A NEW BATTLE COMMAND ARCHITECTURE FOR JOINT ALL-DOMAIN OPERATIONS

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To achieve the objectives of JADC2, the US Air Force must deliver information to warfighters at the edge of the battlespace. The service must rapidly evolve beyond the large, centralized combined air and space operations centers of today—hundreds of people in stovepiped divisions around segregated mission areas—to a much more agile and dispersible set of processes and command-and-control structures. This new architecture must adapt to the air battle management system and JADC2 developments. But given the slow evolution of these programs, the Air Force cannot wait to begin changing the architecture for command and control of aerospace forces.

In mid-2021, the Chairman of the Joint Chiefs of Staff (CJCS) General Mark A. Milley testified to Congress about the US military's new joint warfighting concept (JWC) and the importance of the associated Joint All Domain Command and Control (JADC2) framework to its realization.

> The JWC is a multi-year effort to develop a comprehensive approach for joint operations against future threats and provide a guide for future force design and development. Supporting concepts to the JWC describe key warfighting functions. They are fires, logistics, C2, and information advantage. The Joint All Domain Command and Control (JADC2) framework enables the holistic development and realization of the JWC and Supporting Concepts.[1]

The fundamental basis of the joint warfighting concept is the notion of all-domain operations. This concept is the next evolution in the US military's journey to optimize the synergy of effects that accrues from operating in an integrated fashion across the domains of air, space, sea, land, and the electromagnetic spectrum. The journey began with the passage of the Goldwater-Nichols Department of Defense Reorganization Act of 1986 that aimed to improve the ability of the armed forces to conduct joint (interservice) and combined (interallied) operations.

If developed and implemented properly, the joint warfighting concept will yield a far more decisive, powerful set of combat outcomes than today's joint operations that, in many cases, simply involve service component deconfliction versus integration. For the joint warfighting concept to happen, the Department of Defense (DOD) needs to

1. *The Fiscal Year 2022 National Defense Authorization Budget Request from the Department of Defense, Before the US House of Representatives Committee on Armed Services*, 117th Cong. (2021) (Statement of General Mark A. Milley, Chairman of the Joint Chiefs of Staff).

get serious about turning theory into reality. That means taking incremental but concrete steps toward meeting the objectives of JADC2, not waiting for a complete solution to implement this concept.

Joint All Domain Command and Control will require much time to engineer as it involves a mammoth conversion of existing concepts, capabilities, and service perspectives. But these endeavors can be accelerated through the rapid evolution of current command and control (C2) paradigms. Specifically, it is time to move beyond large, centralized, static command and control facilities to mobile, distributed command and control, with the capability to handle the same volume and diversity of information as a regional combined air and space operations center.

As it seeks all-domain synergy by embracing complementary versus merely additive employment of capabilities from different domains, the goal of JADC2 is to attain interdependency that enhances effectiveness and compensates for individual vulnerabilities of each of the domains. Desired military effects will increasingly be generated by the interaction of systems that share information and empower one another.

Instead of a set of disconnected, singularly focused combat systems in each of the domains, the JADC2 vision sees assets combined through digital connective glue to become a weapon system capable of conducting disaggregated, distributed operations over an entire operational area. This effort will require treating every platform as a sensor and an effector. It will require a new battle command architecture and C2 paradigm that enables automatic linking, as does cellular phone technology today. This architecture will also need to transfer data securely, reliably, and seamlessly without the need for human interaction.

The Envisioned Transformation

The overarching goal of actualizing JADC2 with the degree of integration required to achieve a self-forming, self-healing complex into reality will be difficult and require significant effort. Every military service and combatant command will be involved. Several major obstacles in organization, culture, training, acquisition, and policy will need to be overcome. This effort will require connecting, decision making, and responding at speed. It will require resilient networks and a degree of sharing among service components, Allies, and partners not yet achieved.

These numerous and multifaceted challenges are being addressed across services, combatant commands, and our Allies and partners even now. But due to their complexity, it will take many years—if not decades—before the ultimate vision of integrated, interdependent, self-forming, self-healing all-domain joint and combined operations are a reality. Yet the growing threats facing us demand solutions today. Accordingly, it is time to address the elements of JADC2 that can be changed now to meet these challenges.

