

20th ICCRTS

“Advancing C2 Effectiveness at the Tactical Edge Operational Approach and Method with New M2 Capability”

From a Combat Power & Tactical Gain Standpoint

Topic 1: Concepts, Theory and Policy

Topic 10: Operational Issues

**A Military Science Study - An External Report
[For Analytic Basis & Due Diligence towards the Advancement of Technology]**

Mr. Kevin Diaz

Joint Concept Integration for Unmanned Ground Vehicle Systems

for Naval Expeditionary Marine Warfare

Boston, Massachusetts 02025

Abstract

Advancing C2 effectiveness to the Tactical Edge is critical for mission success. This proposed method describes how to optimize planning and project Force Application FA utilizing a combined arms approach. This shall simultaneously create new C2 capability, fill the requirement for present breaching delays and provide Force Protection for dismounted warfighters. This specifically relates to supporting a Mission Needs Statement (MNS) and an Operational Requirements Document (ORD) to identify the MEB C2 capabilities needed to achieve mission objectives and fill breaching requirement gaps.

This Course of Action COA allows dynamic, flexible Lines of Effort LOE to advance and extend AO boundaries for any deep GCE. In order to enable and enhance MEB commander's control over troops for maneuver warfare, functional steady state communications, SADL shall extend operations BLOS.

A robust UGV platform delivering ISR to the tactical edge for Battlespace Awareness BA shall synchronize dismounted warfighters' advances allowing retasking where IED/mines exist for on the move agility. In turn, platform mobility delivers Situational Awareness SA for C2 decision making via multiple view streaming in hostile settings. Tactical performance for MAGTF forces shall overcome significant stop and delay which exists due to frequent breaching requirements and lead to future mission success.

Introduction

Irregular Warfare and Area Denial methods are the most frequent and most important enemy methods used in recent wars. Additionally, thousands of mines exist and are laid by enemy forces where future missions will occur. Providing optimized EOD and ISR with Unmanned Vehicle assets allows for Mobility, SA, Force Protection and Minefield Breaching forming indispensable operational capability.

Existing operational strategy relies on maneuver warfare combining ISR directly interfaced with the soldier advancing to perform for the highest level of mission success and tactical advantages. The frequently used IED/mine is the prevalent weapon that halts warfighter advance including the capabilities of the ISR system in use. These delays cause significant risk to mission success and casualty increase.

The case is presented for minefield breach requirements with an effective tactic using technology solutions addressing these persistent issues assembled as an Analytic Basis to increase certainty for CCMDs assessment. The functionality of this proposed Tactic can be thought of as Technology and Mechanization paired for the objective of mine breaching lane operations with benefit of Force Protection during any activity. The integration of human abilities is closely matched with mechanical engineering technology to survive within blast exposure environments. This can be thought of as a continuous process with multiple procedures performed concurrently by either a UGV or likewise fashioned robot. At present many agile moving UGS robots exist being over 600 lbs in weight. Both lightweight materials and technology exist to form a mobile robotic solution to defeat IED/mines. This Joint Concept combines the C2 SA process with UGV ability to breach while preventing fragmentation forming a Material Solution.

As a concurrent capability, a designated platoon robot with turret and housing allows a prevention method against infiltration of insurgents providing a strong measure of perimeter safety, forward advance threat assessment and C2 connectivity making any operation much more able to maneuver. Safe zones are made by route sweeping and under-fire conditions increasing FP. The development and regular use of these capabilities allows for an added dimension of tactical performance and robust ability to perform in changing austere environments for Commanders to establish, adapt and control field strategy.

Battlefield missions require an adaptable robot chassis able to traverse various terrain in the same theatre of operation with physical characteristics able to withstand HE blasts. The combined flexibility and strength to simultaneously advance links mission objective success with Force Protection. This suite of performance metrics allows for tactical mission mobility for CONOPS.

Current Organizational Framework

The advancement of new technology is two-fold in nature. This study proposes presenting a Technology concept within the JCIDS approach for Documents to generate sponsor activity and prioritize the Gap. The study articulates relevant tactical mission capabilities for JOPP allowing for alternative COAs for concept of operations planning. The process also involves proving CONOPS would substantially benefit with JEON category capabilities and there is an “enduring requirement”.¹ This report shall present a Joint Concept using scientific principles to form a practical solution using applied military science for use in our existing CONOPS and mission tasks.

Within recent years the Navy’s EOD unit was formed and aligned for tactical use within various organizations having operations concerning IEDs and minefields. Each of the branches has separate procedures, theory and definitions. The Joint Operation perspective from JP 5-0² is presented here due to the Navy having control over minefield EOD breaching strategy per DOD Directive 5160.62, Single Manager Responsibility for Military Explosive Ordnance Disposal Technology and Training (EODT&T). From this standpoint, an existing autonomous UGV robot program of development has been underway utilizing design suites for scalable modules. Other UGV programs exist as well.

The technology development shall enable new tactical maneuver performance with Combined Arms principles to execute tactical missions required during all CONOPS. The Technology is formulated to work within the JFC’s JOPP process while using JCIDS to establish the range of Force Protection benefits and Tactical Advantages offered. Following an Analytic Basis, the relationships of the JCAs, KPPs and KSAs are conveyed to apply through other branches’ intent for multiple Branch suitability & in their procedures as well (Marines, MCDP-1, MCRP 5-12D; Army, TRADOC Pam 525-3, ADP 5-0, FM 71-3, FM 3-90-1 & FM 100-5).³

Navy EOD Teams functioning concurrently have not been traditionally available for tactical missions requiring speed and surprise. They are not linked in this way due to their pause and stop for neutralization procedure requirements after detecting a mine. Similar teams function such as SST's. The existing definition for useful operations for Combat Engineers is:

“(1) **Mobility.** Combat engineering mobility capabilities and activities assure the ability of land combat forces to maneuver. They only include tasks that meet the definition of combat engineering, and they typically include tasks associated with conducting **combined arms breaching operations, clearing operations, and gap crossing operations**; constructing and maintaining **combat roads and trails**” additionally:

“Joint forces should be prepared to encounter obstacles (including IEDs, mines, and other UXO) across the range of military operations.”

and:

“breaching, neutralization, or large-scale clearing of land-based mine hazards is the responsibility primarily of combat engineer units and special units of the Navy.”⁴

A recommendation is presented to designate a Joint OP Squad through the continued use of the Navy's EOD team structure with a combined arms approach in areas determined to contain IEDs and AP Mines, currently being present in all Middle-East and other locations worldwide. With current Technology, UGVs mounted with breaching countermeasures may be used during dismounted advance providing the Tactical Gains and advantages of Mobility and Low Cast Fragmentation Protection in addition to providing benefits in overlapping joint capability areas. These M2 and C2 enhancements are a valuable addition at an affordable cost within a funded program. The proposed Concept of Operations describes how to plan and project expeditionary Force Application FA utilizing combined arms. This approach shall simultaneously create new capability to fill the requirement and bridge the gap between present breaching effort delays encountered by Dismounted Warfighters to affect task performance to achieve mission objectives. This specifically relates to supporting a Mission Need Statement (MNS) and an Operational Requirements Document (ORD) to identify the MEB capabilities needed to achieve mission objectives and fill breaching requirement gaps. In order to support this Joint Concept this Case Study has been prepared as a reference document to assist in identifying robust solutions and achieve tactical consensus within an affordable budget for fielding technology.

