# Fighting in the New Frontiers: Multi Domain Operations, Convergence, and Offense-Defense Integration

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## *Painting the Battlefield*

The ever-evolving battlefield is complex in nature. The rate at which military technology is advancing is opening this battlespace to new domains; the traditional spaces of land, sea, and air have now had space and cyberspace join their ranks. This has resulted in the persistent need for the careful integration of the United States' Joint Force into a singular concept that builds careful coordination of command & control to ensure the warfighter has access to the latest intelligence and an array of capabilities that span services. This concept is Joint All-Domain Operations (JADO), an expansion on the Army's operationalized Multi Domain Operations (MDO) warfighting concept.

## *Introducing Multi-Domain Operations and Convergence*

As the emphasis of our nation's warfighting priorities has been redirected to defeating near-peer adversaries, the military has developed and has begun to implement the MDO concept. This concept integrates capabilities and actions across all domains of warfare: air, land, sea, space and cyber. In order to do so, the complete view of the battlefield must be married to operations across all domains so that all sensors are combined to ensure that the best shooter is employed. As each military component needs to be able to create favorable space in each domain, multiple projects are underway within the Department of Defense with the intention of allowing these respective components to get inside the enemy's decision cycle and achieve the nation's objectives.

In open conflict, the ability to operate freely in all domains requires control of the airspace which has become extremely crowded and lethal. This requires the Joint Force to be able to dis-integrate enemy anti-access and area denial (A2/AD) zones and penetrate enemy defenses to destroy long range weapons systems. The Army needs to protect the force from an ever-increasing array of threats from the air in order to maneuver freely in the land domain. There is no force on Earth that can defeat the U.S. military once they enter the region, assemble, and maneuver to fight. As the saying goes "You go to war with the army you have, not the army you might want or wish to have at a later time." So, we must deliver the all-domain capable military we want, what we need, as expediently as possible.

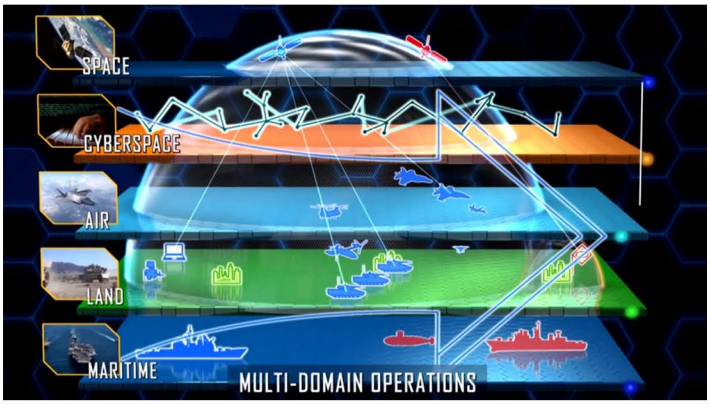
Integration of precision offensive fires and integrated air and missile defense (IAMD) under an all-domain command and control system is required for the speed of the evolving battlefield. It is imperative that the Department of Defense continues to mature systems in an efficient and timely manner to deliver combat-capable equipment to the warfighter in the next decade.

## *Multidomain Operations*

Offense-Defense Integration (ODI) brought together through integrated Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) infrastructure is the gold standard of convergence across domains as envisioned in MDO and JADO. This integration serves to enable and/or directly accomplish the principles of Compete, Penetrate, Dis-integrate, Exploit, and Re-compete laid out in "The U.S. Army in Multi-Domain Operations 2028".[1]

MDO as a concept is intended to be utilized most prominently and crucially in the tactical environment. The warfighter is the one to gain most from the implementation of improved convergence. This is because it allows for a friendly scheme of maneuver uninhibited since all domain layers are secured and in constant coordination with one another; providing unalterable security. When this upgraded convergence not only allows the freedom of movement for the boots on the ground, reciprocally, it also tightens the enemy's

tactical approach. When all ground is covered, decision making is more efficient and more readily equipped. Better tactical and operational linkages across the sectors need to exist to aid in a rapid, dynamic response to events.[2] This frees up the posture of friendly forces.




