



Soldiers with the 1st Multi-Domain Effects Battalion (1st MDEB) train on the 1st Lt. John R. Fox Multi-Domain Operations Non-Kinetic Range Complex at Fort Huachuca, Arizona, 13 February 2023. The 1st MDEB demonstrated a wide array of nonkinetic effects during this training event, highlighting the event's significance as a milestone on the 1st MDEB's path to become fully operationally capable. (Photo by Sgt. 1st Class Henrique De Holleben, U.S. Army)

Multi-Domain Effects Battalion

Space Integration and Effects in Multidomain Operations

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In a fight with China as the pacing threat, understanding and then leveraging friendly and adversary dependencies on space systems will drive a relative advantage. As the biggest user of space systems, the U.S. Army must be prepared to effectively mitigate risks from dependencies on space while seizing the initiative to exploit adversary use. China has clearly invested in and demonstrated a systems approach to threaten others' ability to leverage space, and the U.S. Space Force (USSF) was established in 2019 to focus on capabilities needed in the space domain as a result.¹ Despite maturing USSF capabilities to organize, train, and equip guardians for operations and defense of capabilities in the space domain, the Army fights and wins the Nation's wars by dominating in and from the

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land. Fighting from the land does not prevent the Army's use of space or remove responsibility for sensing and engaging threat capabilities in all other domains. The Army's primary formation for sensing and engaging across warfighting domains is the multi-domain task force (MDTF). The MDTF has been designed as a joint force enabler, competing forward inside threatened areas to enable a position of relative advantage across all warfighting domains. The MDTF includes new long-range fires capabilities and nonkinetic assets in a first-of-its-kind formation. While understandable focus and emphasis is placed on the kinetic long-range fires' capabilities, those are not always the most impactful enablers for

the joint force. Emphasis on MDTF long-range precision fires (LRPF) from rockets or hypersonic missiles to hold targets at risk on the land or sea requires a deeper understanding of how space enables their success.

Sensor-to-shooter for most LRPF will include space-based or space-enabled sensors providing target acquisition, identification, and custody. As a cornerstone of the 1st MDTF, the 1st Multi-Domain Effects Battalion (MDEB) provides the "secret sauce" for LRPF through both sensing and converged effects delivery. The primary purpose of the MDEB is to provide all-domain, long-range sensing and nonkinetic effects delivery. Each company within the MDEB leverages space capabilities to sense and support delivery of kinetic and nonkinetic effects in all domains. The formation is capable of such feats because MDEB soldiers lead the joint force as subject-matter experts for multidomain operations (MDO), providing the key to disintegrating antiaccess/area denial (A2/AD) systems and building interior lines. The Army must continue to invest in the formation of experts and address three persistent technology challenges related to space and high altitude. For rapid and successful disintegration and penetration of A2/AD systems, the MDEB requires (1) a fielded high-altitude family of systems with payload flexibility, (2) a nonkinetic planning and technical firing solution for Joint All-Domain Command and Control, and (3) survivable/maneuverable systems for electromagnetic reconnaissance and satellite communications (SATCOM) on the move.

Background

Space capabilities have provided the Army an asymmetric advantage in achieving the mission since Operation Desert Storm three decades ago. As the bar to entry for the use of space has lowered, adversaries have increased investments to lessen the advantage. Despite recent press about the importance of space with the USSF and U.S. Space Command stand-up, limited exposure and understanding of the Army's use of space persists. Unfortunately, the public (and by extension most soldiers) have limited exposure or education on Army space capabilities that are viewed as overly technical or too classified to discuss. In fact, the Army is the largest user of space capabilities in the Department of Defense (DOD) and has grown expertise in the space career field over the last twenty-five

years. Army space professionals have been largely distributed through Army and other DOD organizations to support the integration of space capabilities. Advances in threat capabilities and plans to impact our use of space have driven senior leaders to consider necessary Army structure changes.

