



A mobile-low, slow, small-unmanned aircraft integrated defeat system (M-LIDS) launcher fires a counter-unmanned aircraft system missile at a fixed-wing target from a mine-resistant ambush protected (MRAP) vehicle on 25 January 2026 during a training exercise in Bahrain. (Photo by Petty Officer 2nd Class Iain Page, US Navy)

Fighting Air Defense Capabilities in Multidomain Operations

Aerial Engagement Areas and Using Airspace as Maneuver Space

Brig. Gen. Glenn A. Henke, US Army

As our adversaries advance the scale and sophistication of their aerial arsenals, the Army is adjusting to these new realities. While much of this adjustment is necessarily focused

on providing equipment to units, it is equally critical to ensure soldiers and leaders understand how to effectively employ these capabilities. If trends in the Russo-Ukrainian War endure as most observers expect,

the Army will face an aerial threat far greater than in any previous war, to include both world wars. Ongoing combat operations in the Iran War provide a more direct preview of the threats to US forces.

While the equipment and technology to defeat aerial threats continue to evolve, the basic doctrine to employ these capabilities to maximum effect endures. The principles and tenets of air defense artillery employment are fundamentally sound methods to address growing threats. However, the Army requires a different expression of this doctrine, compelling it to accomplish two things. First, commanders must visualize airspace as maneuver space for which they are responsible. Second, units employing any type of air defense capabilities must use multidomain engagement-area development as the principal organizing construct. Both these tasks require visualization tools that easily allow a three-dimensional perspective of the battlefield.

This article is a discussion of warfighting. While it will briefly discuss some doctrine, the purpose here is to discuss practical application and techniques. Most of this work focuses on active air and missile defense, with a brief discussion of passive air and missile defense as well as deception. This article will not discuss targeting and efforts to defeat aerial threats prior to launch. While we prefer to kill the archer and not have to shoot down the arrow, a comprehensive discussion of targeting is worthy of a separate article. For a deeper discussion of the elements of the joint counterair operational framework (active defense, passive defense, command and control, and attack operations), refer to Field Manual (FM) 3-01, *U.S. Army Air and Missile Defense Operations*.¹

Terminology

Before proceeding, we must ensure the reader is clear on key terms since some of the terms overlap, leading to confusion. Air defense refers to the “defensive measures designed to destroy attacking enemy aircraft or aerodynamic missiles, or to nullify or reduce the effectiveness of such attacks.”² Active air and missile defense expands this definition to include ballistic missiles.³ Integrated air and missile defense refers to “the integration of capabilities and overlapping operations” to defend specific assets and forces, primarily through the application of Army and joint capabilities.⁴ Air defense artillery (ADA) is “the dedicated Army systems, personnel, and forces that provide active,

land-based defense against air and missile attacks.”⁵ Air defense capabilities refer to either ADA weapon systems or nondedicated air defense capabilities, such as unit-common counter-small unmanned aircraft system (C-sUAS) capabilities like sensor-enabled crew-served weapons or soldier-common C-sUAS capabilities like Drone Buster or Smart Shooter.⁶