As a further level of operational control, C2 On-the-Move C2OTM (as defined by Tidwell and Teske, JFCOM 2011) provides a strategy for improving control over missions particularly at the Tactical Edge. The present CONOP provides a new Course of Action COA for dynamic, flexible Lines of Effort LOE to advance and extend AO boundaries for any deep GCE. In order to enable and enhance MEB commander's control over troops for maneuver warfare with quickness, functional steady state communications that extend operations BLOS are needed. A robust UGV platform delivering ISR SADL to the tactical edge for BA shall synchronize dismounted warfighters' advances which contain mitigating blast countermeasures for on the move retasking agility. In turn, platform mobility delivers Situational Awareness SA for C2 decision making via multiple view streaming in hostile settings able to perform breaching tasks in austere environments saturated with IED/Mines synergistically. This performance solution for MAGTF MEB and Joint Service forces shall overcome significant stop and delay which exists due to frequent breaching requirements and lead to leading to higher mission success.

Tactical Variables and Risks

The threat environment and countermeasure capability present in today's battlespace has a direct relationship with mission success most often due to the use of kinetic threats. Warfare with minefields has imposed conditions with considerable effects onto both offensive and defensive tactics during Dismounted Warfighter's missions. In this analysis the case for time spent for forensics collection as well as international law and treaty administration is not the focus. Present and future conditions have caused the requirement for evaluation of means and methods to achieve Force Protection to further improve the order of battle for Tactical Missions involving IED obstacles as the enemy has achieved conditions which predominantly force mission execution from the dismounted state of advance.

To greatly improve the success percentages, the nominal speed and momentum of missions must be improved. Technology development in the way of combined arms shall establish mobility allowing for ISR sensors to be positioned. The aspect of planning and actual task execution shall be greatly improved through the use of dynamic positioning of Situational Awareness nodes. This is warranted as the enemy has succeeded in producing numerous mission delays, reduced mobility and increased casualties. It follows technology can improve offensive maneuvers and should be developed to provide the means of carrying out those missions against kinetic threats within the environment set by those enemy weapons.

“Clearing operations involving explosive obstacles are especially difficult because the detection systems employed are imperfect and available neutralization systems are only partially effective.”⁷

and

“Engineers must discern and identify patterns and plan specific detection strategies based on the threat. The proliferation of mines and IEDs requires engineers to continuously develop new counter procedures. The tactical integration of EOD capabilities has become an increasing requirement.”⁵

These required operations represent the standard from history and are employed today for ground forces to advance.

“The goal of breaching operations is the continued, uninterrupted momentum of ground forces to the objective; therefore, these operations should be planned and executed in support of the ground forces' needs to ensure that actions at the objective are supported by actions at the breach.”⁶

Solitary IEDs may be set in isolated areas. Standard conventional AP Mines are mass produced having a pressure plate trigger mechanism. What has been in demand is the capability to provide proper equipment for ground forces support in a synchronized manner, an included tenet in Breaching Fundamentals. Each factor in this rationale is presented from direct cause-effect relationships. Tempo is primarily and significantly affected with a maximum effect to delay the advance. The tactical mission's objective is lost due to speed and surprise lost. This is true for both an event and simply detecting the presence of an IED. This represents a significant consequence in the effectiveness of overall strategy. The consequence is as the successful IED placement eliminates the opportunity to trace back enemy communications networks, effectively eliminating soldiers and team's chance of success for mission objectives. Consequentially forfeiting time, expense, objective and potential casualties committed to the mission. This manner of obstacle use creates an advantage and the enemy may further set composite SDZs causing greater confusion and casualties. Of special consideration is the mission encountering a minefield and to a degree more complex, the integrated minefield.

To each recent and past enemy tactic of IED use and those in the future, the use of IEDs by the enemy has the effect to cause significant reduction in mission success combined with loss of equipment and warfighters. Deactivation procedures increase time to target, allows for enemy to mobilize and causes increased risk of allowing enemy time to position for an attack.

All manual or autonomous robot procedures to collect forensic evidence or deactivate require claw, scrape and wire trace procedures which are time intensive with over 20 minutes of on position time required to perform defeat measures. Use of a clearing charge to detonate for high order detonation does not always result. Besides the obvious risk to probe or deactivate by hand or otherwise manipulate the soil, the reduced mobility amounts to lost speed and increased time to enemy target.

Limited means of evaluation exist for present anti-lift type, or modified pressure plate triggers. Enemy HE weapon laying practice has included significant effort in deception techniques by way of triggering means and methods with many Anti-Handling Features for causing EOD technician errors and have caused considerable delays in neutralization procedures. This added risk compels EOD teams to detonate in-place. This is the decision for a high percentage of detected IEDs where forensics recovery is not a sustained priority due to the risk in a neutralization procedure.

All of these factors and risks are associated with the present detect and Stop procedure for missions encountering a mine field or solitary IED. Before the platoon can set out again significant time expires allowing enemy to increase his distance or allowing an ambush to get into position.

Problematic changing environmental conditions create factors creating reliability issues from the information gathered by AI detection sensors related to surface modification. Desert conditions present certain vulnerabilities in route sweep procedures as winds are constantly spreading sands. This requires a detect and stop means of procedure even with the AI module system technique.

A feasibility assessment for this capability shall exhibit both utility and be deemed an enduring requirement. The potential for this concept to be gap prioritized exists and the capability can move as a rapidly fielded capability solution for all existing Minefield Breaching Operations to improve Mobility and Safety. “the assessment may address refinements to the original capability requirements as needed to reflect lessons learned from operating the rapidly fielded capability solution.”⁷ These types of technologies shall improve tactical mission effectiveness for WAS and CAM operational strategy.

