JADC2:

Tactical Edge Networking to Win in
Great Power Competition

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Tomorrow … JADC2 at the Tactical Edge

At an undisclosed location in a geopolitically charged region of the world, an elite team of U.S. Marines and skilled operators prepares to conduct an aerial insert along an island chain of expeditionary advanced bases. Embarked aboard a section of MV-22 Ospreys, the primary assault support aircraft for the U.S. Marine Corps, this tactical unit serves as the main effort of a larger naval task force from one of the Marines' newly designed and organized littoral regiments.

Specifics of the mission are classified. However, this highly trained team is forward postured at the tactical edge with other joint forces to delay, degrade or deny adversary aggression in the region. These operators mark the first line of defense in the new U.S. global operating model. Together, they serve as one tactical node within an elaborate and integrated maritime network, which includes an array of sensors, shooters, sea- and land-based logistical and aerial support hubs, manned and unmanned surface and sub-surface combatants, and combat operations centers ashore and afloat.

To succeed, the team and many like it conducting littoral operations, rely on rapid access and unbroken connectivity to a range of information across air, land, maritime, space and cyberspace domains. Such critical information enhances their situational awareness, facilitates decision-making and enables lethality and survivability against threats from peer adversaries. Critical to mission success is collaboration across these units and with command and control (C2) elements embarked on ships and operating from distributed nodes ashore, joint shooters with precision weapons, and a multitude of tactical and national sensors.

Enabling this sophisticated and fully integrated connectivity is an elaborate web of multi-domain communications linkages throughout the U.S. military's joint force, what Department of Defense officials refer to as the Joint All-Domain Command and Control (JADC2) system.

Today … DOD Vision for Information Dominance in Great Power Competition

What Great Power Competition Means for Tactical Edge Missions

Often characterized as renewed great power competition (GPC), the U.S., China and Russia are battling to shape everything from trade and investments to security norms and technologies around the world. In this geopolitically charged environment, the fight will not necessarily be won by

the side with the most advanced technology or biggest bombs. Instead, it will be won by the side with the most current, accurate and comprehensible data. The key to tactical edge missions and victories in the modern era is information dominance.

In complex military operations, the timely, efficient and secure exchange of tactical information — from sensor to decision-maker to shooter — plays a decisive role in determining the outcome of military action and the success of the mission. In the new normal of GPC, our nation's adversaries will challenge military power unconventionally and asymmetrically. The real art and science of effective command, control, communications, computers and information is the way military units generate, protect and transmit data. Ultimately, success is about moving data from the right sensor to the right decision-maker, whose information management and ability to decide and act can outpace the adversary.

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The DOD's JADC2 Vision

The Department of Defense's answer to gaining influence and control over a peer threat is JADC2. Conceptually, this joint all-domain command and control system connects the multitude of sensors from all the military services — Army, Navy, Air Force, Marine Corps and Space Force — into a single network.

DOD officials and operators at the tactical edge argue that the existing C2 system is insufficient to meet the demands of today's complex operational environment. They believe the paradigm shift away from current, often incompatible, systems used by each military service will address two of the most critical technical shortfalls across the joint community: lack of a common operating picture (COP) and joint sensor-to-shooter capability limitations.

In TRADOC Pamphlet 525-3-1[1], General Stephen J. Townsend, U.S. Army, emphasizes, "The Joint Force requires a COP, or visualization and decision support tool, which allows commanders in any Service, at any echelon, in any mission area and at any classification level to 'down-select' the categories of information they need to make informed decisions. It should also include the technical means to get that information pushed to them from all supporting components."

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A Look at JADC2 Initiatives

Modernization of the military's C2 architecture is expected to produce the joint COP that commanders at all echelons seek; integrate capabilities across domains; and enable interoperability throughout the uniformed services. This integrated network will rely on data from cutting-edge fifth-generation assets like the F-35 Joint Strike Fighter, the Air Force's F-22 Raptor, and the Navy's Aegis Combat System, as well as established platforms like the F/A-18 Super Hornet combat aircraft, the B-52 Stratofortress bomber and a host of manned-unmanned intelligence, surveillance and reconnaissance systems. Equally integral to this network of sensors are the unmanned surface vessels (USVs) in production today.

