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“Four Joint Functions”**



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Joint Air and Missile Defense Operations in the Maritime Domain Must Emphasize and Strengthen the “Four Joint Functions”¹

Nan Xiang, Xie Lu, and Zhi Xi²

Abstract: With a focus on missions directed toward the maritime, and closely aligning with the objectives of the “Three Major Strategic Capabilities,” this article outlines four critical functions to enhance joint air and missile defense capabilities: strengthening joint situational awareness through multi-domain integration and all-domain reconnaissance and surveillance; optimizing command structures and integrating systems to enhance joint command and control (C2); leveraging systemic strengths and deploying forces methodically to strengthen joint defense and countermeasures; and ensuring flexibility, agility, and efficiency to strengthen joint support. These efforts aim to achieve defense against incoming threats as early as possible and as far away as possible, across all domains, at all times, and in all dimensions, ensuring the ability to withstand the first strike and deliver the first blow.

Introduction

Recent regional conflicts have demonstrated that air-to-ground missile strikes and air defense and missile defense have become the primary focal points of offensive and defensive operations and serve as key determinants of victory or defeat. Given the current environment in which air and missile defenses must operate in the maritime theater, it is essential to understand and plan joint air and missile defense operations from a strategic and holistic perspective. We must establish large and comprehensive battlespaces comprising exterior and interior lines of operations, implementing joint situational awareness, joint command, joint defense and countermeasures, and joint support. This will enable us to establish defenses as early as possible and as far away as possible, prior to adversary strikes, and allow us to operate across all domains, at all times, in all dimensions, and throughout the entire process, ensuring we can withstand the first strike and deliver the first blow.

¹ 南翔 [Nan Xiang], 谢露 [Xie Lu], and 支熙 [Zhi Xi], 海上方向联合防空反导作战重在强化“四联” [“Joint Air and Missile Defense Operations in the Maritime Domain Must Emphasize and Strengthen the ‘Four Joint Functions’”], *军事学术* [*Military Art*], no. 10 (October 2023), pp. 34-37.

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I. Multi-Source Fusion, All-Domain Surveillance and Monitoring, and Strengthening Joint Situational Awareness

Joint situational awareness serves as the “eyes” of combat operations and triggers the initiation of joint air and missile defense operations. To detect targets as far away as possible and respond to threats as quickly as possible, we must focus on “systems, all-domain coverage, and joint operations.” Relying on theater-level operational intelligence, we must integrate multi-dimensional, multi-source intelligence collection across land, sea, air, and space to build a large-area joint early warning system characterized by agile, efficient, and precise multi-level coordination and all-domain integration.

(1) Multi-Dimensional and Networked Early Warning.

Guided by the principles of “tiered integration of close and long ranges, mutual supplementation between air and ground assets, and coordinated multi-source deep detection,” we must establish a dynamic early warning network that combines fixed capabilities with mobile and concealed assets, integrates both special and conventional capabilities, and interconnects ground-, sea-, air-, and space-based platforms across different systems and frequency bands. This will enable multi-source, multi-dimensional, and multi-domain early warning against air and space targets. First, we must establish an integrated space/ground network and develop space-based early warning capabilities to create a comprehensive joint reconnaissance and early warning system, featuring forward deployed early warning satellites supported by ground-based radars and supplemented by naval and air assets. This will enable strategic early warning with long-range, persistent situational awareness and continuous monitoring of high-threat targets. Second, we must establish an integrated air/surface network to form an early warning “large network” comprising coastal radar stations along with naval vessels to form a “large-scale early warning network,” with airborne early warning assets serving as “key nodes.” This will establish an extended early warning network that integrates ground (and maritime) radar networks with early warning aircraft, leveraging the multi-frequency capabilities of different airborne early warning assets to implement diverse networks and wide-band, deep-penetration detection. By coordinating with ground (and maritime) radar networks for wide-area reconnaissance and precise target acquisition, this approach ensures continuous situational awareness of the air domain. Third, we must network small-scale systems. We must practically incorporate small-scale systems at the unit level and innovate independently networked capabilities at the unit (or sub-unit) level such as coastal radars, electronic countermeasures, surface-to-air missiles, and technical reconnaissance. This will enable rapid coordination between target detection, reconnaissance, and engagement, thereby establishing a tailored joint air and missile defense early warning system.

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(2) Coordinated Detection by Stealth and Conventional Capabilities.

