Marines assigned to Battery R, 5th Battalion, 11th Marine Regiment, launch High Mobility Artillery Rocket System from Guided Multiple Launch Rocket System during Operation Steel Knight, aboard Marine Corps Air Ground Combat Center, Twentynine Palms, California, December 7, 2017 (U.S. Marine Corps/William Chockey)

Multidomain Ready

How Integrated Air and Missile Defense Is Leading the Way

By Jonathan C. Stafford

The U.S. military's dominance in the traditional domains of land, sea, and air has been a key advantage that has greatly helped ground forces succeed in recent conflicts. However, strategic competitors have begun to challenge U.S. dominance in these domains with advanced surface-to-air missiles, antiship cruise missiles, tactical ballistic missiles (TBMs), antisatellite weapons, mobile sea mines, drones, electronic warfare, and cyber/electronic warfare. Along with these new technologies, new tactics, such as the use of Russian paramilitaries in Ukraine[1] and of Chinese fishing boats to enforce territorial claims in the South China Sea,[2] have further challenged U.S. military dominance.

These new capabilities and tactics have not gone unnoticed by senior U.S. military leaders. General David Perkins, former commander of U.S. Army Training and Doctrine Command, stated, "Since the rout of Iraqi forces in [Operation] *Desert Storm* 25 years ago, potential foes have found ways to counter how the U.S. military wages war within an air/land concept. They are fracturing our way of war by using other domains. . . . We can't do it with two domains; air and land are not enough."[3]

General Robert Brown, commander of U.S. Army Pacific, has noted that in the Pacific area of operations, adversaries have developed technology and tactics that have led to a loss of U.S. dominance in the sea and air. To regain dominance, Brown advocates for integrating operations in multiple domains: "We in the Army can no longer simply focus on the land, leaving the air and sea to other Services. All U.S. forces must change their distinct Service cultures to a culture of inclusion and openness, focusing on a purple (or joint) first mentality."[4] The former commander of the U.S. Indo-Pacific Command (USINDOPACOM), Admiral Harry Harris, reemphasized Brown's point, stating that "the Army's got to be able to sink ships, neutralize satellites, shoot down missiles and deny the enemy the ability to command and control its forces."[5]

These calls from senior military leaders to focus on additional domains and increase openness to joint operations are being described as multidomain operations (MDO).[6] The Army defines *MDO*

Lieutenant Colonel Jonathan C. Stafford, USA, is the Military Science Department Chair at Eastern Washington University.

Soldiers enrolled in Basic Leadership Course, instructed by 7th Army Training Command noncommissioned officers, conduct field training exercise at Yavoriv Combat Training Center in Yavoriv, Ukraine, July 11, 2018 (U.S. Army/Derrick Garner)

as "a joint combined arms concept for the 21st century" that "places greater emphasis on space, cyberspace, as well as other contested areas such as the electromagnetic spectrum, the information environment, and the cognitive dimension of warfare."[7]

Building on the Air-Sea Battle concept established in 2013, MDO advocates for contesting the five domains of land, sea, air, space, and cyber, as well as the electromagnetic and information subdomains. MDO also advocates for conducting operations more jointly to increase operational advantages across all five domains.[8] Joint doctrine is beginning to reflect this focus on MDO. Joint Publication (JP) 3-0, *Joint Operations*, views the strategic environment as "increasingly trans-regional, multi-domain, and multi-functional in nature."[9]

Changes in doctrine and organization have been recommended to emphasize increasing joint operations and focusing on multiple domains. This article argues that integrated air and missile defense (IAMD) operations are already executing MDO by focusing on the five overarching concepts. The lessons learned from these concepts should help inform the development of MDO.

Complementary Capabilities

IAMD features some of the U.S. military's most complex technology; its capabilities stretch across all domains. For the Army, the primary capability for IAMD is the combat-proven Patriot system. The Patriot has been the workhorse for air defense operations for nearly 40 years, providing point defense to designated critical assets.[10] It most recently supported U.S. combat operations during Operation *Iraqi Freedom*, where it was credited with intercepting nine of nine short-range ballistic missiles.[11] Patriot batteries continue to be deployed around the world in support of combatant commanders.