Each of the service components and combatant commands have well-established operating command and control concepts, facilities, and procedures that have proven workable in past conflicts. Each of the variety of command and control architectures

that currently exist, however, will require extensive modification in order to survive—much less operate—against emerging threats.

A prerequisite to successful operations in all the domains is control of the aerospace environment. Once established, this control facilitates the freedom of action and movement for all other joint and combined forces—without it, effective joint and combined operations are not possible. Accordingly, the critical functions that ensure effective command and control of aerospace operations must be a priority.

The ability to command and control air and space forces is affected by three major elements: threats, technology, and the velocity of information. The changes in these three areas since the design, establishment, and operation of the US Air Force's air and space operations center—the AN/USQ-163 Falconer—have been dramatic and continue to accelerate.

Therefore, it is time to ask the question, can the Air Force achieve success in future operations by evolving our current concepts of operation, organizations, and acquisition processes for modernization or must the service seek fundamental change to each of these elements that affect the current theater air and space control system? Before providing an answer, let's take a brief look at each of the trends affecting our ability to effectively command and control aerospace operations.

Future Threats and the Operational Environment

Threats

Today, peer threats pose unacceptable risk to current means of command and control when the US military is attempting to operate inside an anti-access/area-denial (A2/AD) environment. For over 30 years, the US Air Force has essentially been on a command and control holiday having the luxury of not being contested in the aerospace domains. Those days are over.

Military competitors have accomplished modernization on an unprecedented scale. They have rapidly closed the gap with the US, Allies, and friendly militaries across a broad spectrum of capabilities including aircraft, spacecraft, missiles, weapons, cyber, command and control, jammers, electronic warfare, data links, and others.

Potential adversaries have also studied the American way of war and have determined it is better to keep us out of their neighborhood rather than face our combat power. They have adopted and are proliferating A2/AD capabilities designed to deny the US and its Allies and partners freedom of action. Mitigating these capabilities pose significant challenges driving us to operate with greater risk and farther away from potential areas of conflict.

Anti-access/area-denial capabilities threaten the service's ability to command and control air and space operations in multiple ways. Near-peer adversaries can employ kinetic and nonkinetic weapons to deny us communications and intelligence, surveillance, and reconnaissance from space-based assets thereby isolating our forces and blinding our view.

Cyber attacks are becoming more sophisticated and can disrupt operations at well-established combined air and space operations centers. Accurate long-range cruise and ballistic missiles now threaten these large, fixed, and vulnerable facilities. As the factory for generating strategy, plans, and the tasking orders for air and space assets, the combined air and space operations center has become an extremely lucrative target.

Technology

New technologies are enabling new capabilities that optimize command and control mechanisms to accomplish desired effects. The service needs to think beyond constraints that traditional culture imposes on new technology. For example, next-generation aircraft may still be labeled in traditional nomenclature such as fighters, bombers, and airlifters, but technologically they have the capability to perform multiple missions due to the miniaturization of sensors, processing power, weapons, energy production, and other capabilities. They are flying "sensor-effectors" that can form the basis of highly resilient redundant-node networks and multiple kill paths to minimize the critical system value of current highly centralized and limited command and control nodes—like combined air and space operations centers—that an enemy could easily target.

This will require leading-edge networking capabilities, assured communications, and different approaches to solving our data bandwidth challenges. For example, to solve the explosion in data growth from advanced sensors, instead of building bigger pipes to transmit the collected data, increases in processing power now enable the processing of data on-board and the off boarding of only what is of interest to the users. This approach inverts the way we do intelligence, surveillance, and reconnaissance processing today.

Rapid information exchange is especially important at the forward edge of combat, for the value of actual data is often transitory and diminishes as time and circumstances pass. The development of a technological approach to share information automatically and rapidly among diverse users and across multiple classifications and Allied and partner nations will be a key to creating the future force.

The old adage, "speed is life" is no longer just about flying—it is also about rapidly evolving software tools to fight and win. We must think outside of the organizational constructs that history has etched into our collective psyche. Network-centric, interdependent, and functionally integrated operations are the keys to future military success.

Velocity of Information

Significant advancements in telecommunications, sensors, data storage, and processing power are emerging every day. As a result, the targeting cycle has evolved from weeks to days to minutes, and from multiple, specialized, and separate aircraft to the ability of one aircraft to "find, fix, and finish" in minutes. Growing accessibility to information requires the restructure of command and control hierarchies to facilitate

rapid engagement of perishable targets and to capitalize on our technological capability. Information synthesis and execution authority must be shifted to the lowest possible levels while senior commanders and staffs must discipline themselves to stay at the appropriate level of war.