We must leverage the advantages of stealth aircraft in extending airborne detection ranges, their ability to operate in full stealth mode in the far seas to detect and transmit fire control system (FCS) data in real time and synchronize with early warning aircraft (AEW aircraft), surface vessels, and third-generation aircraft as relay nodes to integrate detection data into the network. First is the integration of “AEW aircraft + fourth generation aircraft,” which can establish an

information link that integrates “fourth-generation aircraft covert intelligence collection + early warning aircraft intelligence sharing + expanded systemic situational awareness” to link the target identification matrix of the “AEW aircraft+” detection mode with the FCS-level target detection and identification matrix of fourth-generation aircraft, and delivering early warning information directly to fires elements. Second is the integration of “Unmanned Aerial Vehicles (UAVs) + AEW.” Stealth UAVs equipped with high-performance sensors must penetrate forward to establish communication links with AEWs to ensure uninterrupted relay of data to rear nodes. Third is the integration of “third-generation aircraft + fourth-generation aircraft.” We must organize mixed, echelon forward deployments of multiple aircraft types to leverage the multi-aircraft coordination capabilities of fourth-generation aircraft fighter data links (FDLs) and the active phased-array radar detection advantages of third-generation aircraft. We can achieve forward-deployed early warning and early target detection by networking these air capabilities with information nodes such as surface vessels and land-based coastal missile batteries to share deep-range detection data.

(3) Rapid Analysis and Dissemination.

The AEW aircraft’s independent network can, predicated on the theater joint operating environment, integrate and analyze multi-source intelligence, including from space-based, technical reconnaissance, and shipborne collections platforms, to disseminate precise intelligence. First, we must integrate resources and establish a unified and standardized data architecture to aggregate battlefield intelligence data from early warning and detection systems, as well as fragmentary reporting from airborne (or missile-borne) reconnaissance and human observations. A joint air domain battlespace picture can be formed by this cross-network information exchange, overlaid with enemy positions. Second, we must conduct analysis and assessments. By interfacing C2 information systems with intelligence databases and comparing historical data against typical operational scenarios, we can analyze the patterns of enemy sea and air platform activity to identify targets, provide indications and warnings, and discern enemy intent through a “machine-assisted + human intervention” model. Third, we must rapidly disseminate intelligence. We must standardize intelligence dissemination protocols from combat platforms across all military branches to AEW aircraft and establish low-latency, high-bandwidth, and resilient transmission links, to enhance AEW aircraft capabilities to rapidly upload and operationalize intelligence, achieving seamless integration, precise processing, and precise dissemination of multi-source operational intelligence.

II. Optimize Hierarchies, Integrate Systems, and Strengthen Joint Command

Joint air and missile defense operations are characterized by high target volume, dispersed weapon platforms, tight response windows, and a large operating area. To ensure the system’s maximum effectiveness, it is essential to dynamically employ combat forces, rapidly control the area, seize favorable windows of opportunity, and precisely engage and destroy incoming threats.

(1) Integrating Lines of Operations and Systems.

Joint air and missile defense operations integrate air defense forces from multiple military branches. Only by relying on a unified network and a unified chain of command can all participating units be truly connected, unified, and effectively employed. The focus is on establishing three key linkages. The first linkage is the intelligence, surveillance, and

reconnaissance (ISR) link, which integrates multi-source intelligence into the network, creates a common operating picture, and disseminates intelligence information to diverse air defense weapon platforms as needed. The “intelligence integration in-flight” model, which utilizes AEW aircraft, reconnaissance aircraft, and surface vessels as intelligence nodes to analyze and process reconnaissance data in real time, enhances the efficient transmission of target information. The second linkage is the C2 chain. We must clarify the limits of authority and responsibility for air and missile defense operations at all echelons within the theater; explore integration mechanisms for early warning and detection, fires interception, jamming and countermeasures, and logistics support; develop integrated C2 processes; standardize terminal-phase and missile defense operational command; and enhance joint planning and integrated C2 for air and missile defense operations. The third linkage is the collaborative kill chain, leveraging the high-altitude advantages of airborne platforms and using AEW aircraft and fighter jets as airborne information hubs and guidance nodes. We must implement rules for coordination and establish collaborative relationships to provide targeting information for surface-to-air missiles (SAMs) and destroyers/frigates, thereby creating a “AEW/fighter aircraft + SAMs/destroyers/frigates” collaborative kill chain.

(2) Optimize Processes and Coordination Rules.