The Air Force has taken the lead on this complex effort to enable future all-domain operations through the development of its Advanced Battle Management System, or ABMS. Similarly, the Army's effort to modernize its network, Project Convergence, is intended to integrate legacy and current systems to enable joint interoperability and the sharing of information. For their part, the Pentagon's sea services — the Navy and Marine Corps — plan to integrate into the overall JADC2 concept with Project Overmatch, which will develop a new fleet architecture using artificial intelligence and manned-unmanned systems to enable distributed maritime and expeditionary advanced base operations.[2]

Cross-Service Cooperation for Shared Goals

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Lieutenant General Dennis Crall, chief information officer and director of command, control, communications and computers/cyber at the Joint Chiefs of Staff, is leading the JADC2 endeavor. Speaking at a defense technology summit[3], LtGen Crall expressed his confidence in joint force collaboration, saying, "I'll just say that in my many years of working on projects, either this one specifically or ones like it, I have never seen a time when the services are more cooperative in looking at ways

to solve these problems, because they're complex, in many cases they're expensive, and we can't do it all and we certainly can't do it all alone."

That said, despite this shared pursuit across the DOD to network the operational environment and enable joint expeditionary operations, the realities of linking everything across the modern battlefield is a complex task for the U.S. military services.

JADC2 Challenges … Technical, Tactical and Operational

The goal of developing a battlefield web to gain information superiority and enable rapid decision-making is a critical one for the DOD — and the right one for the U.S. military as it plans for warfare in the modern era. However, the integration of such a sophisticated communications architecture will not be easy. Our military services are currently reliant on a system that doesn't provide the necessary bandwidth to meet the demands of modern combat against an advanced threat.

Sensor, Platform and Technology Infrastructure Complexities

The complexities of tactical edge networking and limitations of both sensors and their respective platforms make this effort a technically and tactically challenging problem. For example:

- The F-35C lacks the ability to connect seamlessly with the F/A-18, making a fully networked battlefield a difficult goal to achieve.
- The U.S. military's ability to manage information in today's operational environment is currently dependent on aging network links that differ across aircraft, sensors and weapons.
- Planes, like the non-stealthy E-8 Joint Surveillance and Target Attack Radar System (JSTARS), have become increasingly vulnerable to adversary interdiction and airborne C2 compromise.
- Joint and, equally significant, coalition platforms have different communications schemata, adding another dimension of complexity.

Further compounding the situation is the state of the U.S. military's network infrastructure. Designed in the late 20th century, antiquated structures limit access to critical information and fail to support rapid, data-informed decision-making. There are high costs and long timelines associated with modifying tactical aircraft and other surface and subsurface platforms with the latest technologies to support an all-domain network.

Organizational Inertia vs. Enemy Advancements

On the non-technical front, the military services will need to address doctrinal and organizational challenges associated with how they will manage information across a contested battlespace.

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Today's commonly practiced centralized C2 and decentralized execution will also need to transform into a C2 architecture that accounts for the distributed nature in which the joint force will operate in the modern era.

And, of course, there's the threat of an advanced enemy. Today's peer-like adversary possesses the kinetic and non-kinetic means to attack our current C2 architecture, its nodes and its communications pathways.

The Solution … Information Superiority Through Industry Collaboration

Achieving the reality of DOD's web of connectivity requires a fully integrated, multi-domain, information-intensive combat environment that reliably and securely connects a joint expeditionary force network with a seamless communications infrastructure. Pushing data to warfighters inside and outside the adversary's weapon engagement zone — a defined airspace where the responsibility for engagement of air and missile threats rests with a particular weapon system — is a critical part of planning[4]. This next-generation warfare approach makes warfighters more effective and C2 centers less vulnerable to enemy threats.

Information Wins

In today's digital battlespace, information wins. In his planning guidance to Marines[5], General David H. Berger, the 38th Commandant of the Marine Corps, wrote, "Our most challenging adversaries have initiated a new paradigm of warfare, based on the

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development and fielding of long-range precision weapons, as well as information-related capabilities."

Berger, like many senior personnel throughout the DOD, understands that information dominance defines warfare in the modern era. In 2017, then-Secretary of Defense James Mattis highlighted the critical nature of information in GPC by introducing "Information" as a new, seventh joint

function[6]. Adding Information to the established six functions — C2, Intelligence, Movement and Maneuver, Fires, Sustainment and Force Protection — signaled the primacy of data management on the modern battlefield and the urgency in addressing JADC2 complexities.

Expansion and widespread availability of information technology continues to impact military operations and the character of modern warfare in the Information Age. Evolving threats require the right information to the right warfighter at the right time.