Multi-Domain Operations Graphic. (Photo Credit: U.S. Army Training Support Center)

MDO acts as an all-encompassing system for defensive and offensive strategy. More importantly, it minimizes human error caused by faulty planning, an issue exemplified at several points in the past. Several case studies from the post-Cold War era display the need for MDO, but also the potential it holds. Conventional conflict was forever out of reach of American enemies once the U.S. displayed its total air supremacy. The advantages of this strategic dominance combined with a refined command and control (C2) system gives unparalleled support for all operations. While understanding the strategic level capabilities of MDO, the methodology as outlined in U.S. Army Training and Doctrine Command's (TRADOC) multi-domain operations serves best to effectively perform tactical level courses of action, especially because the methodology is intended to work on all domains, even those in which the U.S. is not dominant like the electromagnetic spectrum (EMS), and the information environment. This is crucially important given the intentions of near peer adversaries like China and Russia in their military strategy, what some scholars refer to as 'hybrid warfare'. When all the steps are carried out in the process, it serves to narrow down hostiles and eliminate all factors that prevent the warfighter from achieving the mission in hostile engagement, maximizing performance outcomes. MDO, in its rawest display of success, will make the warfighter more effective than ever before. Thus, it is not the system itself that is the most lethal, it is what the system allows other assets to achieve.

## *IAMD and ODI Applied to Dominance*

*Army field artillery and air & missile defense are like two boxers, one who can only punch and the other who can only block. "We've got to have one boxer that has the ability to strike and block simultaneously. That's the speed that we're going to need in the future."* - BG (Ret.) Randy McIntire, former director of the Air and Missile Defense Cross Functional Team.[3]

MDO seeks to create a convergence across domains to give joint and allied forces a dominant position, even if just for a limited time, in time and space by pressing forces into gaps in adversary A2/AD networks. These gaps are shaped by active maneuver enablers and the advantage sustained in part by critical fires support to the infantry and armor. This is manifested in the answers to the operational problems of how to penetrate, dis-integrate, and exploit.

In the penetration phase, air and missile defense impede adversary maneuver by air as forward deployed forces contest multiple domains. Missile defense is also key to ensuring joint and allied forces can mobilize and begin necessary strategic maneuver with minimal interference. Simultaneously, long range precision fires work to neutralize adversary long range fire platforms in order to erode A2/AD networks. This allows for the safe passage of the main body to assist friendly forward deployed forces.

As the joint force moves into the dis-integrate phase of MDO, a zone of proximal dominance[4] is established by forward deployed forces and follow-on forces as a front solidifies along lines of friction. This concept of proximal dominance set up by "any formation in contact or that envisions contact with the enemy" as put forward by Major Amos C. Fox in his paper "Getting Multi-Domain Operations Right Two Critical Flaws in the U.S. Army's Multi-Domain Operations Concept" is an important descriptor for how to think about the influence of units on a long front against a near peer. However, MAJ Fox does not provide in his report capabilities that build and contribute to the zone of proximal dominance. Based on the descriptions and graphical renditions provided by MAJ Fox, ODI of fires is a major contributor to the strength and size of the proximal dominance projected by a unit.

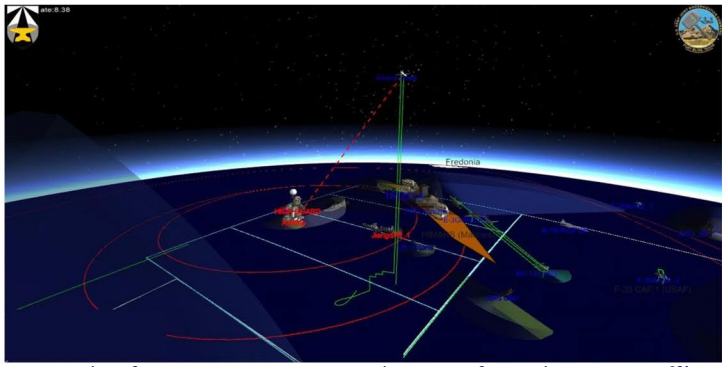
In the dis-integrate phase, ODI of fires works to further neutralize the enemy A2/AD network and defeat long-range systems. IAMD provides cover for operational maneuver at the deep maneuver, close area, and tactical & operational support areas. Mobile air defense provides a bubble of aerial dominance that is non permissive to adversary aircraft and allows for joint air support in theater. Coordination between the maneuver force, IAMD assets, and aerial support is all down over a joint all-domain network. Offensive fires begin targeting enemy medium range systems to aid operational maneuver, with targeting data communicated over the same joint all-domain network.