In 2012, the joint staff formally designated space as a warfighting domain along with the cyber, air, land, and maritime domains in the *Joint Operational Access Concept (JOAC)*.² This concept first defined the terms *antiaccess* and *area denial* and combined them into *A2/AD*, describing an adversary *systems warfare* concept to target technological aspects of U.S. force projection capabilities in depth. The JOAC called for greater integration of space and cyber capabilities at lower echelons, recognizing peer adversaries' systems also leverage space capabilities in depth providing opportunities for exploitation.

In 2016, Adm. Harry B. Harris, then combatant commander of the U.S. Indo-Pacific Command, said, "A Combatant Commander must be able to create effects from any single domain to targets in every domain in order to fight tonight and win."³ He clarified in the same speech, "That means the Army's got to be able to *sink ships*, *neutralize satellites*, *shoot down missiles*, and *hack or jam the enemy's ability to command and control its forces*."⁴ Neutralizing satellites fits generally within the doctrinal language of space control or what is known as negating the adversary's use of a space system (ground, space, or link) while protecting our own.⁵ On the protection side of the coin, the Army has focused on improving use of space systems with additional efforts identifying space vulnerabilities and mitigating those risks for Army formations since the 1990s. The Army space training strategy has improved training and education across the service, with an expansion to include considerations for high-altitude platforms and payloads. In the last few years, the Army established a cross-functional team under Army Futures Command to improve the Army's ability to leverage space and high-altitude capabilities.

The Army's answer to the JOAC and Harris's charge came in 2017 with the experiment to create a nonkinetic combined arms battalion. The experimental formation began integrating intelligence, information, cyber, electromagnetic warfare, and space capabilities (I2CEWS) under an existing fires

command structure at Joint Base Lewis-McChord in Washington state. The 1st MDTF was recognized as a joint-force-enabling capability and moved under U.S. Army Pacific Command for improved command and control at the theater level. Due to the success of the rapid experimentation and realized benefits provided, the Army further adapted the I2CEWS name to appropriately capture its function as the multi-domain effects battalion.

In the MDEB and across the 1st MDTF, soldiers leverage work in each of the space mission areas: SATCOM; intelligence, surveillance, and reconnaissance (ISR); position, navigation, and timing (PNT); environmental monitoring; space situational awareness; and space control. As global competitors and adversaries have increased investments in the use of SATCOM, ISR, and PNT, opportunities to negate those systems to achieve a relative advantage are expanding faster than the capacity of the Army to engage.⁶ In recognition of the threat outlined in the JOAC and by the intelligence community, the Army published Training and Doctrine Command Pamphlet 525-3-1, *The U.S. Army in Multi-Domain Operations*, in 2018 for outlining several required space capabilities that have manifested in the MDEB full design structure.⁷

Since the 2018 concept was published, the 1st MDTF has continuously evolved and experimented with capabilities to advance the application of MDO. In a personally published white paper, Chief of Staff of the Army Gen. James McConville designated the MDTF as the lead for multidomain experimentation to advance the Army's ability to conduct MDO.⁸ 1st MDTF has experimented with technologies as well as organizational structures and pulled from each of the subordinate battalions to create agile fighting elements known as multidomain cells (MDCs). These cells may be comprised of any combination of kinetic or nonkinetic capabilities from the long-range fires battalion, MDEB, indirect fire protection capability battalion, or task force support battalion. This evolution continues as the 1st MDTF competes forward in the first island chain throughout the year, exercising with allies and partners in competition. As the Army continues to invest in MDTFs, Secretary Christine Wormuth highlighted the importance of these alliances, suggesting potential forward stationing of MDTF assets in



Soldiers train on emerging electronic warfare capabilities 29 August 2019 during Cyber Blitz 19 at Joint Base McGuire-Dix-Lakehurst, New Jersey. Co-led by the U.S. Army Combat Capabilities Development Command's C5ISR Center and the U.S. Army Training and Doctrine Command's Cyber Center of Excellence, the Cyber Blitz exercise informed the Army on how to perform evolving cyber electromagnetic activities across the full spectrum of operations. Cyber Blitz 19 was executed in conjunction with U.S. Army Pacific's Orient Shield Exercise in Japan, marking the first time that the Army combined field based experimentation with an Army Service component command tier 1 exercise. The experimental exercise pairing gave more than thirty organizations from across the Army, Navy, and Air Force, along with the Japan Ground Self-Defense Force, a realistic first look at how the intelligence, information cyber, electronic warfare, and space (I2CEWS) formation could fight and win as part of a multidomain task force. (Photo by Edric Thompson, U.S. Army Combat Capabilities Development Command)