The Patriot's success has caused adversaries to develop and proliferate more advanced and longer range ballistic missile technology. These more advanced missiles fly through the space domain above the capability of the Patriot to intercept. In response, the Army's newest ballistic missile defense (BMD) system, the Terminal High Altitude Area Defense (THAAD), has been fielded with the capability to provide area defense against medium- and intermediate-range TBMs.[12] THAAD is able to intercept these threats by employing a powerful ground-mobile X-band radar called the AN/TPY-2 (Army Navy/Transportable Radar Surveillance). Once incoming TBMs are acquired by the AN/TPY-2, the radar helps guide interceptors fired from THAAD launchers to intercept the incoming threats either above or below the Earth's atmosphere. Since the start of the THAAD test program in 2006, it has achieved a perfect intercept record (15 for 15).[13]

The flexibility of the AN/TPY-2 radar also gives it the ability to influence the maritime domain. The radar can be

configured in a standalone surveillance mode without the rest of the THAAD components to provide cueing data to other missile defense assets. For example, the cueing data allows the Navy's Aegis BMD system to conduct launch-on-remote exoatmospheric engagements of enemy TBMs over the maritime domain with the Standard Missile–3 (SM-3).[14] This capability increases the area defense capability of the SM-3 against medium- and intermediate-range missiles.

THAAD, Aegis, and the AN/TPY-2 radar are not the only assets that have stretched missile defense operations across multiple domains. Army National Guard personnel in Alaska and Colorado operate the Ground-Based Midcourse Defense system that has the capability to defend Alaska, Hawaii, and the U.S. mainland against a limited intercontinental ballistic missile (ICBM) attack from North Korea or Iran. The system does this by firing interceptors from Alaska and California to conduct exoatmospheric engagements against ICBMs by using data provided by land-, maritime-, and space-based sensors operated by each Service. Combined, these joint missile defense systems complement each other and provide a capability to defend against all ranges of missile threats across multiple domains. As the U.S. military looks to expand MDO capabilities, each Service will need to develop or innovatively use existing systems to access and provide complementary cross-domain effects as well.

Interoperable Data Network

For future multidomain operations, a common and reliable data network will need to be shared among the Services. Missile defense systems already excel at using data provided from joint assets that stretch across domains. An example of an ongoing multidomain operation executed by joint BMD assets is the defense of the U.S. territory of Guam.[15] The early warning of a North Korean missile launch toward Guam would be provided by space-based sensors from the Air Force's Defense Support Program and Space-Based Infrared Surveillance satellites.[16] These satellites pick up the infrared heat of the missile during boost phase. The next system to track the TBM would be land-based, Army-operated AN/TPY-2 radars in Japan. Besides the AN/TPY-2 radars, if deployed, tracking data can also be provided from the maritime domain by U.S. Navy Aegis BMD ships and the Sea-Based X-Band (SBX) radar.[17] The SBX is the world's largest X-band radar and can track an object the size of a baseball flying over San Francisco from New York Harbor.[18] All these joint sensors provide cueing data to Aegis or THAAD units to help successfully intercept any TBM attack against Guam.[19]

These joint missile defense assets are able to execute their mission to defend Guam only because they all use the Link-16 data network.[20] Link-16 is an encrypted, jam-resistant, tactical digital data link network that can transmit and receive messages. Link-16 is used by the United States, the North Atlantic Treaty Organization, and other nations to share data among missile defense assets, ships, and ground forces. Integrating Link-16 data requires a robust command and control (C2) interface for effective battle management. For joint missile defense operations, the primary C2 system is the Command and Control, Battle Management, and Communications (C2BMC) program, which integrates and synchronizes missile defense sensors and weapons systems to optimize performance and provide a common operating picture (COP) that enables commanders at the strategic level (including the President, Secretary of Defense, and combatant commanders) to collectively see a ballistic missile launch develop to aid decisionmaking. C2BMC also assists staff officers with planning operational-level missile defense operations to achieve strategic- and regional-level objectives. It gives Soldiers at the tactical level operating the AN/TPY-2 radars the ability to view and manage missile defense operations as well.[21] The ability of C2BMC to provide effects from the strategic to tactical levels is made possible by Link-16.

Link-16 also could be used to create cross-domain effects. An example of this potential was demonstrated during Northern Edge 2015 in Alaska. During the exercise, an F-18 Hornet passed Link-16, targeting data of an enemy ship to a High-Mobility Artillery Rocket System (HIMARS).[22] The concept was further advanced during the 2018 Rim of the Pacific exercise when targeting data was not only passed to a HIMARS unit but also used to strike a target ship. The success of these exercises shows that expanding the use of Link-16 for future multidomain operations has enormous potential to optimize cross-domain effects. However, a system that provides a COP usable from the strategic to the tactical level, such as missile defense currently has with C2BMC, is needed to command and control, plan, and synchronize these cross-domain effects.