Dis-integration of systems will create a brief moment of overmatch and dominance, allowing for force projectors to extend their proximal zone of dominance through gaps in the adversary's front. This is the exploit phase. Short range air defense (SHORAD), man-portable, motorized, or mechanized systems that accompany infantry and armor, will continue to support maneuver forces in the deep and close maneuver areas. Offensive fires will eliminate tactical A2/AD networks and support the maneuver force by dislodging enemy defensive units and targeting exposed enemy command systems in order to create favorable force ratios for the maneuver force to further exploit.

With proper logistics and resources to feed these processes, the zones of dominance will continue to grow and extend forward along the front as enemy resources are expended and joint dominance increases. As adversary long and medium range ground-based systems and strike aircraft are destroyed, the zone of proximal dominance increases as a source becomes less contested along the front. Coordination of logistics to sustain combat operations and maintain the character of dominance, as well as ODI in support of maneuver is enabled by a joint all-domain network.

## *Network Convergence*

Synchronization of information and command and control across the Joint Force is necessary for "shooters" to be able to penetrate, dis-integrate, and exploit the enemy on the battlefield. Having a distributed and resilient network will give the Joint Force an exponentially faster dynamic to responding to incoming threats and countering adversaries. The Defense is working to create a system that best connects and manages joint force operations during conflict to enable MDO. This system is called Joint All-Domain Command and Control (JADC2).




Example of a common operational picture from the Joint Staff's JADC2 Campaign Plan Experiment 2. (Photo Credit: DVIDS - Joint Modernization Command. Photo by Jonathan Koester.)

The Department of Defense intends for JADC2 to be a "network of networks", shifting from the current highly centralized concept with rough linkages between previously stovepiped legacy systems, to a more distributed one that connects every sensor to every shooter and blends artificial intelligence (AI) with human judgment to accelerate decision making. It is a joint effort that seeks to bring input from every service branch and operates in a bottom-up fashion by allowing for the transfer of data from one domain to another. An example of JADC2 in use is an Army command and control (C2) node could provide data from space-based tracking sensors on a target to aircraft or vessels from sister services that are better positioned to carry out an intercept or strike. All services plan to incorporate artificial intelligence into their JADC2 platforms to aid in the processing of unprecedented amounts of data to allow leaders to make the most informed decisions.

On July 22, 2020, Chairman of the Joint Chiefs of Staff General Mark Milley assigned each service a role in developing a key concept for Joint All-Domain Operations. The U.S. Air Force (USAF) was assigned JADC2, as outgoing Chief of Staff of the Air Force General Goldfein was the strongest advocate for JADC2 and has invested significant dollars into the Advanced Battle Management System (ABMS). The Air Force is also the service with the closest entity to a real-time command-and-control system, its regional Air Operations Centers (AOCs).[5] Each service has a network that it is currently developing to serve as its network within JADC2, with development led by the Air Force: ABMS (Air Force), TITAN (Army), CEC (Navy).

## *ABMS*

The Air Force's Advanced Battle Management System (ABMS) is an alternative to the E-8C Joint Surveillance Target Attack Radar System (JSTARS), an aircraft system that performs ground surveillance, battle management, and command and control, offering valuable information regarding situational awareness for the combatant commanders. ABMS is intended to provide the best information directed towards cross-service defense operations while being composed of a "network of intelligence, surveillance, and reconnaissance sensors and will utilize cloud-based data sharing to provide warfighters with battlespace awareness for the air, land, sea, space, and cyber domains."[6]

Brigadier General David Kumashiro, Director of Joint Force Integration at USAF HQ, said that ABMS will be "the technical engine" driving the Air Force's approach to its Multi-Domain Command and Control (MDC2). The Air Force hopes ABMS will be the backbone of JADC2. The budget proposed by the Air Force can be broken down into seven categories:

1) Digital architectures, standards, and concept development:
2) Sensor Integration
3) Multi-domain data management
4) Multi-domain secure processing
5) Multi-domain connectivity
6) Multi-domain applications
7) Effects integration, which encompasses "open smart munitions," attritable aircraft, and "real-time updates to mission data files to improve electronic warfare system performance"[7]

The ABMS technology would allow for a comprehensive plan allowing for the moving of data at machine speed across the globe, from subs to satellites, aircraft to ground troops, and ships to shore. It would therefore fuse a wide quantity of data from hundreds of sensors in order to provide situational awareness for combatant commanders across the globe, functioning as a "decentralized system that draws on all domains" according to former Air Force Chief of Staff General David Goldfein.[8] This comes after Air Force officials have decided to abandon the idea of adhering to the 2018 National Defense Strategy and instead focus on the ABMS as a future backbone for the JADC2. It is thus concluded that aircraft is not the sole way to acquire command and control capability across multiple domains, hence the joint initiative ideas that resulted from this shift.