Japan.⁹ She said this as the Army continues to stand up additional MDTFs. 2nd MDTF was established in Germany while 3rd MDTF recently stood up under U.S. Army Pacific Command in Hawaii.¹⁰ MDEB capabilities, enabled by space, remain the centerpiece for each of the MDTFs established.

Multi-Domain Effects Battalion— Space Integration

The MDEB includes six unique companies designed to enable a complementary and combined arms approach to sensing and delivery of effects. Though the signal and military intelligence companies may be

viewed as support formations, each company includes space-enabled capabilities and supports all-domain deep sensing and delivery of effects for the joint task force. The success of the MDEB is enabled through a family of systems approach to distribute sensors and effectors throughout the joint area of operations from the land, in and through all warfighting domains. For success throughout the competition continuum MDEB must be viewed as a combined arms battalion requiring cross-domain maneuver to close with and engage the enemy.

Perhaps most obvious of the space enabled, the signal company executes the SATCOM mission and

leverages the timing provided by the Global Positioning System (GPS) constellation to ensure the MDTF and supported joint task force can communicate with disaggregated and decentralized subordinate elements. The company will provide support through both line of sight and SATCOM while ensuring the communications security aspects required to leverage encrypted

situational awareness. The MICO's ability to leverage the TPP for direct access to commercial space-based imagery has greatly improved 1st MDTF's ability to share and collaborate with partners through Operation Pathways.

The extended range sensing and effects (ERSE) company provides the land/sea, airborne, and high-altitude layers of the MDEB's all-domain sensing and

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PNT from GPS are properly utilized. Signal soldiers will be adding to all-domain sensing through increased awareness of the electromagnetic spectrum (EMS) as they conduct general electromagnetic reconnaissance. The signal company is a critical element to enable distributed operations for the MDTF's small and agile MDCs. The signal company ties the MDC's ability to sense and provide target-quality information to the rest of the MDTF and out to the joint force as it seeks to penetrate and exploit the A2/AD network of systems.

The MDEB military intelligence company (MICO) provides multiple functions to support overall target development and intel support to space while also leveraging space capabilities in support of the broader MDTF intel mission. The MICO informs the Army's development of the TITAN (Tactical Intelligence Targeting Access Node) program of record through daily operation of the TITAN preprototype (TPP) system and leveraging live space-based information forward in theater. The TPP is a key capability, enabling timely target acquisition and custody. MICO soldiers understand and feed the data from long-range sensors through the TPP to targeting and engagement systems as part of convergence packages. They also provide the soldiers conducting analysis and intel support to targeting using National Reconnaissance Office overhead systems and other commercial space-based ISR capabilities. The open-source intelligence section also has access to commercially available space-based information to support addressing intelligence requirements that can be more rapidly shared with partners and increase overall

effects delivery. High altitude specifically refers to the area of the stratosphere above normal air operations between sixty thousand and one hundred thousand feet above ground level. The Army has been the DOD proponent for high-altitude operations for decades, working with industry to advance technology to a point where it has only recently gained traction for military use. As the Army's only current force structure designed for high altitude, the high-altitude platoon within the ERSE company has two sections to support the launch, recovery, and operations of high-altitude balloons with payload flexibility to support various functions. Envisioned payloads/missions include electromagnetic warfare (EW) (including navigation warfare [NAVWAR]), communications extension, and various types of ISR to provide organic coverage and dynamic augmentation persistently with the space layer. The EW platoon within the ERSE company will support the NAVWAR space mission area along with additional electromagnetic reconnaissance and attack. The unmanned aircraft (UA) platoon will provide similar functions to the high-altitude platoon through persistent and long endurance UA platforms with various payloads. Unlike traditional UA, ERSE's concept of employment seeks to leverage automation for pilots to fly squadrons of UA from a single control station supported through resilient mesh-networked systems. In addition to extending a mesh communications architecture to support target acquisition and custody, the ERSE family of systems will also support assured PNT, marrying the

space, high altitude, and UA systems for improved network coverage and resilience.