We must shift away from the traditional model of manual planning and assigning tasks through a hierarchical chain of command and instead explore a multi-echelon coordinated operational model that rapidly generates orders and drives precise, swift, and efficient task execution. First, we must streamline rules and procedures to leverage the advantages of geographically distributed, networked joint operational procedures. Through tiered, coordinated planning, air defense units across all military services can simultaneously develop tactical procedures. Within the same timeframe, plans are unified, tasks are assigned, rules are established, formations are standardized, modules are defined, and systems are built to enhance the efficiency of coordinated operations. Second, we must standardize outputs and products. Through multi-echelon coordinated planning, plans are rapidly converted into operational outputs such as task lists, mission orders, air control directives, and rules of engagement. Standardized orders are generated in accordance with approved processes to direct and implement command coordination, thereby simplifying coordination echelons and ensuring orders are directly received by front lines. Third, we must strengthen auxiliary support. By adopting a “generalized platform + specialized system” developmental approach, we can promote functional integration within the air and missile defense C2 system to comprehensively integrate early warning data and engagement updates, thereby enhancing data- and system-based rapid decision-making capabilities. By introducing intelligent algorithms, we will improve the networked, dynamic, and automated “information-fires” coordination, effectively countering high-intensity, large-scale systems-on-systems confrontations in complex battlefield environments such as massed fires/missile saturation and multi-directional assaults by drone “swarms.”

(3) All-Domain Command, Joint Control.

To resolve the challenges of large-scale, high-intensity command during joint air and missile defense operations in wartime, the key lies in delegating command authority and shifting

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command tasks to lower levels within the theater-level joint operational command construct. First, we must establish a command model that extends vertically to the lowest operational/tactical levels linking “theater joint command + air component command + AEW aircraft + task force commanders.” This will streamline command echelons, shorten chains of command, delegate command authority and responsibilities, and innovate command methods to ensure C2 chains remain unbroken and closed-loop, achieving integrated, real-time, and efficient C2 for air and missile defense operations. Second, we must establish a coordination model that extends horizontally to the periphery by establishing coordination relationships between theater service branches at every level, with a focus on establishing C2 links between component combat groups and mission groups, as well as between ground-based air defense units, air superiority combat formations, and surface vessel formations. This will enable precise and rapid alignment with operational priorities and air defense requirements at each phase of operations, enhancing the efficiency of joint counter-attack and coordinated support operations.

III. Optimize the System, Deploy Forces Scientifically, and Strengthen Joint Defense and Countermeasures

We must capitalize on the first strike advantage inherent in offensive operations and the systemic advantage inherent in defensive operations, dynamically adjusting the deployment of joint air and missile defense systems deployments across multiple domains and large areas. We must also coordinate seamlessly with task groups to advance the front, pushing back the powerful enemy’s aerial strikes to the exterior lines and repelling [the powerful enemy] in the far seas (拒在远海) to ensure a stable air defense posture.³

(1) Establish Zonal Control and Complementary Formations.

Performance characteristics of air defense weapons across all military branches and services are fully leveraged through the integrating of fighter jets, destroyers and frigates, and SAMs to form joint operational formations characterized by zonal, integrated firepower, and complementary strengths. This will create a multi-layered, multi-domain air defense posture featuring echeloned defense and countermeasures. First is the “fighter + destroyer/frigate” integrated air-maritime formation. Air superiority forces, commanded by AEW aircraft in the operational area, coordinate with naval task forces to establish an intercept posture along exterior lines to engage cruise missile targets at maximum range; supported by tanker aircraft, fighter jets are forward deployed to maintain overlapping defensive fires with distant destroyers and frigates, creating a mutual cover posture to lure, pursue, and engage enemy air formations through long-range maneuver-based interceptions. Second is the “fighter + SAM” integrated air-surface formation. By integrating air forces and navy surface-to-air missile units, ground force air defense units, and reserve air defense forces into an air-surface air defense group, this formation coordinates directly with nearby fighter squadrons to conduct friend-or-foe identification (IFF), target capabilities assignment, and echeloned interception. Third is the “SAM + electronic countermeasures” integrated kinetic-nonkinetic formation. In the vicinity of key targets such as major airfields and troop assembly areas, short-range SAMs, integrated missile-and-artillery systems, and terminal electronic defense systems will be comprehensively employed to carry out

³ **Translator’s Note:** In PLA writings, the term “powerful enemy” (强敌) is a common euphemism for the United States.

hard destruction and soft kills against incoming targets, demonstrating active terminal defense and comprehensive countermeasures.

(2) Identification of Typical Targets and Tailoring Defensive Measures.