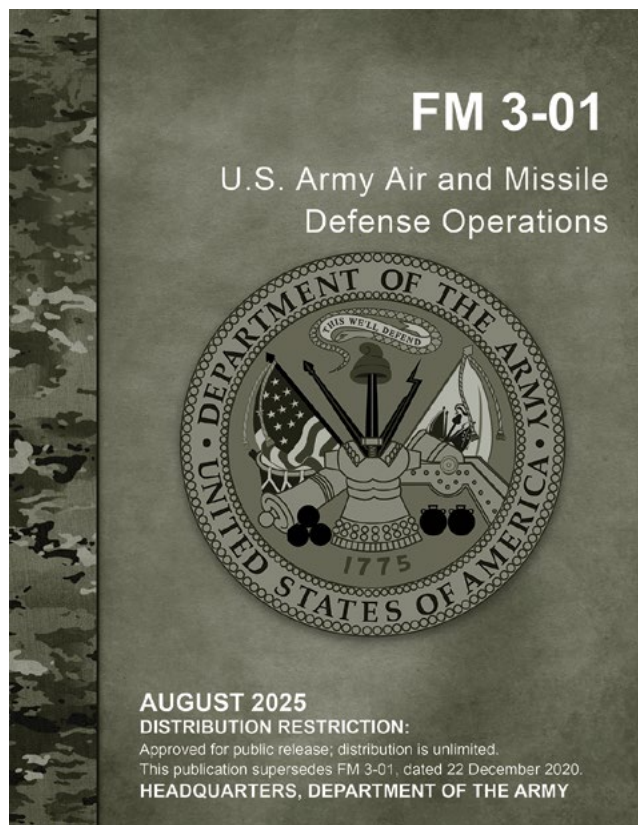
In short, air defense and air and missile defense are operations, air defense artillery is an Army branch, and air defense capabilities (dedicated and nondedicated) are weapons systems. This work will avoid acronyms or shorthand for these terms for the purpose of clarity.

Planning

Air and missile defense operations require deliberate planning to ensure maximum utility of limited assets. Most air and missile defense capabilities achieve point-defense or small-area defense, such as defense of an air base. This is primarily a function of the physical characteristics and design of the individual systems. Weapon-system placement is a significant factor in what specific asset can be defended. A few systems, like the Terminal High Altitude Area Defense or Ground-Based Midcourse Defense weapon systems, can achieve wide-area defense against certain categories of ballistic missiles.⁷ This point-defense limitation forces planners and commanders to make difficult choices on what will be defended with available air and missile defense capabilities. Achieving area defense with point or limited area defensive systems like Patriot requires commanders to maneuver air defense systems to where they can achieve decisive effects.⁸ This also requires staffs to take a more dynamic approach to what have traditionally been static critical asset lists.

The complexity of air and missile defense systems creates additional planning challenges. Planners must link sensors with shooters through the fire control systems. Older systems are often self-contained within a fire unit limited to a defined area, such as a Patriot battery site. Emerging systems, such as Integrated Air and Missile Defense Battle Command System, allow commanders to disaggregate sensors and effectors from fire control nodes.⁹ This enhances survivability and flexibility, which

Brig. Gen. Glenn A. Henke, US Army, is the forty-sixth commandant of the US Army Air Defense Artillery School and the chief of air defense artillery.



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comes at the price of added complexity in planning. In the “sense, decide, act” framework, the most challenging planning problem is typically in the decision-making, whether it is automated, distributed, or delegated. Decision-making is a joint problem, since contrary to popular belief and exercise design, Army units have no inherent authority for identification and engagement authority below the coordinating altitude.¹⁰ Army units still retain self-defense authorities, although these are distinct from identification and engagement authorities for threats beyond visual range, which are typically retained by the area air defense commander (normally the joint forces air component commander).

Another more practical constraint on planning is speed. First, many ground-based air defense capabilities cannot rapidly move to a new location. This limits flexibility and responsiveness over wide areas. Second, the speed of both threats and kinetic interceptors means the fight is for all purposes “set” once the air battle

begins, particularly for ballistic missile defense. The flight time for a close-range ballistic missile traveling three hundred kilometers is two to three minutes. The engagement windows for air defense systems against these threats are typically measured in seconds. In missile defense, milliseconds matter when the interceptor and threat object are closing at hypersonic speeds (greater than Mach 5), covering one-to-two miles per second. A complex air battle may only last a few minutes from start to finish.

The final planning challenge is interceptor allocation. All air and missile defense systems can carry a basic load and a specific number of reloads. Like aircraft, the configuration of missiles on the launcher cannot be changed during a specific air battle. This requires planners to carefully configure ammunition types and quantities in response to the anticipated threats. Most systems, particularly missile-based systems, cannot fight and reload at the same time. Additionally, limited magazine depth must be shared across air defense units, often arrayed across broad geographic areas. Planning for movement of limited interceptors is a major planning activity for air defense unit staffs.

