The Shift to Open Systems Architectures (MOSA) and Its Impact on Cabling & Connectors

Executive Summary

The U.S. Department of Defense's adoption of the Modular Open Systems Approach (MOSA) is reshaping the design, integration, and procurement of military systems. This whitepaper explores how MOSA—through its emphasis on modularity, plug-and-play interfaces, and open standards such as CMOSS, SOSA, and FACE—is transforming interconnect design requirements. Specifically, it examines the implications for cabling and connector systems, highlighting new expectations for standardization, interoperability, lifecycle flexibility, and procurement agility.

Introduction

The defense industry is undergoing a paradigm shift from proprietary, vertically integrated systems to modular, interoperable architectures. This transformation is driven by the statutory requirement for MOSA in major defense acquisition programs. MOSA mandates the use of open standards, well-defined interfaces, and modular components to enable rapid technology refresh, multi-vendor competition, and reduced lifecycle costs.

While much attention has focused on software and computing elements, the physical layer, particularly cabling and connectors—plays a foundational role in realizing MOSA's goals. As systems become more modular and interface-driven, the design and specification of interconnect hardware must evolve to support plug-and-play functionality, standardization, and long-term adaptability.

MOSA Principles and Their Physical Layer Implications

MOSA is built on five key tenets, each of which has direct consequences for cabling and connector design:

- **Modular Design**: Encourages the decomposition of systems into discrete, swappable modules, necessitating standardized interconnects that support rapid integration and reconfiguration.
- **Defined Interfaces**: Requires precise documentation of physical and logical interfaces, including connector types, pinouts, and signal integrity parameters.
- **Open Standards**: Promotes the use of consensus-based standards such as CMOSS (C5ISR/EW Modular Open Suite of Standards), SOSA (Sensor Open Systems Architecture), and FACE (Future Airborne Capability Environment), which define mechanical, electrical, and protocol-level interface requirements.

- **Vendor-Neutral Interoperability**: Demands that cables and connectors support multi-vendor compatibility without proprietary constraints.
- **Lifecycle Agility**: Supports incremental upgrades and technology insertion without full system redesign, placing new demands on connector durability, backward compatibility, and interface abstraction.

Open Standards Driving Interconnect Evolution

CMOSS, SOSA, and FACE

These open standards are central to MOSA implementation and are redefining interconnect expectations:

- **CMOSS**: Defines a modular chassis and backplane architecture for C5ISR/EW systems, standardizing VPX-based interconnects and high-speed signal routing.
- **SOSA**: Builds on CMOSS to unify mechanical, electrical, and software interfaces across sensor and processing modules, specifying connector types and pin assignments.
- **FACE**: Focuses on software portability but indirectly influences physical interfaces by requiring hardware abstraction layers that depend on standardized I/O.

Together, these standards mandate that interconnects support high-speed digital signaling, RF and optical transmission, and modular backplane integration within a plug-and-play framework.

- Impact on Cabling Systems
- Standardization and Modularity

Cabling is shifting from custom, platform-specific harnesses to modular, reusable assemblies:

- **Standard Cable Types**: Ethernet, MIL-STD-1553, USB, and fiber optic formats are increasingly favored for their interoperability and bandwidth.
- **Modular Harnessing**: Pre-terminated, labeled, and testable harnesses simplify installation, reduce errors, and support field-level upgrades.
- **Digital Engineering Integration**: Cable routing, bend radius compliance, and connector mating cycles are now modeled in digital twins and interface control documents (ICDs).

Plug-and-Play Expectations

Cabling must support hot-swappable modules, zero-configuration interfaces, and rapid fault isolation. This requires:

- EMI shielding and signal integrity for high-speed data
- Color-coded or keyed connectors to prevent misconnection
- Standardized labeling and documentation for traceability

Impact on Connector Design

Open Interface Compliance

Connectors must conform to open interface specifications, including:

- **Mechanical**: Form factor, shell size, and mounting defined by standards like MIL-DTL-38999, ARINC 600, and VITA 67.
- **Electrical**: Voltage, current, impedance, and signal type compatibility across vendors.
- **Environmental**: Sealing, vibration, and temperature performance per MIL-STD-810 and RTCA DO-160.

Lifecycle and Upgradeability

Connectors must support:

- **Backward Compatibility**: New modules must mate with legacy connectors without performance degradation.
- **Futureproofing**: Support for higher data rates, hybrid RF/optical interfaces, and increased pin density.
- **COTS Integration**: Use of commercial connectors that meet military performance specs reduces cost and lead time.

Procurement and Supply Chain Considerations

Multi-Vendor Sourcing

MOSA enables competitive sourcing of cables and connectors, reducing reliance on proprietary suppliers. Procurement teams must:

- Evaluate suppliers based on conformance to open standards
- Require interface documentation and test reports
- Maintain approved vendor lists (AVLs) aligned with CMOSS/SOSA/FACE

Configuration Management

As systems evolve, connector and cable configurations must be tightly controlled:

- Use of ICDs and interface databases
- Version control of connector pinouts and cable assemblies
- Integration of configuration data into PLM and ERP systems

Conclusion

The shift to MOSA is not merely a software or systems engineering initiative, it is a physical design revolution. Cabling and connector systems are now strategic enablers of modularity, interoperability, and lifecycle agility. By embracing open standards like CMOSS, SOSA, and FACE, and designing for plug-and-play integration, engineering and procurement teams can unlock the full potential of MOSA-compliant architectures.

To succeed in this new paradigm, stakeholders must treat interconnects not as afterthoughts, but as critical infrastructure—standardized, documented, and future-ready.

Appendix A: Procurement Checklist for MOSA-Aligned Cabling & Connectors

This checklist supports acquisition professionals, engineers, and program managers in evaluating and sourcing interconnect components that align with MOSA principles and open standards such as CMOSS, SOSA, and FACE.

General Compliance

- [ ] Does the component conform to an open, consensus-based standard?
- [ ] Is the interface specification (mechanical, electrical, environmental) fully documented and sharable?
- [ ] Is the component interoperable across multiple vendors without proprietary constraints?

- [ ] Has the supplier provided Interface Control Documents (ICDs) or Interface Description Documents (IDDs)?
- [ ] Is the component listed on an approved vendor list (AVL) aligned with MOSA-compliant programs?

Connector Evaluation

- [ ] Does the connector support modularity and plug-and-play integration?
- [ ] Is the connector rated for the required signal types (e.g., RF, fiber, high-speed digital)?
- [ ] Are mating cycles, sealing, and vibration resistance compliant with MIL-STD-810 or DO-160?
- [ ] Is the connector backward-compatible with legacy systems or future-proofed for upgrades?
- [ ] Are pinouts, keying, and shell sizes standardized per program ICDs?

Cable Assembly Evaluation

- [ ] Are cable types selected based on open interface requirements?
- [ ] Are harnesses modular, labeled, and testable for field-level integration?
- [ ] Has the supplier provided test data (continuity, shielding, impedance, attenuation)?
- [ ] Are cable routing and bend radius constraints modeled in digital engineering tools?
- [ ] Is the cable assembly traceable via part number, revision, and configuration ID?

Supplier & Lifecycle Considerations

- [ ] Is the supplier capable of supporting multi-year sustainment and configuration control?
- [ ] Are lead times, minimum order quantities (MOQs), and obsolescence risks documented?
- [ ] Does the supplier offer COTS variants that meet military performance specs?
- [ ] Are there provisions for technical refresh or connector upgrades without full system redesign?
- [ ] Has the supplier agreed to provide data rights or interface information as required?