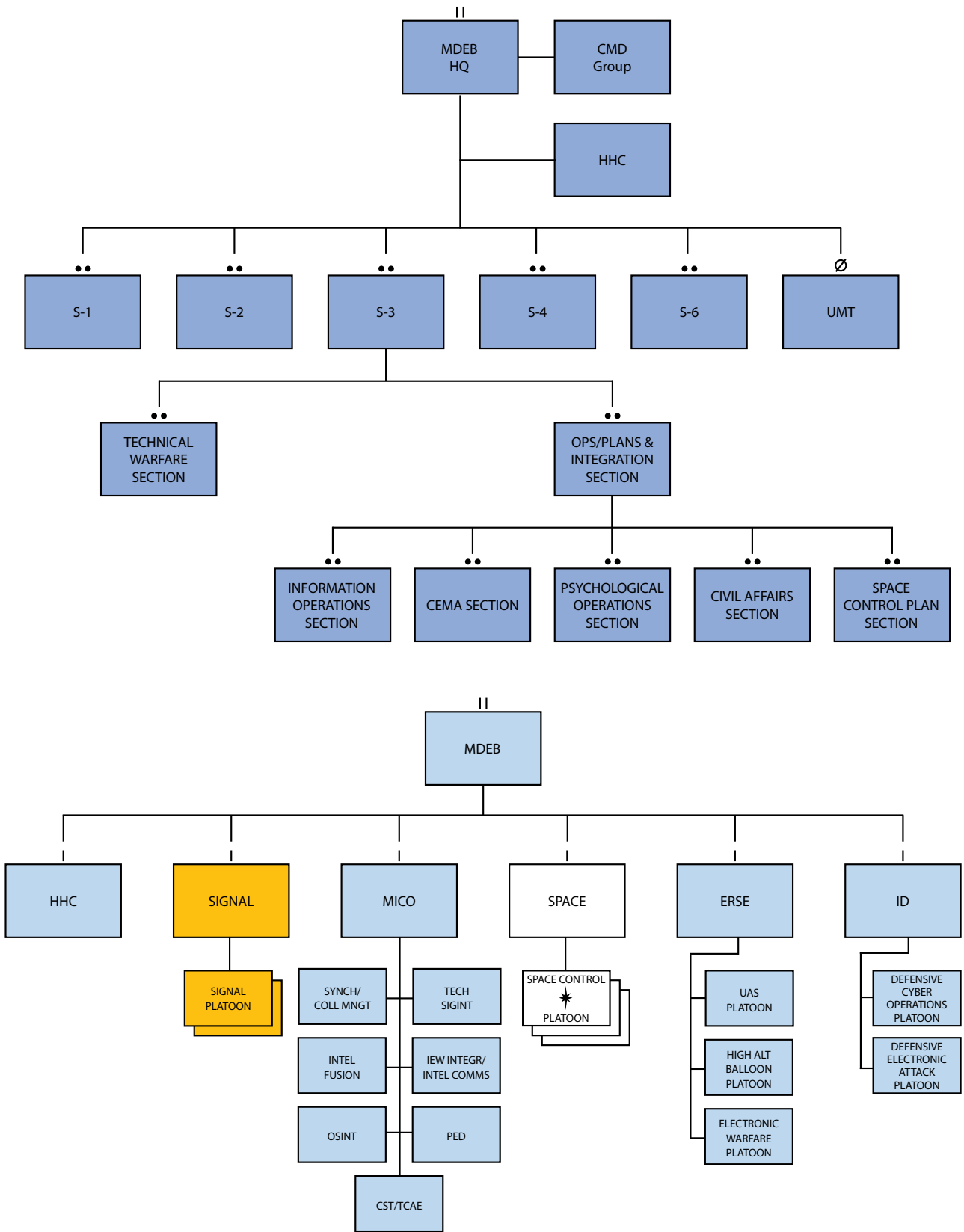
The information dominance (ID) company is primarily protection-focused to provide defensive cyberspace operations and defensive electromagnetic attack (DEA). Defensive cyberspace operations are accomplished through its mission elements performing the role of cyber protection teams on behalf of the joint task force; this unique command relationship places mission elements outside of the U.S. Cyber Command and enables prioritization of joint task force critical cyber terrain. The ID company's DEA platoon will work along with its sister indirect fire protection capability battalion to protect joint task force critical assets from threats and preserve freedom of maneuver to maintain a relative position of advantage for the MDTF. The DEA platoon will have EW assets like the tactical layer system, echelons above brigade to support the NAVWAR space mission by identifying threats to PNT in the EMS while training to effect adversary PNT-enabled systems. While defensive cyberspace operations soldiers will defend cyber key terrain across Army systems, cyber analysts within the ID company will work with space planners to identify any space-related critical assets and support their protection as well.