Air Defense Principles and Tenets

An enduring observation from the C-sUAS fight is the need to layer capabilities across the battlefield. This theme is also described as “tiered.” This observation is simply a restatement of the existing air defense principles and employment tenets. These have served as the core of US Army ADA doctrine for decades. The air and missile defense principles consist of mass, mix, mobility, integration, flexibility, and agility.¹¹ The employment tenets consist of mutual support, overlapping fires and coverage, balanced fires, weighted coverage, early engagement, defense in depth, and resilience.¹² These principles and tenets apply to any air defense capability, to include C-sUAS systems. Refer to FM 3-01 for a comprehensive discussion of these principles and tenets.

Planning Activities

In multidomain operations, commanders can organize their active defense counterair fight using three principal planning activities. The first activity is organizing the area of operations in three-dimensional space and the electromagnetic spectrum. Commanders communicate this to their staff through

their operational framework during the course-of-action development phase of the military decision-making process.¹³ This requires commanders to “look upward” and consider the airspace as battlespace. This battlespace is now saturated with UAS, cruise missiles, launched effects, field artillery fires, electronic warfare effects, and all forms of spectrum interference. While the electromagnetic spectrum resides within the cyberspace domain, electronic warfare effects simultaneously exist within specific volumes of airspace and can impact anything that travels through it.

Commanders must incorporate this multidomain visualization at the start of their planning. More importantly, they must resist the temptation to delegate airspace planning to specialty staffs led by aviators, air defenders, or fire supporters. These staffs are concerned with the application of control measures to deconflict airspace usage. As with graphic control measures on a map, airspace control measures support the operational framework after a commander has organized the battlespace, including the airspace. City planning offers a useful analogy: planners develop the roads and add the traffic signals after they zone the land for specific purposes; they don’t start with the road signs. Commanders should not start with airspace control measures before they organize how they intend to use the airspace.

For the second counterair planning activity, commanders must decide what specifically to defend since they will usually lack capacity to defend everything. When considering countering aerial threats, commanders should consider active defense, passive defense, and deception into their planning. This will be based on a detailed assessment of the enemy’s courses of action and an assessment of what assets are most critical to defend.

Active defense incorporates all kinetic and nonkinetic capabilities that can engage, disrupt, or destroy aerial threats while in flight. These can be broadly categorized as defensive fires. While I will not cover passive defense or deception here, commanders and staffs must consider them since they may be the only options available due to limited capacity of air defense capabilities. Passive defense seeks to make assets more survivable from air threats. Deception operations seek to disrupt enemy targeting of our air defense capabilities.

The third planning activity is to develop multidomain engagement areas for all defensive fires