## *TITAN/IBCS*

The Tactical Intelligence Targeting Access Node (TITAN) is an Army prototype system for a next-generation scalable and expeditionary intelligence ground station. The task of TITAN will be two-fold. It will provide multi-discipline intelligence support to targeting, and situational awareness and understanding for mission command.[9] Second, TITAN is designed to leverage space and high altitude, aerial, and terrestrial layer sensors to provide targetable data to fires networks. The Army wants to tie "deep-sensing" reconnaissance to long range precision fires in order to erode enemy A2/AD capabilities.[10]

According to Brigadier General Rob Collins, Program Executive Officer for Intelligence, Electronic Warfare and Sensors (PEO IEW&S), the Army has roughly 100 tactical ground stations, 13 operational ground stations and a few other dissemination vehicles to inform battlefield commanders with some of them reserved for certain echelons.[11] The goal of TITAN is to provide a consolidated, modular ground-system tailorable to all echelons in order to replace the varied ground stations at present.

Developed by Northrop Grumman for the U.S. Army, the Integrated Air and Missile Defense Battle Command System (IBCS) is a C2 capability that integrates air and missile defense systems to eliminate stovepipes and allow warfighters to use any sensor or weapons to achieve mission objectives.[12] Using IBCS, soldiers can perform surveillance, identification, weapon management, and engagement functions and collaboratively plan and execute joint engagements of air and missile threats.[13] The system is capable of incorporating current and future air and missile defense systems, sensors, weapons and battle management command, control, communications, and intelligence systems into a fully integrated network.

Integration provided by IBCS allows the department to invest in new capabilities in a much more fiscally responsive way by investing in sensors or weapons that

can fill capability gaps without having to buy complete weapon systems. IBCS enables common mission command across Air Defense Artillery, other U.S. Army forces, and other IAMD forces.[14] In addition to providing the means for integrating U.S. IAMD assets, IBCS also establishes the means for connecting complementary and coalition systems for joint and cooperative multinational missile defense.

IBCS components emplaced for an intercept test at White Sands Missile Range, New Mexico. (Photo Credit: DVIDS - U.S. Army)

## *CEC*

Cooperative Engagement Capability (CEC) is a sensor netting system for the U.S. Navy that enables high quality situational awareness and integrated fire control capability, significantly improving the battlespace of air and missile defense capabilities of the U.S. Navy ships, U.S. Navy aircraft, and U.S. Marine Corps Composite Tracking Network (CTN.) The geographically dispersed sensors enable a Navy Integrated Fire Control-Counter Air (NIFC-CA) capability, which provides intelligence, surveillance, and reconnaissance (ISR) ability and allows various sensors, airborne or afloat, to detect and begin the kill process for incoming air and missile threats.

CEC provides the Navy with a single, integrated air picture. Once linked into JADC2, the Navy can use joint sensors to populate their air picture as well as provide ship and airborne sensor data to other services.

## *Networks and Kill-chain*

Possession of the "network of networks" is key to the ability to rapidly and seamlessly integrate offensive and defensive fires. From deep strike to the interception of ballistic and hypersonic missiles, an open architecture of communication across the available sensors and shooters allows for the greatest persistence in target acquisition and tracking, and then flexibility in how to engage targets. Kill chains characterized by a robust architecture give greater order in contested environments characterized by swarming aerial threats and electromagnetic and cyber warfare.

The greatest operational application of JADC2 is the ability of services to easily share sensory data that previously was not easily coordinated or obtainable. Leveraging the space domain across the joint force will give unprecedented ISR capability to low level leaders, as previously space assets were kept at a high echelon and difficult to task and share information. With JADC2, Marine or Army ground commanders will have the latest information and ability to utilize rocket artillery and long-range precision weapons to their potential.