The MDEB's space control company is the only Army space formation not assigned to U.S. Space Command and provides three platoons to conduct focused electromagnetic reconnaissance and support delivery of space effects for the U.S. Indo-Pacific Command. The space control company will conduct cross-domain maneuvers; emplacing and displacing from position area to position area in the land domain for survivability and operational access while conducting electromagnetic reconnaissance through the space and cyber domains. The space control platoons will provide beyond-line-of-sight sensors from the land and are another key component to the unique nature of the MDEB's family of systems approach. As SATCOM modernizes to provide reduced spotbeams and frequency reuse, space platoons will require the ability to operate in multiple locations to conduct electromagnetic reconnaissance on adversary communications. The company's ability to monitor, detect, and characterize electromagnetic interference will support indications and warnings of adversary

attacks in the EMS while enabling mitigation of threat impacts to friendly SATCOM. The need to maneuver for access and survivability will drive unique coordination measures with battlespace owners and require flexible and smaller form factor technology for SATCOM on-the-move to enable rapid emplacement and displacement in crisis or conflict.

In the headquarters and headquarters company, the space control plans section in the S-3 (operations) shop (shown in the figure) is the principal means to plan employment of space control capabilities within the battalion structure. The space control plans section will analyze friendly and adversary use of space capabilities like SATCOM and plan optimal position areas for the platoons. Coordination with battlespace owners will likely occur within the plans section to free the company and platoons to focus on force protection, and maneuver as they conduct their missions. The section will also coordinate with the MDTF space control planning team on necessary effects coordination measures and allocate targets to platoons based on location and operational or system status as necessary. The MDTF space control planning team will support the necessary command and control, including coordination measures with adjacent or higher space control elements across the joint force through the theater space coordinating authority. When the demand for capacity grows beyond organic assets, the MDTF space control planning team will work through the targeting process to request joint assets for support.

Currently the integration of planning with space as part of nonkinetic capabilities is challenged without a system for holistic target systems analysis and planning for nonkinetic firing assets. Like planning systems for kinetic fires assets, MDEB sensors and nonkinetic effects platforms require planners to assess available combat power and allocate assets to targets. Planning considerations for maneuver and environmental factors like traditional fires requirements for accurate predictive fire (including weather) must be accounted for in a tactical firing solution for nonkinetics. As the Army and joint force work through Joint All-Domain Command and Control, development of a nonkinetic planning system that enables nonkinetic sensor-to-shooter collaboration must be a priority.