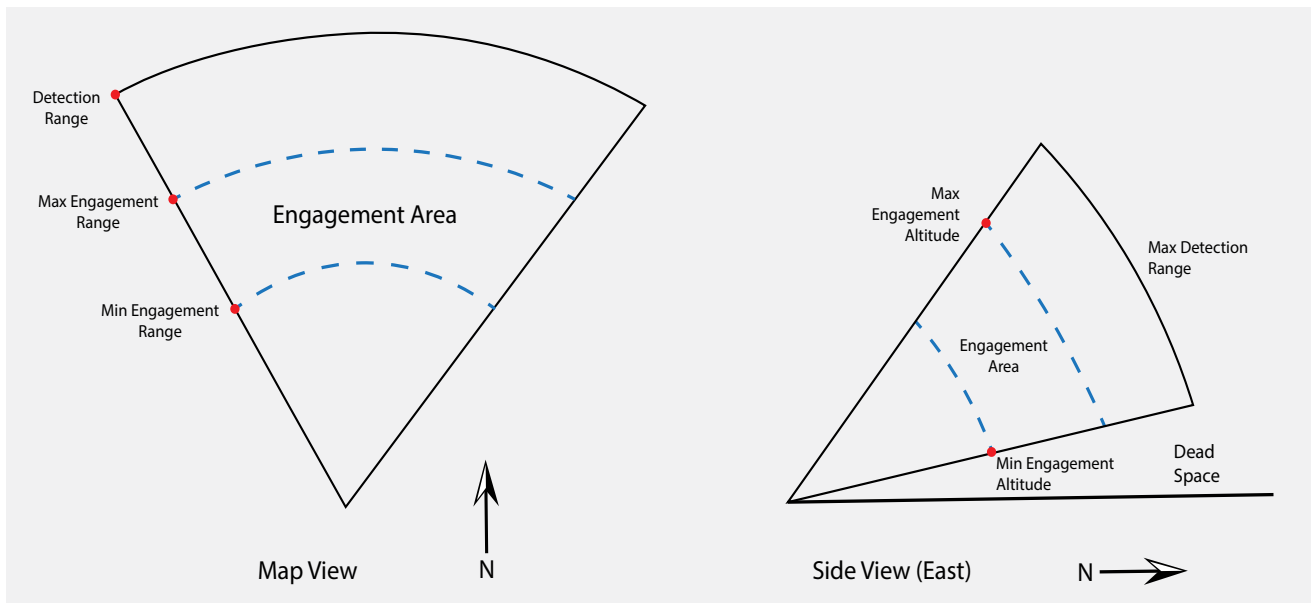
capabilities. Here is where planners apply air and missile defense principles and tenets. Put simply, apply the logic of engagement areas to air defense. The 2025 edition of FM 3-01 introduced aerial engagement areas into Army doctrine.¹⁴ This is an enemy-focused methodology where commanders decide where and how to kill enemy aircraft. This is in contrast to traditional asset-focused methodology that starts with the asset being defended and then attempts to optimize employment.

Multidomain Aerial Engagement Area Development

Previous air defense planning doctrine used the term “defense design,” which was a form of engagement area development. Army air defense doctrine eliminated this term after the Army formally defined design as the primary means of conceptual planning. The defense plans (formerly “defense designs”) developed for systems like Patriot were the result of detailed planning and included keep-out altitudes, engagement ranges, minimum engagement altitudes, and detection plans specific to the capabilities of radars. This is a form of engagement area, and now doctrine describes it this way.

This points to a problem with common descriptions of air defense capabilities. These capabilities do not create “domes” or “bubbles” under which some measure of protection is provided. All ADA weapon systems have detection and engagement envelopes that have specific directions and occupy discrete three-dimensional volumes of airspace. This volume of airspace rarely forms anything resembling a bubble. Engagement areas for directed-energy systems (high-energy lasers and high-power microwaves) more closely resemble a bubble, although these systems usually have a directional limitation and specific maximum and minimum ranges of lethal effects. Some electronic warfare capabilities and nonkinetic effects may fit this description, depending on the specific systems being employed.

To build a multidomain aerial engagement area, begin by deciding the optimal location to defeat the enemy. Just like a ground engagement area, commanders should consider where to kill aircraft and missiles throughout the depth of their area of operations. Next, array detection capabilities and then the effectors. In some cases, specific air defense systems like the SGT Stout have onboard sensors; they can also leverage Sentinel radars to extend their detection capabilities.¹⁵



(Figure by author)

Figure 1. Aerial Engagement Area (Top and Side Views)

When depicting the engagement areas, differentiate between detection zones and engagement zones because these are rarely the same. Finally, determine the three-dimensional portion of airspace where the effectors will destroy enemy aircraft.

Multidomain engagement areas must incorporate both dedicated and nondedicated air defense capabilities. This can include electronic warfare and other nonkinetic effects since these systems have physical effects in specific volumes of airspace, as discussed earlier.

The airspace control measures supporting the engagement areas must account for manned and unmanned friendly air assets. We must avoid fratricide against manned aircraft while also protecting our own unmanned aircraft. For unmanned systems, fratricide wastes our limited magazine of effectors. If we treat our own small-UAS as ammunition, shooting them down wastes that magazine as well. The loss of a specific UAS could also be detrimental to the commanders employing them. While the Alpha Company commander may determine it prudent to destroy an unidentified UAS, the Bravo Company commander may have lost the unit's primary reconnaissance asset for their mission.