Building upon the existing air defense and missile defense system, we must accelerate the deployment of new capabilities: employ high-end interceptor missiles to counter ballistic missiles, air-launched missiles, and stealth threats, and employ cost-effective munitions and new methods to counter cruise missiles, anti-ship missiles, and UAVs. This ensures that high-end targets can be “intercepted” and low-to-medium-end targets can be “affordably engaged” to support high-intensity, sustained operations. First, we must defend against surprise missile attacks. The key lies in segmented interception, integrated resistance, and comprehensive defense. In far seas areas, fourth-generation fighters will penetrate enemy lines and launch long-range strikes against enemy air-launched platforms; bombers will engage with conventional missiles to conduct multi-directional saturation strikes against ground and maritime targets. In near seas areas, sectoral defenses including mobile interception and countermeasures are deployed in coordination with naval destroyers and frigates, securing key chokepoints and intercepting and engaging targets on sight. Coastal ground-based air defense groups intercept enemy threats at the greatest possible range as part of echeloned resistance. Around critical protected targets, short-range air defense weapons and electronic protection systems are deployed in mixed formations to conduct terminal air defense and electromagnetic jamming, integrating information- and fires-based defensive measures. Second, we must counter stealth penetration. The key lies in early warning, monitoring critical nodes, and concentrating superior forces for defense, utilizing anti-stealth AEW aircraft, ground-based radars, and other detection equipment to approximate the positions of the powerful enemy’s tankers, transport aircraft, and stealth aircraft in the far seas and organize elite naval and air forces to project forward for surveillance and control, and deliver accurate strikes. The stealth advantages of fourth-generation aircraft, along with effectively employed anti-stealth missiles, and coordinated with ground-based anti-stealth air defense weapons and shipborne air defense firepower, can engage in multi-layered interception and suppression of enemy stealth aircraft in specific areas. Third, we must defend against “swarm” attacks. The key lies in tracing the source of attacks, disrupting network systems, and implementing a combined kinetic and nonkinetic defense strategy. Because the range of UAV “swarm” attacks is limited, we must closely track and approach launch platforms, enhance situational assessment, and detect threats as early and as far away as possible to strike at the source. We will comprehensively employ new cyber and electronic warfare capabilities, directed-energy weapons, artillery and missile systems, and terminal defense to jam and disrupt the UAV “swarm” network, while simultaneously strengthening close-range air defense firepower to mount a combined kinetic and nonkinetic defense.

(3) Extend Defensive Systems Forward and Concentrate Superior Forces Locally to Repel Attacks.

The objective is to push the threat of the powerful enemy’s strikes to the exterior lines and repel them in the far seas. By leveraging concentrated, superior long-range joint operational capabilities, we will disrupt the enemy’s distributed strikes and ensure the stability of the overall air defense posture. First, we must leverage exterior lines to relieve pressure on interior lines. We will maintain continuous surveillance of enemy aircraft carrier strike groups and stealth aircraft

formations, deploying elite third- and fourth-generation fighters to coordinate with naval task forces and advance beyond enemy lines to key areas where offensive capabilities are arrayed in “mosaic” formation. In conjunction with long-range conventional missile strike capabilities, we will implement deterrence through firepower and systemic pressure to disrupt the enemy’s “mosaic warfare” formation from the exterior, thereby relieving pressure on the interior line air defense. Second, we must target critical nodes through integrated systems, guided by AEW aircraft, and establish multi-point control, and precisely seize ambush opportunities to launch massed, surprise strikes against high-value targets such as enemy AEW, ISR, and EW aircraft, striving to sever their operational command and information lines of communications. Third, we must employ stealth to penetrate enemy defenses, adopting a

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“stealth-versus-stealth” strategy by organizing integrated formations of manned and unmanned combat aircraft and establish networks and form lines of communications in the far seas to conduct coordinated operations. At critical junctures, we can use stealth to penetrate enemy formations of ships and aircraft, as well as their refueling zones, to covertly seek out and destroy enemy tankers, transport aircraft, and supply ships. This will sever the lines by which the enemy projects forces and firepower and disrupt and delay the tempo of their offensive operations.

IV. Flexible, Agile, and Efficient: Strengthening Joint Support

By advancing systematic, networked, and agile military-civilian joint support, as well as the development of joint, integrated, and multi-purpose support task forces, we will enhance battlefield mobility and protection, battlefield resilience, and system-level support capabilities, resolving the logistical challenges in air and missile defense operations.

(1) Strengthen Maneuver Protection Capabilities.