The Missile Defense Agency (MDA) has also stressed the importance of JADC2 in regards to ballistic and hypersonic missile tracking. At an MDAA virtual round table in June 2020, MDA's Chief Architect Stan Stafira made clear the importance of JADC2 and its ability to create a common air picture to the homeland defense mission: "We need the ability to globally see, track and engage the threats in a multispectral environment in real time with persistent capabilities, so that we can provide the right data to the right targets."[15]

MDA is working with the Air Force to connect their Command and Control, Battle Management and Communications (C2BMC) architecture with JADC2. Additionally, MDA and the Space Development Agency (SDA) are working to build JADC2 capability into new satellite constellations such as the Hypersonic and Ballistic Tracking Space Sensor (HBTSS). By sharing data from HBTSS with joint services through systems like IBCS, this will allow for constant custody of a target by the best sensor, whether it is a tactical or intercontinental ballistic or hypersonic missile, and ultimately allow the best shooter to execute the kill. If need be, HBTSS through JADC2 by the way of TITAN, ABMS, or CEC, can also share tracking data will long range precision strike platforms to neutralize the target in counter battery fire. Dr. Derek Tournear, Director of SDA, said at the MDAA virtual round table in June 2020 that HBTSS's secondary mission is providing this information to emerging Army hypersonic weapons platforms through TITAN.[16]

Providing persistent sensors in the air, at sea, on the ground, and in space, that allow for beyond-line-of-sight targeting can realize the full potential of integrated underlayers and retaliation. JADC2 gives the joint force the ability to tailor comprehensive force packages of multiple systems to leverage the advantages each service possesses. The key to making it all work will be low network latency, especially with regards to missile defense and kinetic interceptors. JADC2 provides persistent, flexible sensing to build a robust kill-chain apparatus, providing nimble deterrence by denial but also powerful deterrence by retaliation through offense-defense integration and leveraging forthcoming long-range precision fire platforms.

## *Operational Environment*

In the operational environment, the following are the tenets in which MDO attempts to make the battlefield serve the advantage of friendlies while closing the window of opportunity for the enemy: compete, penetrate, dis-integrate, exploit, re-compete.[17] Competing, first expands the competitive space, allowing the full spectrum of threats to be observed unilaterally. Penetrating follows, which engages with the enemy's long-range systems and neutralizes the first line of defense. Dis-integration follows which aims to defeat the short-range systems and any A2/AD systems. This allows exploitations to follow, with freedom of maneuver now available to ground forces, this decisive point allows actions-on to follow the initial phases of the operation. Re-competing restarts the process, with the now secured terrain and other objectives in control and the next operation ready to follow. The process in its nature is malleable towards any threat. It can address non-conventional and irregular warfare adversaries while also focusing, when done with the most modern of systems the U.S. military can offer, to defeat large conventional conflict adversaries.

ODI enabled by JADC2 works to open windows of opportunity in time and space to allow for the exploitation by maneuver forces. Convergence of sensors with kinetic and non-kinetic, cyber and electro-magnetic, air and missile defense platforms directly contribute to competition through setting up formidable A2/AD zones, but also sets the condition for successful penetration of enemy defenses by neutralizing or degrading the effectiveness of enemy precision fires. This allows for the maneuver force to more safely position themselves for operations. Once enemy long-range systems have been neutralized, kinetic and non-kinetic fires, aided by JADC2 and leveraging cross-domain sensors, can begin to dis-integrate enemy A2/AD systems and create space for the maneuver force to conduct an attack. Maneuver SHORAD and tactical fires, also connected to TITAN, CEC, etc. will continue to support the maneuver force leveraging a range of sensors providing critical information as they begin to exploit the window of operational advantage, all while continuing to leverage persistence in overhead, terrestrial, and cyber surveillance.

This kind of ODI was not previously possible, despite American dominance in coordination, intelligence, and targeting in conflicts of the post-Cold War era. The U.S. is slowly losing its advantage as China catches up in C4ISR technology and as the Russians and Chinese have developed dispersed A2/AD networks. Much of their trajectory has been driven by watching American conduct of war in Operation Desert Storm, Operation Iraqi Freedom, and Operation Enduring Freedom. As the U.S. continues to develop its MDO and JADO concepts looking ahead to the 2030s, there are lessons that can be drawn by looking at failures and gaps in our engagements over the previous 30 years, just as our adversaries have.

## *Operation Desert Storm*

Air Operations were not discussed in the fray of planning until the 1970s and 1980s when the military was rethinking strategy. This was around the time the battlefield began to be viewed through more focused strategic and operational lenses. Operation Desert Storm most importantly highlighted the inability for military opposition to compete against the West in conventional war. Post-Cold War, there was no force in the world that could rival the U.S. and NATO's air supremacy. This shifted the thinking and integration of this absolute advantage in operational planning. These steps were the first in the discussion of joint-operations, which MDO has further managed for efficiency.