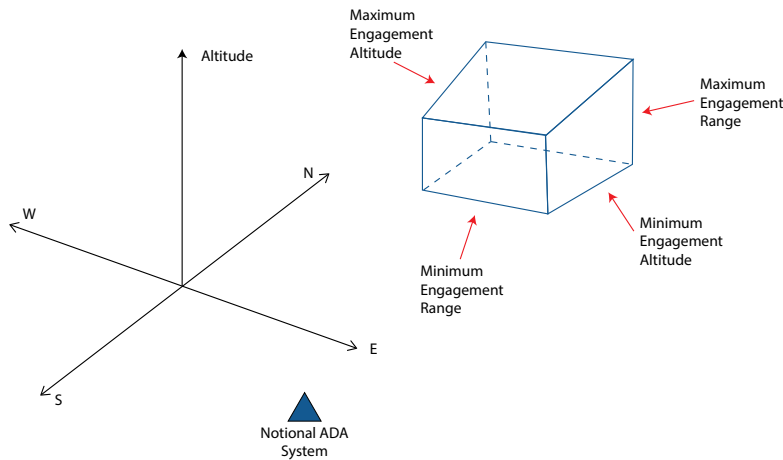
Visualization Challenges

A significant challenge in planning multidomain engagement areas is visualizing the battlespace.

Traditional top-down map views do not facilitate visualizing three-dimensional volumes of airspace. Patriot units fought for decades with this limitation, only recently being able to view the battlespace at multiple angles and elevations in a Google Earth-style perspective. This becomes more acute when dealing with maneuvering threats, since traditional overhead views will not show out of plane maneuvers, such as pull-up maneuvers designed to extend missile range.¹⁶

For units without access to these types of tools, each multidomain engagement area must be described using a top-down diagram and a side diagram (see figure 1). This technique is also useful when describing air routes operating within specific distances above the ground. On a map, it looks like a large block of restricted airspace, when in reality, the restriction only applies to a specific volume of airspace at specific altitudes.

More robust visualization tools are also essential for allowing commanders to appreciate the multidomain maneuver space they are planning for. Currently we only depict this view when describing conceptual diagrams. These “bubbles and lightning bolt” diagrams are intended to show a conceptual view of the capability, with communications networks often depicted as a strange ring in the sky. Figure 2 depicts an aerial engagement area as a volume of airspace in three dimensions.



(Figure by author)

Figure 2. Aerial Engagement Area in Three Dimensions

Multidomain Defense

As a practical example, consider a division-level deliberate defense. Planners should consider every active-defense weapons system capable of defeating the air threats. These include dedicated and nondedicated air defense, directed-energy systems, and electronic systems with the ability to disrupt aircraft. This example will describe some of these systems without attempting to cover every possible capability for the sake of simplicity.

Starting in the forward area, small units with soldier-common and unit-common C-sUAS systems provide a maneuvering capability with 360-degree coverage against specific threat types. Although these systems could be depicted as “bubbles” over their units, this is an asset-based visualization instead of an offensive-minded visualization in which we describe where we want to kill enemy air threats. Just like all direct-fire weapon systems, soldier-common and unit-common C-sUAS systems should use specific sectors of fire. The only difference is the three-dimensional nature of the sector.

SGT Stout short-range air defense systems in prepared fighting positions can provide overlapping coverage and mutual support on the ground and in the air. These systems have their own detection capabilities that exceed the range of onboard weapon systems. Each fire unit requires a weapon engagement zone for the Stinger missile, the 30 mm cannon, and the 7.62 mm machine gun with assigned sectors of fire. Sentinel radars supporting these fire units provide extended

detection capability within the limits of range and terrain.