“(6) Providing adequate engineer capabilities to facilitate survivability for combat maneuver forces as a part of combat engineering.

c. **EOD.** EOD augmentation to the engineer force is not only essential, but critical. The speed and efficiency with which UXO hazards, weapons caches, and IEDs are eliminated directly impacts overall mission success, both militarily and politically.”⁸

Additionally:

“2. Mobility Considerations

a. **General.** Mobility operations include five functional areas, three of which are designed directly to meet challenges from barriers, obstacles, land mines, and other (EHs). These three (breaching operations, clearing operations, and gap crossing operations) are discussed further in paragraphs b through d below. The five functional areas of mobility operations for Army units and Marine air-

ground task forces (MAGTFs) are covered in detail in FM 3-90.4/MCWP 3-17.8, *Combined Arms Mobility Operations*.

(1) **Conduct Combined Arms Breaching Operations:** detect, breach or bypass, mark, and proof mined areas and obstacles. Combined arms breaching operations are typically performed in a close combat environment.

(2) **Conduct Clearing Operations:** employ tactics and equipment to detect and eliminate obstacles, mines, and other EHs. While this is not always part of a combined arms breaching operation and is typically not performed in a close combat environment, it will still generally include the task of breach.

(3) **Conduct Gap Crossing Operations:** fill/cross gaps in the terrain/man-made structures to allow personnel and equipment to pass.⁹

Advance of forces, GFEs, through minefields with a medium sized robot shall produce the Tactical Gain of uninterrupted mobility improving the speed and surprise of several tasks to achieve mission objectives.

New Tactical solutions

From a tactical performance standpoint each AP Mine has the effect on movement and maneuver warfighter functions by reducing the mobility of missions. This proposed Operational approach harnesses new technology to reduce mission delay and increase area stability. This Joint Concept offers Material Solutions for increased mobility while simultaneously providing multiple node Situational Awareness. In light of advances in technology, new tactics are presented to fulfill Force Protection, robot survivability and deploying discrete sensors to fulfill several current operational gaps.

The design of scalable modules for a proposed fast attack mine destroyer is presented for minefield breaching CONOPS. Research and development of fragmentation barriers and simultaneous safe zone detection systems for regular field use are high important capabilities. Alternative technology use is a necessity due to the statistical mission failure and effects when not employing available technology capabilities providing options for Command and Control.

In addition to the mobile Situational Awareness offered in the UGV, an optimized robot would have a shell structure and dynamic mechanical functionality in order to advance in enemy areas subject to shockwave loads and have survivability and interfaced with the soldier nearby in the field. The selected mobility drive module would have amphibious ability and traverse various terrains in the same theatre using the indicated system for detect to engage missions from the littoral zone inland. These alternative protection methods to heavy armor use dramatically lower unit weight for designated equipment used.

These technologies integrate and synchronize the full range of Army and Marine Breaching Force tasks connecting joint operation functions with C2. Capabilities of fragmentation barrier systems may be continuously employed as a countermeasure mechanism. Tactical Speed of hasty breach missions may also be improved. Current use of UGVs do not meet the interoperability requirements for unified joint service standards enabling aerial-ground teaming or controller commonality.

Multiple Terrain MOB Versions are able to traverse several environments, inclinations and reduce obstacles. Multiple terrain maneuverability is a desirable transport capability for tactical communications TDL in DIL. Simultaneous breach capability at the tactical edge provides means to intercept enemy and achieve mission success without delay or Stop.

“(c) **Hasty Breach.** A hasty breach is an adaptation to the deliberate breach conducted when less time is available. It may be conducted during either a deliberate or hasty attack due to lack of clarity on enemy obstacles or changing enemy situations to include the emplacement of scatterable mines and/or networked munitions.¹⁰

As obstacles, mines are usually not visible and all tactical missions require mobility to maintain Tempo. Speed and Surprise are key attributes in order to succeed in objectives.

UGV Programs may readily incorporate modular Technology as needed for rapid fitting and deployment following existing Requirements in established programs for C2 and Breaching for Freedom-to-Maneuver. These module designs include shock incident angle applied in a way to counter chassis overturning effects and fragmentation trajectory angle applied in a way to block lethal effects. Added module crawler arm drive trains reduce bypassing effort allowing for hill and rock pathway climbing and amphibious maneuver with thrust drive. Fleets may benefit through these and other configurations and with simple module use.

The offensive and defensive maneuvers as detailed in Chapter 7 & 8 of MCDP-1 are afforded greater operational effectiveness due to individual mission speed increase and with the ability to gain surprise. JCA, KPP & KSA Tables exist to define objective thresholds for this capability solution in AOs with mine obstacles. This Technology applies to most dismounted missions and tactical tasks which have factors of METT-T containing exposure and intensive use of IEDs and AP Mines. These threat conditions shall exist as persistent threats and for the future creating an enduring requirement for the technology as a C-IED MCM countermeasure asset. This shall increase the speed and reliability filling Breaching Requirements to improve CONOP.

Technology Features required that shall extend or improve KPPs:

- Fragmentation Containment
- Disruptor procedures performed at closer distances.
- Robot survivability.

The speed of detection to triggering and the connectivity remaining able to react in a real-time, autonomous behavior in front of the breaching force. The desired and required capabilities RC's of BA, FA, C2, M2 and Force protection are sought to enhance mission needs. Related technology able to encompass and provide benefit for these missions are through module configuration and functionality:

- Choice (selection) with chance (risk) of lane opportunities, Tactical Agility for C2 and for EOD Team Captain in evaluating the forward path to advance with streaming and sensors.
- Practical means of ground, water and air deployment achieved using GOTS Unmanned platforms.
- MCMOPS would receive a new asset to decisively open LOE in AO with minefields enabling wider strategy for both defensive and offensive missions.

The modular robotic concept addresses the enemy countermobility tactic issues of delay, deter and psych effects caused by IEDs. Conventional engine powered platforms are larger, use louder equipment, are less able to move in tight spaces and do not possess the scalable size and modular functionality to serve either remotely or autonomously. From a Psych standpoint, when the enemy sees new tactical missions in place and the regularly used capability to quickly detect and detonate AP Mines, the value to use them in the future will be reduced.

From the various platform configurations possible, several KPPs and KSAs are physically functioning contributing to JCA tiers for this material solution setting measureable performance attributes. These details with corresponding MoE/MoPs enhance M2 & C2 capabilities by filling Force Protection requirements and performance gaps providing added operational capability:

- Force Protection KPP shall be supported by preventing hostile actions against friendly personnel, military and civilians.
- Tactical Gain M2 is produced by Breaching Minefields.
- Survivability KPP is evidenced by asset and force protection
- The Sustainment KPP is supported by long term operational use.