Airpower was acknowledged for its importance to mission success even before this revolution in doctrine. The 1943 Field Manual 100-2, Command and

Employment of Air Power, proclaimed in all capital letters that "LAND POWER AND AIR POWER ARE CO-EQUAL AND INTERDEPENDENT FORCES", and this manual gave precedent to inspire Colonel John Warden's 1988 book Air Campaign: Planning for Combat, which emphasized that air power could independently win wars by attacking the enemy's system from the inside out.[18] This discussion in strategy gave way for the dominance and abundance of airpower used in the Gulf War and shifted discussion to the idea of joint planning. General Herbert Norman Schwarzkopf, who led all coalition forces in the war, made the decision to organize air components under one functional command. He then named Lieutenant General Horner, commander of U.S. Central Air Force, as the Joint Force Air Component Commander (JFACC) in order to provide centralized planning, decentralized execution, and the integration of both service and allied air capabilities.[19] This step in centralizing command and control with coalition helicopters and fixed wing aircraft led to immense success in the Desert Storm Campaign. Keep in mind the coalition force had an overwhelming advantage in firepower, thus it is fair to address that C2 and Joint Planning were not the sole factors towards victory; however, the utilization with no question was an example of effective implementation.

It is important to note the Gulf War was practically the perfect scenario for the U.S. and coalition forces to engage in a successful war; an inferior conventional force fighting in open desert terrain far from major civilian-populated locations. There was no question supremacy of airpower would be overused and ultimately what confirmed victory. However, the utilization of mass airpower without the effectiveness of systems which could have improved precision strikes resulted in an air campaign widely criticized and with much scrutiny related to the overkill aspect of it in addition to what some experts considered violations of UN resolutions. The effects of issues such as these have a longer lasting impact that go beyond the conventional battle. The Coalition of the Gulf War flew over 100,000 sorties, dropping 88,500 tons of bombs, widely destroying military and civilian infrastructure.[20]

Utilization of the MDO frame of reference minimizes the need for massive air campaigns. Airpower with no doubt is the decisive element allowing other defense layers to have increased mobility and violence of action. The convergence of systems however gives the credibility to operations in offering precise and effective pre operations target identification and additional actions-on support. This in theory would reduce the damage and destruction to collateral casualties. The ability to showcase this display of distinction in targets for operational planning gives credibility and increases the support for military campaigns overall.

Additionally, planning and targeting done at the JFACC would have been more efficient with a JADC2 capability. The ability to level data from all sensors available to tailor strikes would lead to a reduction of many of the criticisms leveled against the air campaign during Desert Storm. JADC2 would also enable better execution of the commander's intent in a decentralized execution due to JFACC and lower level commanders being able to share the same intelligence and operational picture.

Desert Shield/Storm also saw the first operational deployment and intercept by the Patriot missile system. Shortly after the 82nd Airborne, Patriots arrived in Saudi Arabia inside the first week of Desert Shield. More Patriots continued to be deployed to Saudi Arabia, as well as Israel. The first intercept by Patriot occurred on January 18, 1991 at 4:30 AM, near Dhahran Airport in Saudi Arabia.

A rearmed Patriot launcher after the first combat intercept of a Scud missile. (Photo Credit: XVII Airborne Corps History Office by SPC Randall R. Anderson)

There were multiple intercepts throughout the remainder of the conflict. For its first operational deployment, the Patriot was notably successful. There were hiccups with launches at false targets and debris because of the poor quality of Iraqi Scuds breaking up

in the atmosphere, as well as a high shot doctrine to achieve intercept. Richard Davis, Director of Army Issues National Security and International Affairs Division, testified to the House that the Army's initial number of 70% success was unsubstantiated. However, Charles A. Zakret, a scholar in residence at the Center for Science and International Affairs of the Kennedy School of Government and member of CFR, testified:

"Patriot performed in The Gulf War at least as well and probably much better than might have been expected beforehand, given the unanticipated nature of the threat. It was a credible, effective performance that warrants credit to the U.S. Army, the IDF, Raytheon and the other contractors who built the system."

He pointed out that without Patriot, damage and ground death tolls would have been higher and the success seen on its first operational deployment, which it was not entirely ready for, showed the Army should prioritize upgrades to a promising system. Zakret's characterization of the Patriots success in the Gulf War contributed to the Patriot being discussed, and now fielded, as part of regional theater ballistic and cruise missile defense.