Cross-Service Authorities

As the U.S. military builds increased MDO capabilities, it must have proper authorities in place to ensure those effects are coordinated across Services. For missile defense operations, these authorities have already been established in joint doctrine. According to JP 3-01, *Countering Air and Missile Threats*, theater missile defense units fall under the joint force air component commander (JFACC), who is usually dual-hatted as the area air defense commander (AADC).

The commanding general for the supporting Army Air and Missile Defense Command (AAMDC) serves as the deputy area air defense commander (DAADC) for the AADC. The DAADC is responsible for integrating joint and multinational missile defense capabilities; developing defense designs; and advising on rules of engagement, air defense warnings, and other control measures on behalf of the AADC.[23] The AADC can then delegate down authorities as required. For IAMD operations, delegation of engagement authorities is critical because the flight time of ballistic and cruise missiles is measured in minutes, which requires quick decisionmaking to intercept. The delegation of authorities becomes even more complex when Army air defense units are defending assets with Aegis BMD ships.

This is why engagement authorities are often delegated to either a senior air

Sailors and Coast Guard Pacific Law Enforcement Detachment Team personnel approach Chinese fishing vessel during Oceania Maritime Security Initiative mission with USS *Sampson*, Pacific Ocean, November 29, 2016 (U.S. Navy/Bryan Jackson)

defense officer (SADO) or an air defense artillery fire control officer (ADAFCO). The SADO, who is typically an Air Force or Navy officer, and the ADAFCO, who is an Army officer, coordinate joint fires to ensure IAMD units are not firing at the same incoming ballistic missile that an Aegis ship is engaging, and vice versa. This tactical-level concern of preventing over-engagement can quickly produce strategic-level consequences if priority-defended assets such as airbases or aircraft carriers are suddenly vulnerable to missile attack due to the lack of interceptors. Another important function of the SADO and ADAFCO is to help control airspace in order to reduce the chance of fratricide within the air domain. The two fratricides by Patriot batteries during Operation *Iraqi Freedom* in 2003 are evidence of why tight control of multidomain effects is necessary.[24] Today, the SADO and ADAFCO play a key role in preventing fratricides within the air domain.

Based on the lessons learned from missile defense, for future MDO, joint doctrine will need to address authorities in order to better coordinate and optimize the employment of multidomain effects across the Services. For example, if the Army is providing effects with HIMARS batteries into the sea domain, control measures will need to be developed that coordinate those effects to prevent any potential over-engagement or fratricide with other joint assets that could lead to strategic-level consequences.

Joint Planning Framework

Conducting multidomain operations will require complex joint planning to optimize physical and cognitive maneuver and create the windows of localized advantage across all domains that the MDO concept envisions. Conducting missile defense operations today provides a perfect example of the complexities of multidomain operations. Some of the complexities missile defense planners must plan for include integrating with the ground and maritime schemes of maneuver, deconflicting airspace, coordinating defensive counter-air lanes, nominating targets, requesting space and cyber effects, and coordinating fires between joint missile defense assets. Additionally, depending on the situation, missile defense planners may have to coordinate with outside organizations, such as the Missile Defense Agency or the Joint Functional Component Command for Integrated Missile Defense, for technical assistance with maximizing defense designs and defending data networks.

These complexities required a framework to properly plan integrated air and missile defense operations. The publication of JP 3-01 provided the needed framework that missile defense planners use to coordinate across Services. For deliberate planning, joint doctrine specifies the use of the Area Air Defense Plan (AADP), the baseline document that integrates active and passive air defense measures, C2 procedures, and supporting mission aspects that provide a comprehensive approach to defending against air and ballistic missile

threats. The AADP is developed by the JFACC, who coordinates its completion with the rest of the joint force.[25]

For crisis action planning, the Joint Theater Air and Missile Defense (JTAMD) process is often used.[26] The process is not yet established in joint doctrine, but it provides the AADC with a means to coordinate, integrate, and synchronize all available IAMD capabilities. The process begins with a working group of skilled planners from the joint force air, land, and maritime component commanders, the Marine liaison element, the AAMDC staff, and Air and Space Operations Center (AOC) personnel. The group develops courses of action and recommendations to the DAADC for approval. The DAADC reviews the recommendations from the group and either accepts them, recommends changes to the courses of action, or rejects them and instructs the group to reconvene and come up with a better solution based on additional guidance. Once the DAADC approves the courses of action, they are presented to the AADC for approval.

Future multidomain operations will likewise need a formalized framework to conduct both deliberate and crisis action planning across Services. An MDO plan based on the current AADP process should be considered to conduct deliberate planning. For crisis action planning, the JTAMD process has been successful in coordinating missile defense operations across Services and could be a model for planning MDO from the strategic to operational levels as well.