Moving further to the rear area, the divisional air defense battalion’s C-sUAS battery is arrayed to protect high-priority assets designated by the division commander. The electronic warfare systems in the battery require their own weapons engagement zone. The onboard Coyote interceptor has an engagement area between the minimum engagement distance and maximum range for the

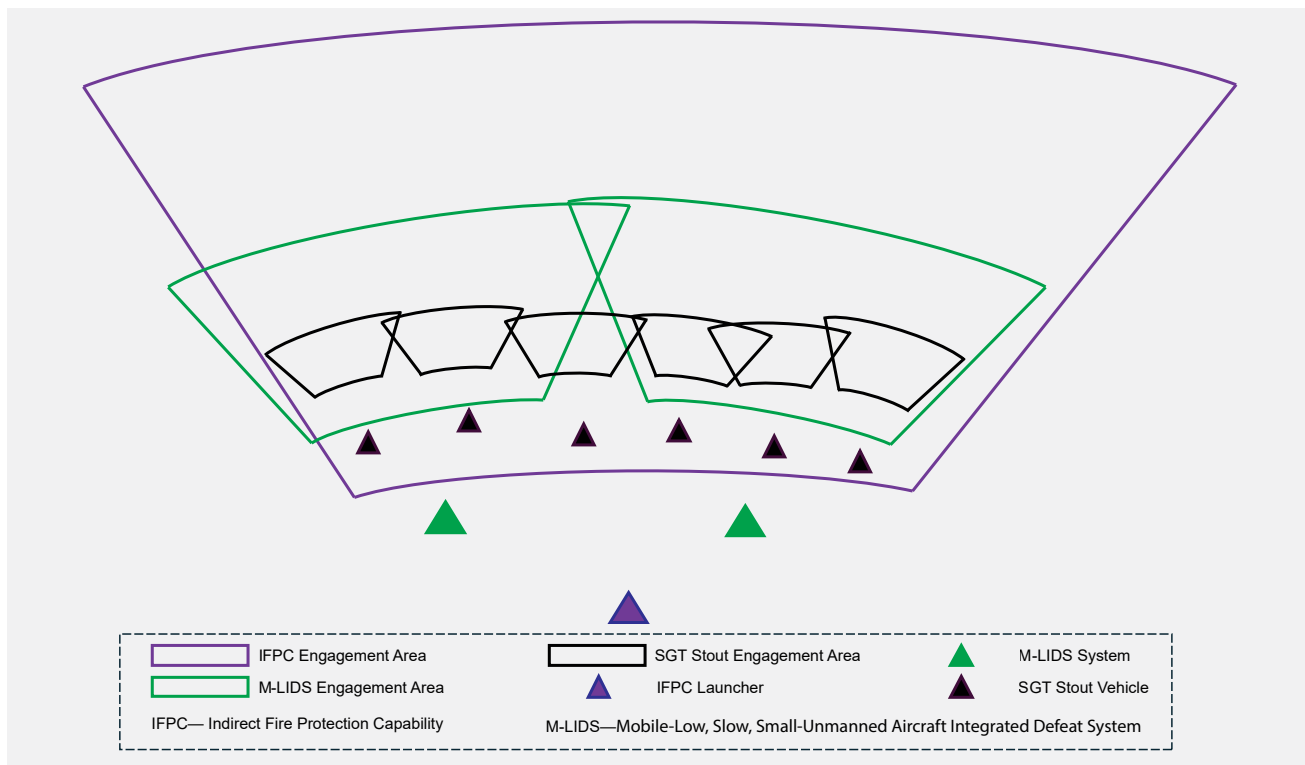
volume of airspace covered by the supporting Ku-band radars.¹⁷ Since the Coyote missile can reengage a target if it misses on the first pass, this engagement area will be necessarily large.

For cruise missile defense, the Integrated Fire Protection Capability firing the AIM-9X missile covers an even larger battlespace.¹⁸ These systems bridge the gap between SGT Stout and Coyote weapons systems and the Patriot weapon system. The Integrated Fire Protection Capability uses data from the Sentinel radar, so detection ranges can also include radars supporting the SGT Stout batteries closer to the main battle area and division artillery Sentinel radars arrayed in depth.