Evaluating several years of Lessons Learned and forming a new UGS protection robot system establishes a capability for tactical maneuvers fulfilling the “optimum means available to support the JFC’s CONOPS”¹¹, an operational use for critical lethal MTs allowing for “tailorable” assessment to “refine capability requirements”¹³. The Assessment designates priority ranking based on tactical advantage and force protection benefits. KPP thresholds for MoP and MoE may show tactical M2 and protection performance benefits reflecting JCAs for solutions to these gaps. Technology may then provide realistic cost effective solutions integrating TDL communications for BA & SA Capabilities through M2 enabled with breaching capability. This in turn provides agility to respond effectively and timely with C2 FMV TDL and OPINT at the tactical edge fulfilling a C2OTM gap concern.

New Defensive Maneuver Capabilities

The Maneuver Warfare Doctrine focuses on overall command strategy. From each Concept of Operation come tactical missions. With the Brigade’s organizational structure each level of command follows these Tactical Missions and performs them to the best of their abilities. The main elements of Speed and Surprise are paramount for success. These elements are highly relevant for Patrol, Raid and Reconnaissance missions and are integral for attainment of objectives based on any given mission’s METT-T. These elements are crucially challenged on the terrain and manner of traversing the ground. Tactical Missions are set forth typically by armored personnel carrier to a drop off point continuing dismounted for several hundred yards in formation to either search or close a perimeter. The success in these missions depends on speed and surprise. The IED/mine effectively stops a mission’s advance with high probability of the enemy being informed of their presence.

In order to prevail in executing missions where the objective is to root out the enemy and provide Wide Area Security, the necessity has always been to sweep and envelope while using speed and surprise to achieve success. To gain these results, it is required to have mobility without stopping and possess optimized area intelligence to perform ISR synchronization meaning having Situational awareness providing a Joint Common operating Picture (COP). Providing these tactical advantages requires technology in order to perform missions successfully in irregular warfare conditions. In order to impact mission outcome and put to use proposed capabilities autonomous modular AI functions must be available to transmit real-time situational awareness with the ability to maintain Mobility.

Each element relies on the ability and training and confidence to perform under the given environment. The presence of AP Landmines creates a HE threat which must be defended against while performing missions as it is an instantaneous attack with no enemy present. Ambush tactics of the enemy in the Middle East theatre relates to dismounted detachment on patrol either for reconnaissance, route

sweep or capture missions. Both the experienced and novice warfighter have the training and instincts present when advancing underfire and during seemingly or what appears safe conditions. Warfighter spirit contains courage, gut feelings, reaction sense and judgment not to kow tow to enemy delay practices or the guise of deception.

As this spirit augments an advance, it is of high value to optimize at the leading edge of the advance to transfer all the human observations, sensor information and AI predictions for adaptive intelligence for best reaction for speed of advance with force protection. This may be enabled by coupling real time autonomy with mobility capability through fast attack breaching operations without Stop. This can be refined to the point of auto-direction of UGV for maintaining forward separation distance ahead of TL of roughly 30 feet or closer. It is noted all dismounted soldiers Pause upon observance or detection of an IED with the distinction being made for the period of time an enemy may either optimize his positioning for an ambush or have sufficient warning alerted by the UXO sound to then have time for making a retreat or escape.

These basic instincts and situational awareness shall be supplemented using technology and increase Dismounted Warfighter Mobility with breaching capabilities. The Human senses are able and actively perceiving enemy threats except mines. They aim and target apex, corners and around openings of structures, parapets, windows, trees, rocks, other obstacles and for terrain features. Each threat sighted in the distance may be camouflaged, be HE Trojan Horses or be obscured by environmental conditions. Psychological reasons and deception are also used by the enemy for situational settings of IEDs, a trap, sniper positions and ambush situations.

The capability to interface human detection and mobile advance visual sensors enhances the ability to detect motion and threats with further AI use resolving disturbed soil and out-of-place characteristics such as containers, liquid residues, objects, maintenance of clothing, individuals and other observable discernable characteristics where judgment may lead to a probable lead to an enemy or threat detection. This available combination of information has the effect to increase reaction time to enhance tactical performance of the dismounted soldier. When continuously coupled, new Technology takes full advantage of combining human observation, sensor information and AI allowing greater mobility, faster forward movements, maintaining force momentum and predictive alerts optimizing potential tactical gain. However, information gathered is as valuable as the farthest position moving forward SA&BA, without mobility the ISR no longer can give forward reconnaissance information ahead of the platoon or company's location for C2 functions at the tactical edge. It is imperative that the UGV advance forward of dismounts collecting information to have synchronized fluid unity for the advance.

It follows that as the Robots are assigned into EOD team units, that the additional capabilities be simply designated and assigned to those same units providing a fast attack, variable terrain and barrier protection Increment. As well, the EOD team captain being skilled as a field tactician delivering the ISR reviewed instructions to the Robot. This real-time logistical manner to enable and meet the needs of Commander's mission needs allows the tactical maneuvering to be performed successfully. This allows for immediate defense of the ground the enemy is attempting to take.

As the warfighter has received his instructions each component of his mission relies on his ability to maintain Tempo, a primary element. An AP Landmine eliminates the possibility of having Tempo. In addition, today's search for target missions many times require tracking and search only a few enemies. This involves traveling to and striking a Focal Point which has a limited window of success due to few fixed command centers or posts with enemy leaders constantly moving about or able to retreat quickly. Use of AP Mines eliminates Surprise to Focal Point for obvious reasons. Therefore it is necessary to concurrently defend against the mine in a manner that does so by removing the need to Stop Advance causing Reduced Mobility allowing for enemy retreat. Providing the Technology presented allows for the Tactical Gain to achieve the advantage of not Stopping upon detection of an AP Mine(s) and IEDs.

Advanced robot reconnaissance prevents separation providing eyes forward and fast attack over AP Mines. This prevents enemy's intention to delay and split line formation. In this way the enemy can cause the place where it is best for him to cause the maximum damage using surrounding of his choice. The first casualty causes the other unit members to stay close to him to save him performing first aid. In the moments after detection or detonation, enemy communications notify whether our troops were injured or killed or had stopped for neutralization procedure. Line of sight disruption after IED effects occur with Delay with enemy utilizing either fixed position or continuous movement and often results in further casualties. Intervisibility further delays and disrupts unit cohesion during crossfire. Further development of the situation by the enemy allows for a critical fish in the barrel situation to be established. Technology allows a team to be properly equipped to perform the defensive tactical maneuver preventing this event.

From this series of available tactics, each commander may be forced to use a certain tactic suitable and available for the situation or be under his own discretion. The Concept of Operation forms a combined arms mission consisting of the relevant troop size complemented with Breaching technology to strike a location with the capability of advancing without Delay from AP Landmines shall be a preferable option to elect. Side shot disruptor neutralizations may be performed up close with installed technology. Upon being given orders and an understanding of overall mission strategy, individual tactical mission are assigned in detail or the commander of the AO may be allowed to create his own plan of attack based on his judgment and his assessment of battlespace threats.