(Figure by author, adapted from the U.S. Army Cyber Center of Excellence, *MDEB Overview*; abbreviation key on next page)

Figure. Multi-Domain Effects Battalion Organizational Chart

Expanding the Army's Delivery of Space Effects

Until recently, the Army Space and Missile Defense Command was the only Army formation enabling delivery of space effects for the joint force. This includes a recent shift in organizational structure within the 1st Space Brigade changing from a focus on Army space support teams to space control planning teams within the 1st Space Battalion. In addition to what the Space and Missile Defense Command provides, each MDTF staff will include space control planners to create the layering and convergence of effects outlined in the Army's latest operational field manual, Field Manual 3-0, *Operations*.¹¹ The MDEB is the principal formation for the joint force to deliver nonkinetic effects converging to defeat adversary A2/AD systems. Increased capacity of space control planners and delivery assets is critical to offset any perceived numerical advantage with reach to address interior lines adversaries may seek to use for an effective A2/AD system. With proper placement and intelligence support, space control companies will have an outsized impact in understanding and defeating adversary A2/AD systems.

It is essential to understand how adversary A2/AD systems integrate space capabilities for their sensor-to-shooter kill chain—extending reach. China and Russia have expanded investments and launches of space-based ISR satellites and continue to improve their architectures for distribution of the data to find and target U.S. and allied forces. As the United States

has invested in GPS-guided capabilities using PNT systems, adversary systems are commonly built with the capability to use expanding Beidou PNT and U.S. commercially available GPS technology. To project command and control of forces over the vast distances in the Pacific, China has also developed robust SATCOM capabilities connecting geographically disbursed forces back to each other and the mainland. The MDEB was designed to train, understand, and enable the disintegration of these systems.

Future of Army Space and the Multi-Domain Effects Battalion

All of this will be underpinned through the Army's soldiers who understand the benefits and risks associated with the use of space systems. Continued education and training of "joint smart" space professionals and "space smart" joint professionals on how to integrate the MDEB's space capabilities into joint plans must be emphasized under the JADC2 umbrella. The Army requires continued increases in capacity for planning and coordinating the convergence of space effects from joint and Army assets. The Army currently maintains a professional cadre of soldiers and civilians who are trained in the basics of space with officers designated as functional area experts spread throughout the Army. While currently under discussion with Army senior leaders, a space career field or branch like the infantry, armor, cyber, and others to manage enlisted and officer personnel through a career has not been established. Efforts to create a space operations branch within the Army to include enlisted and warrant officer personnel will ensure planners and operators have the necessary depth and talent on the team.

Innovative approaches to training through live, virtual, and constructed environments must be enabled through a consistent ability to manage space talent to reduce risks in execution. The MDEB will continue to lead the Army through multidomain experimentation with space and high-altitude capabilities enabled through its people. The MDTFs will continue building realistic all-domain training environments and working through innovative ways to test and improve the integration of space capabilities and effects with the other portions of the MDTF.

The asymmetric advantage provided by the MDEB is not from the space control company alone, but rather

CEMA	Cyber-electromagnetic activities
CMD	Command
CTE	Cyber threat emulation
ERSE	Extended range sensing and effects
ID	Information dominance
IEW	Intelligence and electronic warfare
MDEB	Multi-domain effects battalion
MICO	Military intelligence company
OSINT	Open-source intelligence
PED	Processing, exploitation, and dissemination
SIGINT	Signals intelligence
TCAE	Technical control and analysis element
UAS	Unmanned aircraft system
UMT	Unit ministry team

Multi-Domain Effects Battalion Organizational Chart Key

having it integrated with the other elements to provide a combined arms approach to nonkinetic and all-domain warfare. As the formation advances with training, fielding, and integration of an all-domain family of systems including nonkinetic planning and tactical firing capabilities to tie it all together, A2/AD disintegration and penetration will be more rapid and successful. To continuously deliver these effects and survive the early stages of crisis or conflict, the MDEB must

have capabilities built to support distributed MDCs capable of rapid emplacement and displacement with the ability to conduct SATCOM on the move, launch and recover tailorable high-altitude systems, and tie it all together with a nonkinetic planning and tactical firing system. As the MDTF continues to demonstrate utility to joint force commanders, space integration and effects within the MDEB and MDTFs will remain a key to success. ■

Notes

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