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Modular Open Systems Approaches (MOSA) Panel: Discussion of MOSA Frameworks

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Abstract

- **PANEL:** The Department of Defense (DoD) has employed modular open systems approaches (MOSA) for at least 20 years; however, recent legislation has mandated the use of MOSA to enhance the ability to evolve major weapons systems. Since the emergence of MOSA to save costs by incorporating commercial technologies into weapon system design, the DoD has found additional opportunities to employ MOSA to benefit acquisition programs. Accordingly, the Department of is transitioning from monolithic architectures and closed systems that are inflexible and cost-prohibitive to modular systems with open interface standards that facilitate a more rapid turnover of technologies and capabilities.
- In response to legislation, the MOSA community must develop guidance for programs to the ease the integration of new technologies, mitigate component obsolescence, improve sustainment of mission capability, and allow the adoption, integration and refresh of defense capabilities through use of consensus-based standards, appropriate business practices, and articulation of necessary data rights. The DoD also needs to develop architecture framework elements to further guide engineering staff and decision makers in common ways that recognize and use necessary elements of the modular and open systems approaches and will address the technical performance and sustainment of acquisition systems.
- This panel will discuss the suggested elements needed to consistently implement MOSA. Suggested panel members include representatives from programs who have implemented both frameworks and architectures to support the development of their system, as well as those who develop policy and guidance associated with the use of MOSA. Those programs include: Modular Active Protection Systems (MAPS), Future Vertical Lift (FVL), and Submarine Warfare Federated Tactical Systems (SWFTS).

Modular Open Systems Approach and the National Defense Strategy

Remarks by Secretary of Defense
James N. Mattis
on the National Defense Strategy
January 19, 2018

"It is incumbent upon us to field a more lethal force if our Nation is to retain the ability to defend ourselves and what we stand for."

"We will modernize key capabilities, recognizing we cannot expect success fighting tomorrow's conflicts with yesterday's weapons or equipment. Investments in space and cyberspace, nuclear deterrent forces, missile defense, advanced autonomous systems, and resilient and agile logistics will provide our high-quality troops what they need to win."

"To keep pace with our times, the department will transition to a culture of performance and affordability that operates at the speed of relevance. Success does not go to the country that develops a new technology first, but rather, to the one that better integrates it and more swiftly adapts its way of fighting. Our current bureaucratic processes are insufficiently responsive to the department's needs for new equipment. We will prioritize speed of delivery, continuous adaptation, and frequent modular upgrades."

Acquisition Agility Act
(FY17 NDAA Sec 805-809)

- **Sec 805 of FY17 National Defense Authorization Act (NDAA), 2446a**
  - **MOSA DEFINITION.** The term 'modular open system approach' means, with respect to a major defense acquisition program, an integrated business and technical strategy that—
    - (A) Employs a modular design that uses major system interfaces between a major system platform and a major system component, between major system components, or between major system platforms;
    - (B) Is subjected to verification to ensure major system interfaces comply with, if available and suitable, widely supported and consensus-based standards;
    - (C) Uses a *system architecture that allows severable major system components at the appropriate level to be incrementally added, removed, or replaced throughout the life cycle of a major system platform to afford opportunities for enhanced competition and innovation while yielding*—
      - (i) Significant cost savings or avoidance; (ii) schedule reduction; (iii) opportunities for technical upgrades; (iv) increased interoperability, including system of systems interoperability and mission integration; or (v) other benefits during the sustainment phase of a major system; and
    - (D) complies with the technical data rights set forth in Title 10, Sec 2320 .

Modular Open Systems Approach Considerations
(FY17 NDAA Sec 805-809)

- **(Sec 805) MODULAR OPEN SYSTEM APPROACH IN DEVELOPMENT OF MAJOR WEAPON SYSTEMS**
  - MOSA REQUIREMENT (Sec 805 2446a.) — A MDAP that receives MS A or MS B approval after January 1, 2019
    - shall be designed and developed, to the maximum extent practicable, with MOSA to enable incremental development and enhance competition, innovation, and interoperability…
  - PROGRAM CAPABILITY DOCUMENT (Sec 805 2446b.) — A program capability document for a MDAP shall identify and characterize:
    - (1) the extent to which requirements for system performance are likely to evolve during the life cycle
    - (2) requirements that are expected to evolve, the min acceptable capability for IOC of the MDAP…
  - ACQUISITION STRATEGY (Sec 805 2446b.) — In the case of an MDAP that uses a modular open system approach, the acquisition strategy required under section 2431a of this title shall:
    - (1) clearly describe MOSA to be used for the program
    - (2) differentiate between the major system platform and major system components being developed under the program
    - (3) clearly describe the evolution of major system components that are anticipated to be added, removed, or replaced in subsequent increments
    - (4) identify additional major system components that may be added later in the life cycle of the major system platform….
  - AVAILABILITY OF MAJOR SYSTEM INTERFACES AND SUPPORT FOR MOSA (Sec 805 2446c.) — The Secretary of each MILDEP shall:
    - (1) coordinate with other government and non-government entities, national standards-setting organizations, and, when appropriate, with elements of the intelligence community…