As the enemy inhabits an area, they are present as soldiers, locals or insurgents. When sweeps are eminent in those particular areas, the enemy has spent great effort evaluating our dismounted forces' likely pathways for movement. These include both natural obstacles and manmade structures. As the potential for a sweep mission is to be completed, the enemy has carefully selected and positioned IEDs in the areas where he believes the soldier must move on his route between turning points and possibly needing to maintain cover at corners. It is this method of pinpointing HE threats that causes delay and optimizes effects for casualties of dismounted advancing during their missions.

Mines and "Minefields are used to:

- (1) Produce a vulnerability to enemy maneuver that can be exploited by friendly forces.
- (2) Cause the enemy to piecemeal his forces.
- (3) Interfere with enemy C2.
- (4) Inflict damage to enemy personnel and equipment.
- (5) Exploit the capabilities of other weapon systems by delaying enemy forces in an engagement area.
- (6) Protect friendly forces from enemy maneuver and infiltration."¹²

Additionally, minefields that initially show a category of AP Mines may be set to sabotage effort for disabling of AT Mines present. Capabilities may extend to Mobile Defense efforts as well.

As defensive counterattack missions are carried out, the advance requires dismounted warfighters to move across zones which may include obstacles and minefields. As the enemy tactic in using the IED is to delay, a planned deliberate breach may change into a hasty breach due to circumstances or an ambush condition. Clearing a lane by the breaching force to connect through the area to a village becoming a simultaneous process of attack and counterattack against the Mine or IED. A Mine may cause Pause, Delay, Stop or Cause Retreat. The possibility of an extended level of Contact exists after the initial ambush to disrupt and confuse the detachment. The Tactical Advantage in harnessing the Technology shall allow the Defensive Maneuver of directly encountering the HE Threat without Reduced Mobility and continue the Advance. An ambush that does not produce an initial casualty will have a far less chance of disrupting the Advance and Mobility being preserved, with the ambush being started by the AP Mine. In addition, while troops advance and pause, a mine may be complicated by more complex features to make disassembly and uncovering more time consuming and dangerous. Combined manual trigger and enemy supported crossfire ambush attacks are also possible.

Other maneuvers take place for base defense, perimeter checks and for force protection for peace operations. An overarching benefit extends towards technology use in other missions as well such as PCT and DS programs where security and proximity to non-protected space is entered or Embassy Egress. Establishing, maintaining and defending a perimeter in today's battlefield is not concentrated on repelling enemy breaching efforts. The ability of the enemy to covertly enter into an AO undetected for the purposes of setting an IED remain high. The technical definition of perimeter here relates to edge of AO and outside of our fixed wall structures which act also as means of egress and areas of observation and security watch pathways. To establish a Cordon, a series of robots to simultaneously and continuously monitors the perimeter as a mobile surveillance system providing safe zones.

For tactical mission tasks involving IED obstacles, the mission statement follows as: Theater commanders need a means to obtain responsive intelligence, surveillance, HE detection, capability to breach lanes, force protection and BDA information from within each asset. The system should be usable in multiple scenarios and terrain and be reliable over the mission providing limited risk to dismounted personnel from fragmentation. It should provide reasonable coverage, have multi-spectral capability with near real-time information supplied to the Joint Force Component Commander via SADL, enabling C2 automation for prediction and retasking between MAGTF HQs and platoon CDR for critical mission element integration to increase mobility and synchronized ISR capability (see OV-1).

Having Mobility is central to success in the strategic aim of operations containing Defensive Counterattack missions where tactical speed and surprise are required to achieve objectives. These missions are crucial in tracing back enemy forces as part of WAS.

New Offensive Tactical Maneuver Capabilities

To define a series of Tactical maneuvers is beyond the scope of this Study. However, the Tactical Gain inherent with this Technology provides better Mobility and Mission Speed for any Mission providing the highest advantage with a combined arms approach. The combined arms sequence creates a Tactic for EMST mission success for deliberate and hasty troop movements approaching and breaching minefields. Tactical mobility means ease of maneuvering in varied topography to achieve mission objectives which require speed, surprise and safety.

Using a platoon lead robot gives the detachment leader a “terrain risk grade” in order to judge the potential for ambush complexity to pass under fire with the ability clear the path before the first warfighter breaches a minefield or an enemy ambush setting. Part of autonomous sensor use allows for a near real-time continuous assessment of situational risk. The successful implementation of this equipment establishes a much higher order of reliability for non-delayed missions and assuring tactical unity. To finish missions expediently and succeeding in objectives is a high priority.

Within the AO, on a daily basis, warfighters must break the plane on existing pathways and in controlled areas which contain the risk of being compromised by IED setting by the enemy. As dismounted soldiers cross secured boundaries, the environment may change from neutral to a field of engagement becoming a battlespace. This short time span is the critical link for forward mobility with the need for immediate accessing identification of those locally present. Additionally, upon detection or triggering of IEDs, the ability to move forward is required to maintain detachment integrity and unity. Hesitation or Pause at this point in time allows the enemy an advantage to attack. Preventing Delay and separation of the unit is important for mission success and mission being lost from resulting casualty trios’ efforts. In the ultimate analysis momentum is broken and from the enemy’s perspective attacker Pause has been achieved allowing him time to scatter, retreat or mount a counterattack.

As the platoon sets out on the respective mission with control measures, enemy engagement may force a fluid nature of movement from the established mission plan and new routes with lanes for hasty breaching shall then be required. The operations continuum of individual tasks completed for mission success or failure are dependent on this assured mobility for changes in offense-defensive battlespace conditions for efficient decisive battle results.

As the Navy delivers Marine Expeditionary forces either by sea or air, the potential drop off location may be in a minefield. This has major consequences as most marine and air landings are of a one-way nature. The trip time to target is a priority KPP as the element of surprise with speed being necessary. Any hesitations, Stop, Pause and reduced Mobility result in loss of speed to target even if the detachment does not know they are about to have contact by chance.

For the linear, nonlinear and broad advancing battles, the use of Technology allows for and dramatically improves mission tempo performance. The attributes of speed of advance, force protection, stealth and ISR elements enable dismounted warfighters improve movement to contact, closing to area and targets faster and safer. This has meaning in that as the formation must pass a mine restriction this narrow lane is made where and when necessary. As command push broadens and the field battle lines are broadened, the same tactic may be utilized. From the many Offensive missions performed by the Army and Marines, there are many tactical tasks in which individual dismounted troops carry out their positioning. Each movement is critical for the Tactical Mission to function with success and to achieve the operation objectives.