If the division has a Patriot battalion in direct support, the defense includes capability against manned aircraft, certain cruise missiles, high-altitude large UAS, and tactical ballistic missiles. This engagement zone could extend beyond the division’s area of operations for certain threats.

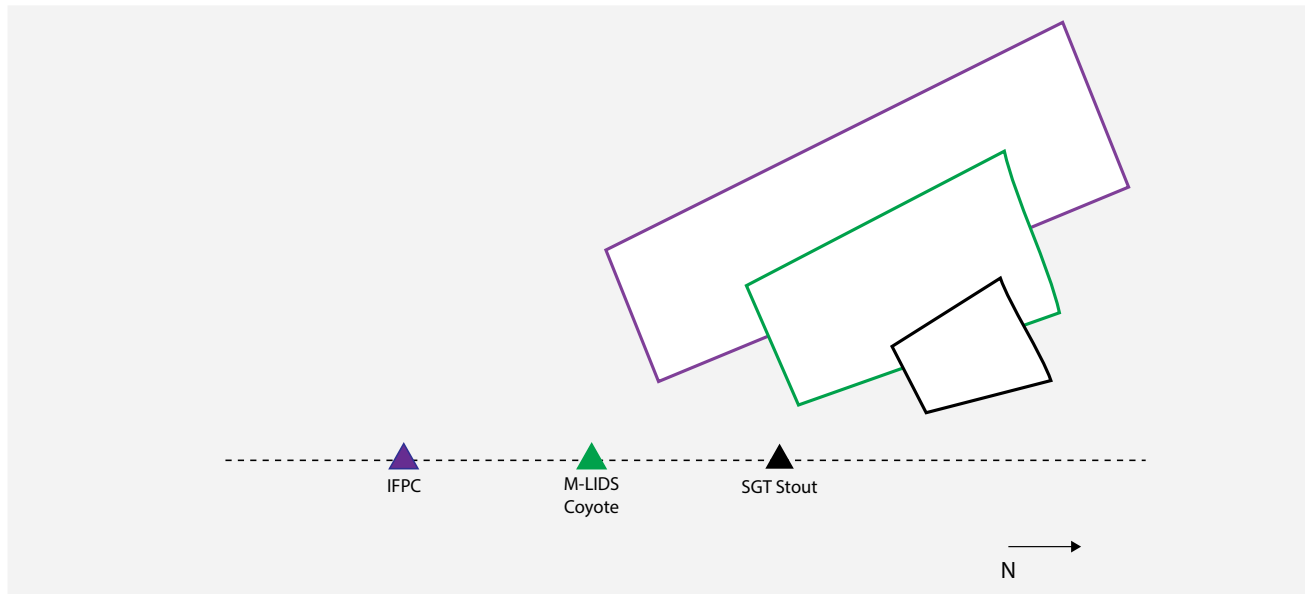
Finally, electronic warfare systems add additional capability to a defense. As discussed earlier, these systems operate in the electromagnetic spectrum but have direct effects in physical space. This is equally true for directed-energy systems such as high-energy lasers and high-powered microwave systems.

This defense plan highlights the visualization problem described earlier. A simple map view shows a series of overlapping detection and weapons engagement zones (some systems described earlier are omitted to simplify the illustration). The smallest engagement areas are arrayed along the deliberate defense



(Figure by author)

Figure 3. Division Defense (Overhead View)



(Figure by author)

Figure 4. Division Defense (Side View)

positions. As weapon systems become more capable, the engagement areas become larger (see figure 3). Detection ranges are past the edges of the diagram in this example.

However, it is a mistake to think the unit has full coverage. A view of these systems from the side demonstrates this clearly (see figure 4). This is because both detection and engagement zones have minimum

altitudes that increase as the range extends further. This reinforces the need for three-dimensional visualization tools in planning.