In focusing on countering diverse air and space threats and addressing the operational demands of various complex missions and environments, we will shift away from the traditional model of concentrating forces and weapons according to organizational structure. First, we will adopt flexible configurations and distribute assets where needed. Sensors, interception and engagement firepower, and C2 units will be widely dispersed to expand the defensive zone, strengthen kill chains, reduce centralized nodes, support distributed defense, and enhance the flexibility, adaptability, and survivability of the air and missile defense system. Second, we will combine real and decoy elements in multiple mobile deployments. Ground forces will adopt “hit-and-run” tactics, conducting rapid, mobile strikes in small units along multiple routes at irregular intervals. By coordinating the use of radar decoys, false targets, and terrain, they will strengthen camouflage and protection to improve battlefield survivability. Third, we will decouple functions and deploy as an integrated area system, upgrading air and missile defense capabilities by decoupling the communications, tracking, guidance, and launch subsystems of large integrated SAM systems. This enables flexible integration among early warning and deep detection, interception firepower, and C2 components across various types of air defense equipment, supporting rapid reconfiguration of air and missile defense systems, flexible and adaptable force deployment and configuration, and integration into kill chains.

(2) Strengthen Battlefield Resilience.

Focusing on the requirements for rapid response and high-speed maneuver operations, we will reinforce combat support for positions and equipment, continuously improve forward airfields, and strengthen the construction and renovation of combat support facilities such as command posts, ammunition depots, and fuel depots. This will ensure that wartime evacuation and protection have a solid foundation, fully enabling sustained support and preparing for emergency support. First, we must build airfield clusters. Based on operational requirements and enemy strike threat posture, we must distinguish between core, support, and supplementary functions to construct airfield clusters featuring tiered, dispersed pre-positioning of support resources and dispersed and distributed backups. We must also clarify allocation procedures, streamline operational relationships, and promote mutual protection of equipment and mutual ammunition support among airfields within clusters. Second is shared position clusters. To address the current challenges in battlefield support for air and missile defense positions, which are isolated, scattered, and dispersed, we will leverage the advantages of island chain force deployment (岛屿链布势) in the maritime theater and the dense clustering of positions to establish a joint, integrated, and universal network of positions anchored by basic support nodes. This network will spoke outward to drive the emplacement of reserve positions for surrounding SAMs, radar, and electronic countermeasures units, thereby enhancing shared support capabilities and minimizing impact to operations. Third, we will optimize resource utilization. Through methods such as delegation and contractual arrangements, we will integrate high-quality civil resources, including technology, personnel, equipment, and logistics, into the joint support system. We will refine cooperative mechanisms, standards, and operational procedures to address gaps in emergency and sustained support to enhance battlefield resilience.

(3) Strengthen Systemic Support.

We must establish a joint support system based on “domain + mobility + mobilization” principles to develop precise support capabilities that enable rapid response and all-dimensional operational participation. First, we must strengthen the military-civil support system and fully leverage the cognitive advantages of joint air and missile defense operations, which are highly relevant to public concerns and to engage a united sense of purpose to address scenarios such as operational setbacks, enemy counterattacks, and prolonged stalemates. We must implement a “one-two punch” of “action + communication,” using combat achievements to inspire public morale and tales of military-civil solidarity to unify resolve. We must firmly reinforce the understanding that “only through unity can we resist and overcome the strong, and only through struggle can we ultimately achieve victory,” waging a people’s war in the new era. Second, we must establish an emergency support system, involving rapid-deployment teams comprising “transport aircraft + fighter jets” equipped with essential support gear and accompanying support personnel, to rapidly advance from rear areas to first- and second-line airfields. A three-tiered support sequence involving rear depots, nearby units, and manufacturers will establish an emergency procurement network, and deep cooperation between Air Force aviation material departments and local logistics enterprises will rapidly respond in support of aviation material logistics, ensuring the timely allocation and distribution of scarce aviation materials. Third, we must establish a shore-sea-island support system. Onshore support operations will primarily focus on joint area support for military supplies, operational energy, field hospitals, precision-guided

munitions, and equipment replenishment, as well as the rapid repair and construction of military facilities. Maritime support operations will focus on providing wide-area mobility support and mid-route logistics support for main combat forces engaged in maritime and air interdiction, area search and destroy operations, amphibious transport, and anti-submarine warfare. Island support operations will prioritize the repair of moderately damaged ports and airfields, as well as the supply of general-purpose ammunition and fuel, and the field treatment of casualties.

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