When units set out through a detected minefield, the practicable width for passing is limited. The width becomes a temporary swept corridor for a particular range having reasonable extents as the enemy had laid out his obstacle plan. This Restricted Width applies in many maneuvers where operations have Tactical Mission Tasks of Movement to Contact, Attack, Exploitation and pursuit involving Attack by

fire, Breach, Bypass, Clear, Control measures, envelopment, Follow and assume, Follow and support, Occupy, Retain, Secure, Seize, Support by fire to Advance without Delay all have high possibilities of the combat units pursuing an enemy in his area of defense, where he has intimate knowledge of terrain and time to have previously set IEDs.

Deeper recon for company movement to contact allows for higher reliability for obtaining mission results, advance speed and assured mobility with point of contact capability to update lanes, create new lane possibilities with real-time ISR provided. Reach at the Tactical Leading Edge of the frontline is a priority to target and follow the enemy. The asset creates situational awareness capability to simultaneously evaluate battlespace and retask from the CONOPS when required with a FRAGORD to allow for breaching alternative lanes and record locations. Whether command push strategy is used with detailed planning or recon pull strategy to probe for paths of least resistance with directive control, the physical advance of dismounted soldiers is the same where enemy has already calculated and planned the footstep positioning. In order to close and intercept on a target, the capability must be present to be able to move w/o delay to close the distance. To get to that level of agility at the tactical edge the platform must be able to breach so as to maintain and close distance to target. Maintaining C2 at the tactical edge is also present for those DIL environments.

As sweep operations continue into smaller and smaller subareas the enemy will be forced to retreat into the mountainous topography for their greatest degree of safety. As sweep missions occur and carried out closer to the AO mountainsides, mission success requires Mobility without delay and is a critical KPP, as to close the loop and complete envelopment is required for tactical success. The METT-T factors of many missions carry the required objective of capturing the “logistical Tail” of the enemy. The COG being a focus of the commander’s intent in operations.

In the case the forces never ultimately engage the enemy due to retreat, no mission objective will be achieved and without contact being made no enemy capture or other primary objective can be reached. Establishing reliable Mobility in IED Blast environments allows for objectives to be reached. The Tactical Gain is achieved having identified the problem with a new Technological solution. This has the effect to reduce mission failure and lower risk substantially by increasing the speed and reliability for missions on routes that must make it through unknown and known minefields. Also, many bypass maneuvers or attempts to make it around mines are additionally set with secondary IEDs and AP Mines. The commander may elect this new tactic for CONOPS with lower risk.

Allocation of funds providing equipment to warfighters underfire in these attack IED obstacle situations preserves the Force and has a high value. Shockwave and Barrier Technology benefit all situations for missions requiring Force Protection capabilities in IED/mine environments. These module designs include shock incident angle applied in a way to counter chassis overturning effects and fragmentation trajectory angle applied in a way to block lethal effects. Utilizing the best method with the latest technology allows for direct mission advance without delay, maintaining cohesion, tempo and reducing casualties. In providing the technology, a Capability Gap Solution is presented as a countermeasure to the enemy’s method of Area Denial through kinetic threat use. This tactical maneuver is not limited by the use of AT Mines as they are concurrently detected and often visible on the surface for marking.

The Benefit Matrix on this page summarizes Technology Utilization during Army and Marine missions. The respective tactical task details are listed from the perspective of having to reduce obstacles and breach lanes. The Tier 1 JCAs which enable Command and Control with Situational Awareness and overlapping benefit for Force Application, Force Protection, Net-Centric and Battlespace Awareness for the ISR equipment having a new degree of battlespace penetration and speed.

Tactical Marine Tasks*	Delay Scenario IED Presence	Troop/Unit Response	Potential Risk w/o	KPP Solution KSA Function	JCA Tier 2 w/MoEs&MoPs
<i>Enemy-Oriented Tactical Tasks:</i>					
Ambush	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Attack by Fire	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Block	NA			Advanced Recon	2.4.4, 5.2.3 & 6.1.2
Breach	Reduce	Pause	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Bypass	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Canalize	Observe/detect/trip	Stop & 5c's	Mine Casualty	Neutralize	3.1.1,3.1.4,7.1.2&7.2.1
Contain	NA			Surveillance	3.1.1,3.1.4,7.1.2&7.2.1
Defeat	Observe/detect/trip	Stop & 5c's	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Destroy	Observe/detect/trip	Stop & 5c's	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Disrupt	Observe/detect/trip	Stop & 5c's	Lost Mobility	Mark&Movew/ISR	3.1.1,3.1.4,7.1.2&7.2.1
Exploit	Observe/detect/trip	Stop & 5c's	Lost Mobility	Route Sweep	3.1.1,3.1.4,7.1.2&7.2.1
Feint	Observe/detect/trip	Stop & 5c's	Lost Mobility	Neutralize	3.1.1,3.1.4,7.1.2&7.2.1
Fix	NA			Advanced Recon	2.4.4, 5.2.3 & 6.1.2
Interdict	Observe/detect/trip	Stop & 5c's	Lost Mobility	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Neutralize	Observe/detect/trip	Stop & 5c's	Lost Mobility	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Penetrate	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Reconnoiter	Observe/detect/trip	Stop & 5c's	Lost Mobility	Advanced Recon	2.4.4, 5.2.3 & 6.1.2
Rupture	Reduce	Pause	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Supportby					
Fire	Observe/detect/trip	Stop & 5c's	Lost Mobility	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
<i>Terrain-Oriented Tactical Tasks:</i>					
Clear	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Control	Observe/detect/trip	Stop & 5c's	Mine Casualty	Surveillance	3.1.1,3.1.4,7.1.2&7.2.1
Occupy	Observe/detect/trip	Stop & 5c's	Mine Casualty	Neutralize	3.1.1,3.1.4,7.1.2&7.2.1
Reconnoiter	NA			Advanced Recon	2.4.4, 5.2.3 & 6.1.2
Retain	Observe/detect/trip	Stop & 5c's	Mine Casualty	Neutralize	3.1.1,3.1.4,7.1.2&7.2.1
Secure	Observe/detect/trip	Stop & 5c's	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Seize	Observe/detect/trip	Stop & 5c's	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
<i>Friendly Force-Oriented Tactical Tasks:</i>					
Breach	Reduce	Pause	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Cover	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Disengage	Observe/detect/trip	Bypass	Mine Casualty	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Displace	Observe/detect/trip	Stop & 5c's	Lost Mobility	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Exfiltrate	Observe/detect/trip	Bypass	Mine Casualty	Mark&Movew/ISR	3.1.1,3.1.4,7.1.2&7.2.1
Follow	Observe/detect/trip	Stop & 5c's	Delayed trigger	Route Sweep	3.1.1,3.1.4,7.1.2&7.2.1
Guard	Observe/detect/trip	Stop & 5c's	Lost Mobility	Immediate Breach	3.1.1,3.1.4,7.1.2&7.2.1
Protect	Observe/detect/trip	Stop & 5c's	Lost Mobility	Surveillance	2.4.4, 5.2.3 & 6.1.2
Screen	NA			Advanced Recon	2.4.4, 5.2.3 & 6.1.2

*Notes: Reference MCDP 1-0. The Joint definition of each technique must be interpreted. JCA Numbers are for MCT capability gap solutions: Mobility for Advance and Breaching, Protection for Dismounted Warfighters & ISR synchronization.