Conclusion

Multidomain air and missile defense is ultimately about organizing aerial engagement areas. This is true for both kinetic and nonkinetic active defense systems. Commanders employing these defensive fires systems should organize the detection capabilities and weapons effectors to defeat threats in depth. While this article largely describes employing air defense capabilities in a defensive scenario, the same logic applies in offensive operations. In this case, commanders can assign sectors

of fire informed by a comprehensive threat analysis to air defense systems, just as they would direct-fire weapons systems.

Regardless of whether planning offensive or defensive operations, the core doctrine of air defense outlined in FM 3-01 provides the time-tested employment principles and tenets that allow all commanders to maximize lethal effects against enemy air threats and sustain combat power for future operations. While Army air defenders will remain focused on defeating larger and more advanced threats, every commander will need to effectively employ their own capabilities against proliferating air threats to ensure their formations can continue their missions. ■

Notes

1. Field Manual (FM) 3-01, *U.S. Army Air and Missile Defense Operations* (US Government Publishing Office [GPO], 2025), 2.
2. Joint Publication (JP) 3-01, *Countering Air and Missile Threats* (US GPO, 2024), I-8.
3. JP 3-01, *Countering Air and Missile Threats*, I-8.
4. JP 3-01, *Countering Air and Missile Threats*, GL-10.
5. FM 3-01, *U.S. Army Air and Missile Defense Operations*, 184.
6. Katie Lange, "Drone Busting: Smart Devices Work Together to Knock Out UAS Threats," US Army, 25 September 2025, https://www.army.mil/article/288720/drone_busting_smart_devices_work_together_to_knock_out_uas_threats.
7. "Terminal High Altitude Area Defense System," Digital Visual Information Distribution Service, accessed 14 April 2026, <https://www.dvidshub.net/feature/thaaddfe>; "Groundbased Midcourse Defense—The Ultimate Smart Weapon," US Army, 13 September 2016, https://www.army.mil/article/175024/groundbased_midcourse_defense_the_ultimate_smart_weapon.
8. "Patriot," U.S. Army Aviation and Missile Life Cycle Management Command, accessed 14 April 2026, <https://history.redstone.army.mil/miss-patriot.html>.
9. Brandon M. Williams, "IBCS and the Future of Offensive and Defensive Integrated Fires," US Army, 19 February 2026, https://www.army.mil/article/290087/ibcs_and_the_future_of_offensive_and_defensive_integrated_fires.
10. Glenn A. Henke, "Once More Unto the Breach: Air Defense Artillery Support to Maneuver Forces in Large-Scale Combat Operations," *Military Review* 103, no. 2 (March-April 2023): 72, <https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/March-April-2023/Once-More/>.
11. FM 3-01, *U.S. Army Air and Missile Defense Operations*, 6.
12. FM 3-01, *U.S. Army Air and Missile Defense Operations*, 8.
13. FM 5-0, *Planning and Orders Production* (US GPO, 2024), 100.
14. FM 3-01, *U.S. Army Air and Missile Defense Operations*, 21, 113.
15. "SGT STOUT: Maneuver-Short Range Air Defense," Leonardo DRS, accessed 14 April 2026, <https://cdn.leonardodrs.com/uploads/wp-content/uploads/2025/12/SGT-Stout-MSHORAD-da-ta-sheet.pdf>; "Sentinel Radar," Raytheon, accessed 14 April 2026, <https://www.rtx.com/raytheon/what-we-do/land/sentinel-radar>.
16. Ralph Savelsberg, "Assessing the Maneuverability of North Korea's KN-23/Hwasong-11A SRBM," 38North, 3 March 2026, <https://www.38north.org/2026/03/assessing-the-maneuverability-of-north-koreas-kn-23-hwasong-11a-srbm/>.
17. "Coyote UAS," Raytheon, accessed 14 April 2026, <https://www.rtx.com/raytheon/lang/ro/capabilities/products/counter-uas/effectors/coyote>.
18. Jen Judson, "US Army's New Fire Protection System Launches Interceptor in Test," Defense News, 19 December 2023, <https://www.defensenews.com/land/2023/12/19/us-armys-new-fire-protection-system-launches-interceptor-in-test/>.