In a future large-scale combat operations (LSCO) against either 2+2 adversary outlined in the 2018 National Defense Strategy, the cruise and ballistic missile threat will be far more advanced than the Gulf War. In the Gulf War, Patriot missile batteries suffered from poor communication infrastructure, poor target acquisition via radar, and poor interceptors. The tethered nature of radars, relays, and launchers meant Patriot could not have dispersed operation, making it less effective for theater defense and diminished to a point defense. Today the Patriot Advanced Capability-3 Missile Segment Enhancement (PAC-3 MSE) interceptor cannot reach its full potential range due to limitations of current legacy radars and the shot doctrine is still two interceptors per target at minimum.

With modern radars combined with a JADC2 architecture, Patriot batteries will not face the same problems in future conflict. The availability of all sensors as part of the Army's IBCS network to provide 360-degree tracking will give the Patriot system accurate targeting and could lower shot doctrine. Improvements in sensing will also allow the PAC-3 MSE interceptor to utilize its full potential range. These two characteristics will allow Patriot systems to operate in a more dispersed environment, leading to better resiliency in future conflict as well as a larger defended area. Patriot will be able to provide a real theater level missile defense capability.

### *Operation Anaconda*

On March 2, 2002, after two months of plan and prep, coalition troops led by Central Intelligence Agency (CIA) paramilitary officers went into Afghanistan's Shahi-Kot Valley to neutralize what was understood to be a small and surprised Taliban and al-Qaeda force. Unbeknownst, they stumbled upon an enemy force 5-10 times larger than initial measures armed with heavy weapons sighted on pre-designated target locations and helicopter landing zones. Under heavy fire, close air-support (CAS) assets became the decisive element towards winning the battle. However, the lack of planning thereof for the integration of this capability ultimately led to friendly casualties and a fight that could have been won quicker and with less human toll. MDO theory in the planning process would have come a long way in achieving this.

Every service understands the need for effective information coordination. However, each has developed its own system to integrate data. But sensor data integration occurs only after each service's specific tools have collected and collated it.[21] Therefore, without proper integration, data and information falls into stovepipes as a result of individuals systems, with even more consequences from individual planning. This was the very case with the planning phase of Anaconda. Conflicting intelligence reports between different task forces assigned to the operations resulted in Combined Joint Task Force (CJTF) Mountain axing the planned integrated air operations along with ISR support and pre-planned airstrikes.[22] Unfortunately, the lack of depth at the time put into doctrinal instruction of joint operations relegated airpower to a support role as opposed to integrated into the primary planning infrastructure. Improved planning and use of various sensor layers for ISR support could have given a better assessment of the battlefield in determining the enemy firepower estimates. This initial lack of joint planning resulted in boots on the ground also lacking this access to air assets during the fight, at least in a time effective manner. Combined Air Operations Center (CAOC), unfortunately, was not included in the planning process

either. CAOC is what gives command and control over air and space-based systems, provides a unified picture of the battlefield, and serves as a link between the strategic, operational, and tactical levels of war.[23] This lack of planning at the strategic level ultimately proved costly. Ultimately, Anaconda was a showcase of the gaps MDO can fill in bringing airpower into the fold.

Integrated planning is an essential function of the MDO precipitated outcomes as is the case of systems convergence. The concept underlines understanding how to effectively employ all assets to ensure cross coordination before the warfighters are even sent in. This ensures efficiency and utilizing more with less. This is one of the crucial tenets of MDO: ensuring joint-force ops compete militarily before the armed conflict begins, penetrating and then disintegrating an enemy's anti-access and aerial denial systems or amassed combat power beforehand, and finally exploiting the resulting freedom of maneuver.[24] This implementation would have allowed the strategic and operational gaps to be covered, giving eyes to components the warfighter lacked. CAS rapidly improved and ultimately became the key to winning the battle when it was finally utilized.[25] However, as mentioned before, ISR utility and air assets should have been understood to be the component instituted to lead in the first phase. Command and control efficiency through systems convergence would have been a key instrument in ensuring the progress on this front was actionable and therefore easy for the boots on the ground to conduct follow-on actions in a timely manner.