This matrix from the previous page is devised to include the portion of tactical mission tasks entering into zones with IED obstacles with *immediacy of time to advance* analyzed. This becomes relevant for COA in assigning priority required by the Commander to achieve each objective. Each of the Tier 2 JCA numbers corresponds to the descriptions defined in the 2010 JCA refinement (BEA) as shown on CV-2 Diagrams. With consideration of unknown obstacle locations, technology use provides M2 capability to contact allowing fast lanes for mobility in areas with IED/mines.

Specifically relating technology applications to the UGV with modular capabilities allows the dismounted soldier to perform tasks without significant delay. Each Marine warfighter is part of the overall operation containing offensive and defensive tasks involving various operations, maneuvers and missions. The offensive tasks are executed in various terrain for movement to contact, attack and pursuit requiring tempo and surprise to have mission success. Mobile and Area Defensive tasks require flexibility and maneuver to provide massing characteristics. All operations have control measures. Each task is executed by dismounted marine warfighters requires tactical breaching tasks to be performed to create marked and clear lanes. AO zones are subject to preexisting or subsequent setting of IEDs. Changes for maneuvers require new lane locations different from the original control measures in the planning stage for troops to move into their new positions to achieve tasks.

Mission and Maneuver readiness for CONOPS;

As the Commander evaluates and selects his COA, Support, Breach and Assault Forces are arranged into situational templates using a reverse planning sequence based on OBSTINTEL. Execution of deliberate and hasty breaching operations is by combat breach forces adapting for METT-TC factors. With sufficient reduction assets, lanes and corridors are created through the obstacle for platoon and company advance and attack without Delay or Reduced Mobility. The effect integrates team unity for delivering maximum combat power forward. Mass, speed and reliability to create lanes are achieved as a MoP for the Breaching Force when implementing the Technology for Capability. For breaching operations, combined arms synchronization is essential to provide speed through engagement zone. The capability to advance over distances without Stop provides flexibility to execute dismounted maneuvers due to changing Battlespace conditions with unknown obstacles. The survivable aspect of the Technology allows for continuation of capability with detection to reduction solution of IED/mines with Force Protection and ISR Mobility for follow-on obstacles and enemy surveillance.

Needed Dynamic Organizational Links

In order to solve the effects on and relationships to Maneuver Warfare by the widespread use of IEDs, EOD, MAGTF, Joint Services and combat engineer teams must be linked together for this Joint Concept. To have the combined arms approach at the battalion level, equipment composition with the logistical makeup in order to effectively carry out operations must be established. This capability solution establishes Technology to perform missions and carry out objectives without the present and consistent need to delay advance and lose the element of surprise. With commanders being maneuver-minded, it is imperative that squad missions be supported to enable tactics with equipment of the highest reliability for task completion which provide and enable mobility capability, a combined arms approach to Lane Breaching with real-time situational awareness.

Recent previous enemy warfare strategies have had only a percentage of large ground troops and significant large sized equipment to wage their attacks with broad lines of engagement. The other percentage of battles require missions which consist of extended WAS Operations requiring detailed tactical advancements of smaller detachments of dismounted soldiers. The enemy's tactics rely on, at many times, IED/mine use to cause local disruptions to predicted mission plans of our troops, primarily in platoon size with dismounted detachments that are in either reconnaissance or search missions.

Future wars may be conducted operationally either WAS or CAM to apply combat power requiring missions highly likely containing minefields. For these environments breach paths set a degree of freedom for immediate advance allowing commander to assume reliable mobility shall occur executing single or when integrating multiple missions. Additionally, Envelopment, Breaching Tactical Missions, PCT and SSTR efforts designed to stabilize an area shall have an enduring requirement due to widespread IED obstacles in existence throughout the Middle East and other likely areas of engagements.

For many maneuver scenarios, a dynamic organizational link is best, preferably single in nature for logistical simplicity. This link allows combined arms EOD Teams to be deployed for tactical offensive, support and defensive missions during active engagements where planning time is least. A common example for Tactical Gain is to use "the MAGTF decisively to seize or obtain the joint force commander's operational objectives"¹³. The benefits from this Technology use extend to all battalions to improve mission speed and success of operations within minefields. Missions have an advantage of surprise with no-delay mobility for detect to engage missions to maximize chance of success. Tactical Unity between branches is key to mission success. The equipment and EOD team integration for joint operations in a minefield can be logistically set into the organization framework and can be simply arranged with the linkage across JOPP planning forming a coordinated operational procedure for deployed combat teams.

Seamless integration between the Branches' Brigade Commanders with a Navy EOD Team Commander enables readiness to deploy for field operation without multiple layer and level approvals. Analysis, templates and coordination of stages are streamlined during operational planning. Forming an efficient and effective Command and Control process with the fewest layers of organizational dependencies shall effectively support platoons to achieve mission objectives at the finite level for maximum operation effectiveness. The other side of dynamic linking needed is the efficient Technology Development through Sponsors. This study focuses on JFC's method of "Operation of the Joint Capabilities Integration and Development System" and Emerging Capability and Prototyping (EC&P) of Technology. After mission analysis is completed, many areas are found to have IED/mines. The elements designated to breach areas are by EOD teams to allow an advance. This capability of advance has the potential for Tactical Advantage and Gain through the development of the Technology described.

"Initial capability requirements documents drive the early acquisition process, and the early acquisition process drives updates to capability requirements documents related to specific materiel and non-materiel capability solutions to be pursued. The updated capability requirements documents then drive the development, procurement, and fielding of materiel and non-materiel solutions that satisfy the capability requirements and close associated capability gaps."¹⁴

Use of the Technology in Tactical missions improves the commander's strategic movement for any tactical mission following C2OTM RCs. The concept and perspective for this series of tactics CONOPS shall have greater success rates for achieving mission objectives. Movements and Maneuvers

include tactical combined arms missions among others. Adequately supporting dismounted troops for missions can increase effectiveness significantly with combined arms principles. At the company and platoon levels, tactical missions shall benefit applying new technology with UGV use. This Joint Concept combined arms approach using current technology provides advantages for both defensive and offensive tactical maneuvers relevant to today's in-demand CONOPS. Technology development shall improve Tactical Edge advance BLOS and Joint Force's mission success maintaining tempo to provide incremental and finite improvements for overall organizational strategy.