To move beyond large, centralized, static command and control facilities to mobile, distributed C2, with the capability to handle the same volume and diversity of information of a regional combined air and space operations center today will require a reappraisal of how the service deals with information flow. The two most important aspects of this future capability will be the "command" metamorphosis it will enable through the synchronizing "control" it will provide.

The "art of command" will morph to realize Metcalfe law network values (Metcalfe's law states that the value of a telecommunications network is proportional to the square of the number of connected users of the system).[2] And the science of control will continue to apply Moore's law expanding technology to extend human capacity.[3] Gaining and maintaining a decision-cycle advantage for both will provide the path for optimal growth.

A New Architecture for Aerospace C2

We are now at a juncture where threats, technology, and the velocity of information require a change in the established architectures that command and control aerospace forces. All the military services have recognized this and have initiated actions to develop new concepts of operation for their respective domains. The challenge will be how to ensure each of the individual service concepts of operation are integrated into a unified Joint all-domain command and control architecture.

Developed with the idea of creating an intelligence, surveillance, and reconnaissance, strike, maneuver, and sustainment complex that uses information-age technologies to conduct highly interconnected, distributed operations, this combat cloud will usher in an entirely different architecture for the conduct of war. The fundamental basis of JADC2 is to push accurate, quality information down to the lowest information node to achieve a desired effect, regardless of service, domain, or platform.

The US Air Force approach to this goal is its efforts to design and develop an advanced battle management system (ABMS). The elements of the ABMS have been defined, but they have yet to be developed into an executable command and control architecture. To get to the desired end state of the ubiquitous and seamless sharing of information across the battlespace in a secure, reliable, and robust fashion for both JADC2 and ABMS will take many years. Given the rapid evolution of significant threats and the vulnerability of current C2 facilities, the service must modify the current command and control construct for aerospace forces now.

2. Techopedia, "Metcalfe's Law," Techopedia, May 28, 2019, https://www.techopedia.com/.
3. Mike Gianfagna, "What is Moore's Law?," Synopsys, Inc., June 30, 2021, https://www.synopsys.com/.

A new architecture is needed to support an operating concept that actualizes the C2 paradigm that has recently been ensconced in US Air Force doctrine of centralized command, distributed control, and decentralized execution. No breakthroughs in technology are required to institute a new battle command architecture as the technology already exists to deal with the immediate challenge of distributing command and control functions so that they cannot be eliminated with a few strikes on a few critical C2 nodes.

The US Air Force has been developing a supporting concept of operations to their new doctrine known as agile combat employment (ACE). Agile combat employment is a concept that disperses forces and assets to multiple separated locations on short notice to complicate adversary planning. With an appropriate C2 system, ACE can hold adversary targets at risk from many locations that are defensible, sustainable, and relocatable. The details for application of the concept are unique depending on the theater of use, but fundamentally the idea is the same, and command and control is fundamental to the concept's success.

The combined air and space operations center will remain a viable means to conduct C2 operations during periods of less than major regional conflict. To achieve the objectives of JADC2, however, the service will have to deliver information to warfighters at the edge of the battlespace without relying on the traditional combined air and space operations center model of hundreds of people organized in stovepiped divisions around segregated mission areas.

Accordingly, the service must rapidly evolve beyond the large, centralized combined air and space operations center structures we rely on today to a much more agile and dispersible set of processes and command and control structures. At the same time, this new architecture must be adaptable to the air battle management system and JADC2 developments. But given the slow evolution of these programs, we cannot wait to begin changing the architecture for C2 of aerospace forces.

Many options exist for this new architecture: build hardened combined air and space operations centers and remote the functions to assigned units; distribute planning functions currently incorporated in combined air and space operations centers to multiple locations and share the resulting plans among them; and create processes and procedures to be executed based on the degree of degradation of connectivity between combat units and their respective command elements by shifting execution authority corresponding to levels of connectivity.

Regardless of what is selected for development, one thing is certain, the US Air Force must undertake a determined effort to distribute the command and control functions necessary to assure the effective use of aerospace forces in a contested environment, and that effort must begin now. *Æ*

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