## *Operation Iraqi Freedom*

The lessons learned from the 1990s and the beginning of the 21st century allowed for continued success of joint-operations and improved command and control during the Iraq War. Operation Iraqi Freedom (OIF) encompassed these lessons and improved upon them to meet the conditions of the environment, through battlefield-inspired osmosis. Due to the need for decisive action, in part because Saddam was attempting to destroy everything left behind, the convergence of precision airstrikes and ground forces were crucial in achieving the mission to take ground and advance in a faster time period. By integrating coordination between precision air strikes and ground forces, U.S. Central Command (USCENTCOM) was able to slim down the U.S. ground force element to a single heavy division, one light division and two light brigades. This represents only about one-third the force required for the far less ambitious mission of evicting Iraqi forces from Kuwait during the First Gulf War, and only about half the size of the ground force called to deal with this contingency in the defense reviews of the 1990s.[26] Combined Force Air Component Command (CFACC) led this call, as part of the recognition from operations like Anaconda, that in order to implement successful air campaigns, it could not be limited as a support force but instead as a central leader in the planning and execution process. This led to the ability at the start of the invasion of Iraq for the U.S. to hit with shock and awe and ultimately, as planned, take the Iraqi military by surprise.[27] These are the advantages precise coordination offer, which are integral as a component of multi-domain operations. The enhanced capability that network convergence will offer makes the process of coordinated layers working hand in hand in the battle space only that much more micromanaged and precise. It is a technical layer to this principle of war.

Captured Iraqi FROG-7 rockets near Ad Diwaniya, Iraq during OIF. (Photo Credit: DOD by SGT Paul L. Anstine II)

Air and missile defense were not a major factor in Operation Iraqi Freedom due to the short nature of the initial ground invasion and weakness of the Iraqi military only a decade after the devastating Gulf War. In the first three weeks of OIF, Patriot did intercept nine Iraqi short-range ballistic missiles.[28] The Iraqis did also launch cruise missiles, but to no success. However, the Department of Defense's "Patriot System Performance Report Summary" conceded "[cruise missile] attacks may have forced us to change our tactics." The report later added that "the ability of these older cruise missiles to penetrate friendly airspace and reach their targets should serve as a warning…that the emerging

cruise missile threat must be addressed."[29] Patriot missiles also struggled to intercept smaller missiles like the FROG-7 due to their 90 second flight time. The amount of equipment necessary for the Patriot also posed a problem of creating a cluttered electromagnetic environment with much interference.

Based on these lessons from the Patriot performance, Patriot PAC-2 and PAC-3 Cost Reduction Initiative (CRI) missiles were on-par for the threat, but may not have been successful against overwhelming swarm attacks by even older ballistic and cruise missiles despite the Patriot deployment being "substantial, involving up to 40 U.S. fire units and 22 fire units from four coalition nations."[30] These swarm attacks by cruise missiles or drones are thought to be a major problem of concern in a potential future conflict with near-peer competitors. Patriot and its radars, especially with how much interference they produce, are not currently enough to counter ballistic and cruise missile swarms due to the lack of persistence and scale of the systems. New radars, like the Lower Tier Air and Missile Defense Sensor (LTAMDS), the new IBCS, and new interceptor platforms need to be rapidly fielded to address the lessons of OIF.

## *Conclusion*

Convergence of systems to bring ODI to fruition in order to enable the successful implementation of Multi Domain Operations faces typical technical, budgetary, and bureaucratic hurdles. As the United States faces the evolving situation laid out by the 2018 National Defense Strategy, ODI has never been more relevant or critical. It is the most complex and ambitious undertaking the Pentagon has undertaken since the Manhattan Project as air and missile threats increase in range, lethality, saturation, and proliferation. Multi Domain Operations is the fighting doctrine that will produce survivable, effective, and winning forces for the modern battlefield.

The convergence of networks and sensors has to lead the way because without integrated networks, our capabilities can't communicate. Linked networks must form a self-healing web to allow all capabilities to be a consideration in a commander's tool box: all sensors, best shooter. JADC2 is an important step to bring a capability rapidly to the field that has shown promising results in IAMD.

The U.S. Army and the Department of Defense as a whole must exercise muscles long atrophied and learn from its own muscle memory and written history. Failing is learning, and to stay ahead we must fail and learn fast, but there is no reason to experience the same failure twice when the lesson is available. The past provides important context and lessons learned to avoid mistakes of the Second Offset in the transition to Multi Domain Operation in the coming Third Offset.

Offense-Defense Integration to provide IAMD with left of launch capabilities supported by a web of networks of sensors as a function of Multi Domain Operations is what's needed for an increasingly lethal battlefield dominated by missiles.

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