Effective solutions must be capable of compressing the kill-chain cycle and accelerating decision-making to information superiority that equates to combat power. Enhanced information content advances battlespace awareness. The means to rapidly sense, collect, analyze and exploit information by combat leaders will lead to tactical and operational advantages over the adversary.

Industry Commitment, Focus, Innovation

The Department of Defense is not alone in pursuing its goal in networking the operational environment and achieving information superiority in today's contested spaces. A number of government contractors such as Fuse Integration are innovating communication, networking and computing solutions that improve the sharing of information, video, text and voice among distributed warfighters.

Teams of engineers, technology experts and former military leaders with operational experience are developing intuitive, agile, and resilient products and solutions that go beyond national security requirements to provide lasting utility and game-changing results across airborne, maritime and ground environments.

> Expert vendor partners are building innovative products to gain and maintain information and decision advantage across today's distributed battlefield.

Like the DOD — and in concert with the DOD — these expert vendor partners are building innovative products to gain and maintain information and decision advantage across today's distributed battlefield. They are focused on:

- Providing rapid access to information for critical situational awareness.
- Accelerating the sensor-shooter-decision-making chain.
- Developing software and hardware to support a unified, integrated and joint network.
- Enabling signature management.
- Ensuring durability and resilience in its systems.

- Advancing lethality and survivability through data-enhanced decision-making.

In short, they are empowering the drive to JADC2.

Driving Forward with JADC2 …

As the U.S. military faces an increasingly complex and dynamic strategic landscape, it must be able to communicate and act across all domains and the range of military environments to maintain a competitive advantage in the global theater. Warfighters across the joint force must be able to securely communicate with each other and with command centers without having to stop and consider interoperability limitations.

Collaborating to harness advancements in network, software and technology systems, the DOD and industry partners will design innovative solutions that enable JADC2 and reliably support the sharing of information and communications across distributed airborne, maritime and ground environments. In our JADC2-enabled future, this operational paradigm is the new norm, accelerating the sensor to decision-maker to shooter cycle and, ultimately, battlefield superiority.

Back at the tactical edge, our future team of Marines and special operators has just landed at its objective. Understanding the speed at which modern warfare operates, this unit races to establish its forward presence and link into the joint force's sophisticated web of connectivity throughout the region. This forward-deployed element, like tactical units at all echelons, depends on DOD's elaborate information infrastructure to maintain essential network services and receive, share, protect, and disseminate critical data and combat information throughout any high-stakes environment.

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About Fuse Integration

As military veterans, Fuse founders recognize that far too many DOD communications and network solutions are disconnected from the mission requirements of users at the tactical edge. Fuse was founded with the noble cause of bringing the benefits of commercial human-centered design processes to military systems engineering.

Today, Fuse builds innovative communications, networking and computing solutions that improve the sharing of information, video, text and voice among warfighters distributed throughout the airborne, maritime and ground environments. Placing the warfighter at the center of every design process, Fuse delivers intuitive, agile and resilient products that go beyond national security requirements — providing lasting utility and game-changing results.

- **CORE® Family of Virtualized Network Systems:** A flexible and rugged small, weight and power (SWaP) networking solution that connects aircraft, ground vehicles and ships with ground operations — across secure and unclassified networks — in rugged conditions. CORE's tactical data link (TDL) and internet protocol (IP) networking platform contain fully ruggedized physical components for military

operations and provide unmatched flexibility for system software and hardware.

- **Fuse Tactical Edge Network (F10):** Running in a virtualized environment, the F10 platform can be configured for any mission profile. It can holistically manage a large set of diverse radios to create a cross-layer optimized heterogeneous network. This means that warfighters across the joint force can securely communicate with each other and with command centers without having to stop and consider interoperability limitations.
- **Distributed Access/Range Extension (DARE) pod:** An airborne networking gateway designed to extend tactical edge networking to disadvantaged users, providing extended network connectivity for airborne and ground-based warfighters. Delivering a distributed airborne networking solution in a wing-mounted pod airframe, DARE is compatible with multiple aircraft. Research and development are currently underway to mount the DARE pod on manned-unmanned surface vessels and ground combat vehicles.

The San Diego-based company has earned recognition as an emerging leader in airborne, maritime and ground networking. For a complete list of Fuse products and capabilities, visit www.fuseintegration.com.