Conclusion

The enemy strategy of utilizing IED/mines for reducing mobility of our dismounted soldiers has been investigated and can be overcome by enabling technology solutions for needed Tactical Gain and Force Protection. These operational needs identify Capability Gaps with Material Solutions. Technology development programs exist for these modular applications.

It is possible to address this operational gap through existing Requirement documents to reflect lessons learned to demonstrate rapidly fielded capability solutions. In this way the assessment work would not duplicate previous efforts. A Material Solution Program to develop Technologies should follow a Material Development Decision (MDD) prioritizing these Capability Gaps which exist in the ICD, Unmanned Ground vehicles validated by the Defense Acquisition Executive, the milestone decision authority. Existing UGVs found within the OSD FY2009-2034 Report as well as new chassis can provide needed platform mobility to enable M2.

Technology

Utilizing Research and Development Programs for Shockwave & Fragmentation Protection shall lead towards Fast Attack CONOPS creating a new tactic available for commanders to achieve mission objectives allowing a faster and broader Ground Force Strategy.

Process

The JCIDS technology development system (Deliberate) and the Rapid Acquisition System, EC&P Program have been followed in preparing this paper. A plan of action has been suggested presenting details to improve tactical missions with CONOPS. This provides a suggested scheme of field logistics to deploy C2 with mobility. This paper is presented with Analytic Basis for M2 Capabilities enabling C2 at the tactical edge.

Team Integration

The intention of this Study is to present the intensive use of IED/mines in such a way that sets in action the needed development steps towards capability solutions. Equipping EOD Teams for combined arms missions and positioning them organizationally between services shall allow for rapid use in existing and new CONOPS and OPLANS which use mine breaching operations as outlined in JP 3-34.

Employing lightweight modular solutions provides breaching capabilities for overcoming frequent mission failure due to IEDs, an ongoing prevalent gap. This study for a capability gap solution has been presented which follows existing doctrine for Breaching Force Operations JP 3-15 and JP 3-34. New modular platforms may be fielded through current Unmanned Ground System Programs. The C2, M2 and FP capabilities may be extended for any expeditionary operation in any geographic environment.

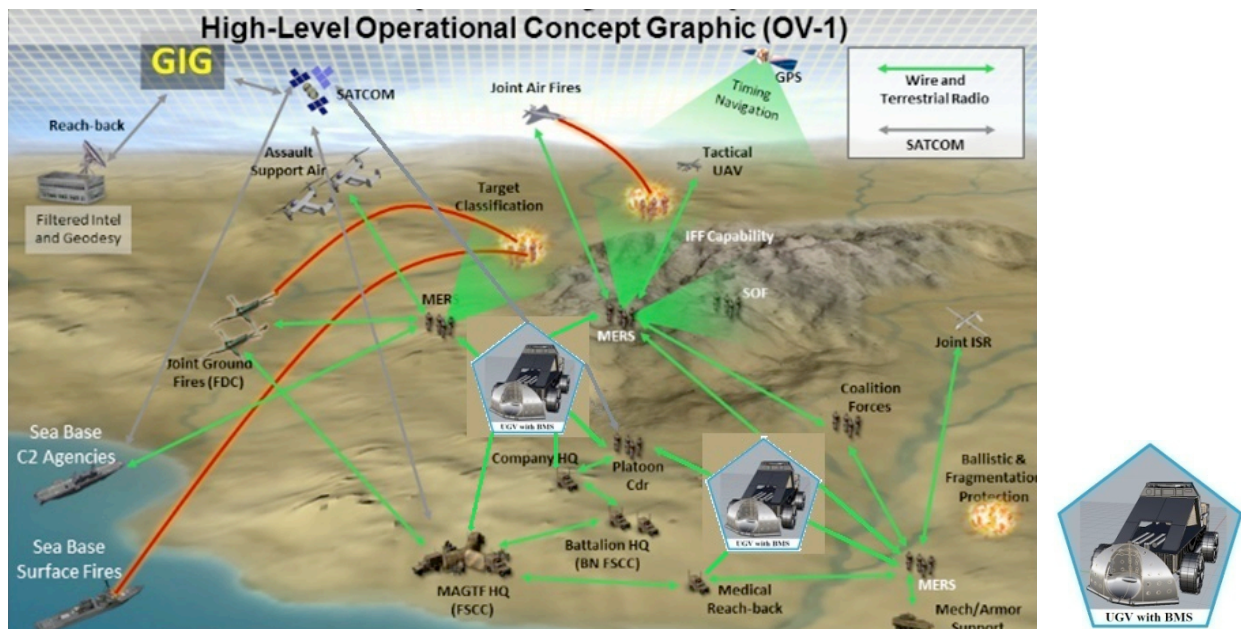
References

Chairman of the Joint Chiefs of Staff and US Marines Publications

1. CJCSI 3170.01H, Joint Capabilities Integration and Development System JCIDS Manual, 19 Jan 2012, pp A-7, 10, 11.
2. JP 5-0, Joint Operation Planning.
3. MCDP-1, Marine Corps Operations, Marine Corps Forces
4. JP 3-34, Joint Engineer Operations, pp. IV-1, IV-4.
5. JP 3-15, Barriers, Obstacles, and Mine Warfare for Joint Operations, pp. III-7, 8.
6. Ibid p. III-4.
7. CJCSI 3170.01H, Joint Capabilities Integration and Development System JCIDS, Enclosure A, 4. d., (4), (b), Page A-7.
8. JP 3-34, Joint Engineer Operations, p. III-22.
9. JP 3-15, Barriers, Obstacles, and Mine Warfare for Joint Operations p. III-3.
10. Ibid p. III-6.
11. JCIDS, Enclosure A, 3. b.; 4. d., (4); 4. d., (4), (b), Pages A-3 to A-7.
12. JP 3-15, Barriers, Obstacles, and Mine Warfare for Joint Operations, pp. C-1, 2.
13. MCDP-1, Marine Corps Operations, Marine Corps Forces, p. 2-9.
14. CJCSI 3170.01H, JCIDS, Enclosure A p. A-1.

Other Publications

On War, Carl von Clausewitz, [Used throughout]



Concept of Operation using UGVs with mobility for C2 SA at Tactical edge BLOS. Legend for UGV SADL Connectivity

DODAF OV-1