanders and battle staffs located onboard the C2ISR team's systems, use Advanced Distributed Simulation (ADS) to conduct realistic training, war planning, and mission rehearsal. ADS is essential because live peacetime exercises provide an extremely limited environment for learning how to most effectively employ C2ISR systems that can detect, locate, track, and target very large numbers of vehicles moving in an unpredictable manner within a vast area. For example, cost constraints severely limit both the number of live exercises and the number of vehicles used in these exercises. Peacetime exercises also tend to be unrealistic because the majority of these exercises are confined to the same familiar and relatively small operating areas and those areas often have little similarity to areas where combat is likely. In addition, safety considerations can greatly constrain the realism of the peacetime training environment.

Another reason for an ADS requirement is the inability of current models and simulations to show the full value of battlespace awareness provided by airborne ground surveillance and the need for airborne battle management to effectively exploit that battlespace awareness with timely precision engagements that complement and reinforce land maneuver. The problem has been the result of limitations in the ability to simulate realistically the surveillance and targeting of large numbers of individual moving vehicles. The lack of realism has extended to both visual displays and surveillance control measures. By being unable to show realistically the value of the battlespace awareness capabilities of ground surveillance systems, current models and simulations have been unable to provide the repetition that is needed for effective concept development, war planning, and mission rehearsal.

Fortunately, ADS can help solve the problems associated with both live exercises and current models and simulations. With ADS it is possible to have a scenario generator provide over a Distributed Interactive Simulation (DIS) network thousands of virtual vehicles, each of which is moving realistically across any desired terrain according to a script that is written to replicate a specific doctrine. More importantly, ADS makes it possible to take virtual target information from the scenario generator and translate it into realistic target reports as seen by the surveillance system by introducing factors such as probability of detection, target location, false detection and terrain screening effects. Displayed on a C2ISR system's operator workstations, these reports are indistinguishable from "live" action.

Since ADS makes it possible to fight realistic scenarios located anywhere in the world and provide repetition, theater commanders could easily use ADS for war planning. With ADS, these commanders could assess a variety of different campaign options. Similarly, battle staffs onboard the C2ISR team could use ADS for mission rehearsal, even while enroute to a contingency. Moreover, by allowing realistic training without having to fly the C2ISR team and conduct live target attacks, ADS could reduce significantly training costs, wear and tear on actual C2ISR systems, and the operations tempo impact of their crews.

Challenges to Implementing Effects-Based Joint Operations

Although implementing effects-based joint operations provides important advantages, it also poses numerous challenges for the Services. Given the critical role played by the C2ISR team, implementation would require that the Services solve the current Low Density/High Demand problem by procuring sufficient numbers of C2ISR systems so that vital areas can be put under a team's continuous coverage well before aggression or internal oppression begins. The team's vital role also requires the Services accelerate their efforts to provide these systems with enhancements that improve the quality of the team's information and their ability to use that information to support dynamic targeting.

Since models play a major role in determining equipment requirements, the Services must develop new warfighting models that treat an enemy's fielded land forces as a system whose ability to function depends on the operation of its machines. The models must be able to show how all vehicles, not just tanks, influence an army's warfighting effectiveness. The models must also be able to show with realism the way people actually behave in war, behavior that is vastly different from how an opposing force's "entities" behave in current attrition-oriented models.

Forces fight as they train. Therefore, it is essential that the Services train together more frequently and more realistically. Effective training for the C2ISR team and the Services' air forces requires an opposing force fielded in appropriate numbers and employing intensive CCD measures. Scenarios should also include the use of simulated civilian vehicles. In contrast to today's training, Army and Marine Corps forces must design their land maneuver to make U.S. air forces more effective at targeting opposing forces without becoming engaged in costly close combat. Also of great importance, training must be conducted in realistic terrain and weather conditions.

Last, but certainly not least, the successful implementation of effects-based joint operations requires increased emphasis on the operational level of war qualifications of U.S. commanders and their staffs. The Services must treat qualifications for this level with the same thoroughness that they currently apply to tactical level qualifications. As is the case with tactical level units, the Services must demand that all personnel, regardless of rank, demonstrate appropriate knowledge and judgment regarding operational level joint operations before assigning them warfighting responsibilities.
