The Role of Next-Generation Interconnects in Enabling Joint All-Domain Command and Control (JADC2)

Introduction

The Joint All-Domain Command and Control (JADC2) initiative represents a paradigm shift in how the U.S. Department of Defense (DoD) executes mission command across air, land, sea, space, and cyberspace. As adversaries develop increasingly sophisticated capabilities to disrupt communications and decision-making, the ability to rapidly collect, process, and disseminate data across domains and echelons has become a strategic imperative. Central to realizing this vision is the deployment of next-generation interconnects—advanced physical and logical pathways that enable secure, resilient, and high-speed data exchange across distributed platforms and coalition partners.

This whitepaper examines the critical role of next-generation interconnects in enabling JADC2, with a focus on how advanced connectors and ruggedized data pathways support distributed sensing, edge-to-core integration, and decision superiority. It also outlines typical procurement considerations and evaluation criteria to guide acquisition professionals in selecting interconnect solutions that meet the operational and environmental demands of future joint operations.

The Strategic Role of Interconnects in JADC2

Next-generation interconnects encompass fiber-optic backbones, 5G tactical edge networks, satellite relays, and software=defined radio links. Their integration supports JADC2s core functions: sensing, sense-making, and acting.

JADC2 seeks to unify sensors, shooters, and decision-makers across all domains into a cohesive, responsive, and resilient command and control architecture. This requires a foundational layer of interconnectivity that can support:

- **Real-time sensor fusion** across geographically dispersed platforms

- **Edge-to-core data flow** for tactical and strategic decision-making

- **Multi-domain synchronization** of operations in contested environments

- **Interoperability with mission partners** through standardized, secure interfaces

 Beyond raw performance, next-generation interconnects—comprising high-bandwidth cables, advanced connectors, hardened data buses, and cyber-responsive protocols—embody a shift toward modular, scalable, and resilient architectures. They ensure that data originating from edge sensors can be

transmitted, processed, and acted upon with minimal informative flow delay and maximum integrity, even under electromagnetic, kinetic, or cyber duress.

The JADC2 strategy outlines five lines of effort, all of which rely on robust interconnects: data enterprise, human-machine teaming, nuclear C2 integration, mission-partner sharing, and resilient communications. Without next-gen interconnects, these efforts would remain siloed and vulnerable to disruption.

Enabling Distributed Sensing and Decision Superiority

Advanced connectors and rugged data pathways are essential to the operationalization of distributed sensing and decision superiority. These components ensure that ISR data from unmanned systems, satellites, ground sensors, and airborne platforms can be reliably transmitted across the mission area. Their contributions include:

- **Environmental resilience**: Ruggedized interconnects withstand extreme temperatures, vibration, shock, and electromagnetic interference, ensuring persistent connectivity in austere and contested environments.

- **Modular integration**: Advanced connectors support plug-and-play sensor integration, enabling rapid reconfiguration of platforms and payloads in response to evolving mission needs.

- **Deterministic data flow**: High-speed, low-latency interconnects ensure time-sensitive data—such as targeting information or threat alerts—reaches decision-makers and shooters without delay.

- **Cybersecurity assurance**: Encrypted and authenticated interconnect layers mitigate the risk of data interception, spoofing, or manipulation.

These capabilities are not merely technical enhancements; they are operational necessities for achieving the speed, precision, and agility that JADC2 demands.

Technical Enablers and Interconnect Contributions

The following checklist outlines how next-generation interconnects underpin key JADC2 capabilities:

Checklist: Interconnect Contributions to JADC2 Capabilities

- [✓] Support for distributed sensing via modular, ruggedized connectors and high-fidelity signal integrity

- [✓] Enablement of real-time AI/ML inference through high-throughput, low-latency data buses

- [✓] Secure cloud-to-edge data continuity using hardened, encrypted interconnect pathways

- [✓] Deterministic control and telemetry for autonomous and semi-autonomous systems

- [✓] Resilience against cyber threats via zero-trust architectures and quantum-resistant encryption

- [✓] Compatibility with legacy systems through protocol bridging and modular adapters

- [✓] Spectrum agility via RF-over-fiber and dynamic spectrum allocation techniques

Procurement and Standardization Considerations

To ensure that interconnect solutions align with JADC2 objectives, acquisition professionals must prioritize the following criteria during procurement planning and supplier evaluation:

Checklist: Procurement Evaluation Criteria for Next-Generation Interconnects

- [✓] Compliance with relevant military and aerospace standards (e.g., MIL-STD-1553, MIL-DTL-38999, MIL-STD-810, SAE AS6070)

- [✓] Demonstrated performance in high-vibration, high-EMI, and extreme temperature environments

- [✓] Support for high-speed data transmission (e.g., 10 Gbps and above) with low latency and jitter

- [✓] Modular, scalable architecture to accommodate future upgrades and mission reconfiguration

- [✓] Interoperability with NATO and coalition systems through standardized protocols and connector formats

- [✓] Cybersecurity features including hardware-based encryption, secure boot, and tamper resistance

- [✓] RoHS and ITAR compliance for exportability and environmental stewardship

- [✓] Proven lifecycle support, including obsolescence management and configuration control

- [✓] Vendor track record in defense-grade interconnect manufacturing and supportability

Conclusion

As the Department of Defense advances toward a fully integrated JADC2 architecture, the importance of next-generation interconnects cannot be overstated. These components are not peripheral; they are foundational. Advanced connectors and rugged data pathways enable the secure, resilient, and high-speed exchange of information that underpins distributed sensing, real-time decision-making, and multi-domain operations.

To achieve decision superiority in future conflicts, acquisition strategies must prioritize interconnect solutions that meet stringent operational, environmental, and cybersecurity requirements. By embedding these considerations into procurement policy and system design, the DoD can ensure that its command-and-control infrastructure is not only interoperable and scalable, but also resilient against the threats of tomorrow.