Allied Integration

Conducting MDO is extremely complex and challenging. The complexities of MDO only become greater when allies are included. As modern threats continue to expand, the Department of Defense made clear in the 2018 National Defense Strategy that allied integration must be a priority in order to share the growing global security burden.[27] The proliferation of ballistic and cruise missile threats is an example of the growing global security burden because it has caused a greater demand for U.S. missile defense assets. In response, missile defense planners are relying more on allied systems to increase capacity to defend multiple domains against growing ballistic and cruise missile threats.

Arguably, the most important aspect of allied integration is interoperability. System interoperability allows data to be exchanged between U.S. and allied missile defense systems. An example of the effectiveness of system interoperability is past trilateral link exercises conducted between Japanese *Kongo*-class Aegis ships, Korean destroyer experimental ships, and U.S. Navy Aegis ships.[28] During the link exercises, the ships demonstrated the capability to pass Link-16 missile track data to each other. Foreseeing the increased need for allied interoperability in the multidomain battlefield, the National Defense Strategy specifies the need for accelerating foreign partner modernization.[29] An example of increased modernization is that the Republic of Korea (ROK) military is upgrading its Patriot air defense batteries to the more modern Patriot Advanced Capability–3 (PAC-3) configuration and has asked to purchase the most advanced Patriot interceptor, Missile Segment Enhanced.[30] Another example is that the Japanese military has already fielded PAC-3, has multiple Aegis BMD ships, and is planning to purchase two U.S. Aegis Ashore batteries to further strengthen its missile defenses.[31]

The purchase of American hardware is critical in allowing these allied nations to be interoperable with U.S. missile defense forces. However, integration into the planning process is important as well. For air defenders, the success of the JTAMD process has caused it to become a preferred method to plan and coordinate with allies. In the USINDOPACOM theater of operations, regional allies are integrated into the JTAMD process for both real-world and exercise events. The process has allowed these allies to influence and provide concurrence on the recommendations presented before final AADC approval.

Besides integration into the planning process, allies need to be integrated into the current operations process as well. A good example of this integration is the Combined Air and Missile Defense Operations and Coordination Center (CAMDOCC) inside the 607th Air Operations Center at Osan Airbase in the ROK.[32] In the CAMDOCC, Soldiers from the 94th Army Air and Missile Command sit side by side with their ROK air force counterparts coordinating IAMD operations and managing a combined COP. The close coordination in the CAMDOCC ensures that IAMD operations are optimized and that rapid information-sharing expedites the multilateral JTAMD planning and decisionmaking process.

There has been much success in allied integration with IAMD operations, with much more work to do. Future multidomain operations will require units from all the Services to become interoperable and integrate their planning and operations processes with U.S. allies as well. Successful allied integration will synchronize operations, better coordinate fires, increase training opportunities, and ultimately provide an advantage to multidomain warfighters that no strategic competitor can match.

The joint community has embraced integrated air and missile defense, and it is time for the joint community to embrace multidomain operations as well. It is a critical time in the Nation's military history—as the U.S. military was preoccupied with nearly two decades of war in the Middle East, strategic competitors were busy developing asymmetric capabilities to challenge U.S. military dominance. The success of IAMD has shown that a multidomain strategy in response to these threats can work. The joint response to the North Korean missile launches in 2017 is an example of this. During this time, Aegis BMD ships, THAAD, Patriot, joint radars, and allied IAMD assets were activated to track the missile launches and defend critical assets. All these assets spread out across the vast distances of the Pacific theater were successfully integrated and command and controlled by joint personnel located at the 613th Air and Space Operations Center at Hickam Field, Hawaii. All these assets working together produced the

strategic effect of reassuring American citizens and our allies in the region of the Nation's commitment to defend them and signaled to North Korea that the U.S. military was well prepared to respond to any miscalculation.

The former Pacific Air Forces commander and current U.S. Northern Command commander, General Terrance J. O'Shaughnessy, summarized the success of the joint response: "Pretty much anything we do out here, we do as joint partners and we do completely integrated in that fashion. If you walk into our AOC right now, you don't just see Airmen. You see Airmen, Soldiers, Sailors, Marines, working together every day."[33]

The MDO concept needs to advance to where one day Soldiers, Marines, Sailors, and Airmen are fully integrated and providing cross-domain effects to the level described by O'Shaughnessy for integrated missile defense. Getting there is going to take a commitment from all the Services to embrace MDO. This culture change will not be easy and will take time, but the time to start is now because there is too much at stake to delay. Basing future MDO concepts on the lessons learned from IAMD operations is a good place to start. **JFQ**

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