Modular Open Systems Approach Considerations
(FY17 NDAA Sec 805-809)

- **(Sec 806) DEVELOPMENT, PROTOTYPING, AND DEPLOYMENT OF WEAPON SYSTEM COMPONENTS OR TECHNOLOGY**
  - DISPLAY OF BUDGET INFORMATION (Sec 806 2447a.) — The Secretary of Defense (Sec Def) shall set forth the amounts requested for acquisition programs of record and development, prototyping, and experimentation weapon system component (WSCs) or technology prototype projects
  - OVERSIGHT (Sec 806 2447b.) — The Secretary of each Military Department (MILDEP) shall establish an Oversight Board to manage prototype projects for WSCs, and other technologies and subsystems, including the use of funds
  - REQUIREMENTS AND LIMITATIONS FOR WSCs (Sec 806 2447c.) — Defines the duration, Service Acquisition Executive (SAE) selection process, type of transactions, funding limits, and other authorities for WSCs or technology prototype projects
  - DEVELOPMENT SPEED OF WSCs & TECHNOLOGY PROTOTYPES (Sec 806 2447d.) — Defines SAE selection of prototype projects for production and rapid fielding; defines Secretary of MILDEP special transfer authority of appropriations to rapid fielding projects for [Low-Rate Initial Production]
  - DEFINITION OF WEAPON SYSTEM COMPONENT (Sec 806 2447e.) — Equates 'weapon system component' to the term 'major system component' defined in title 10 U.S.C. 2446a; adds a new MS A approval requirement for MDA to assess technology maturity of MSCs 2366a(b)

Modular Open Systems Approach Considerations
(FY17 NDAA Sec 805-809)

- **(Sec 807) COST, SCHEDULE, AND PERFORMANCE OF MAJOR DEFENSE ACQUISITION PROGRAMS**
  - PROGRAM COST, FEILDING AND PERFORMANCE GOALS IN PLANNING MDAPs (Sec 807 2448a.) — Before funds are obligated for technology development, systems development, or production of a major defense acquisition program, the Sec Def shall ensure, by establishing the goals that the MDA for the major defense acquisition program approves a program…
  - INDEPENDENT TECHNICAL RISK ASSESSMENTS (Sec 807 2448b.) — For MDAPs, the Sec Def shall ensure an independent technical risk assessment is conducted before MS A, MS B, LRIP, FRP, and any other time as necessary; the Sec Def issue guidance and a framework for categorizing degree of technical and manufacturing risk in a MDAP

- **(Sec 808) TRANSPARENCY IN MAJOR DEFENSE ACQUISITION PROGRAMS**
  - MILESTONE A SUBMISSION TO CONGRESS (Sec 808 2366a.)
  - MILESTONE B SUBMISSION TO CONGRESS (Sec 808 2366b.)
  - MILESTONE C SUBMISSION TO CONGRESS (Sec 808 2366c.)
    - — Not later than 15 days after granting Milestone A approval for a MDAP, the MDA for the program shall provide to the congressional defense committees and congressional intelligence committees a brief summary report

Modular Open Systems Approach Considerations
(FY17 NDAA Sec 805-809)

- **(Sec 809) AMENDMENTS RELATING TO TECHNICAL DATA RIGHTS**
  - RIGHTS RELATING TO ITEM OR PROCESS DEVELOPED EXCLUSIVELY AT PRIVATE EXPENSE (Sec 2320) — Subsection (a)(2)(C)(iii) of section 2320 of title 10, United States Code, is amended by inserting after ''or process data'' the following: '', including such data pertaining to a major system component''.
  - RIGHTS RELATING TO INTERFACE OR MAJOR SYSTEM INTERFACE — Subsection (a)(2) of section 2320 of such title is further amended— (5) by inserting after subparagraph (E) the following new subparagraphs (F) and (G):
    - (F) INTERFACES DEVELOPED WITH MIXED FUNDING.— Notwithstanding subparagraph (E), the United States shall have government purpose rights in technical data pertaining to an interface between an item or process and other items or processes that was developed in part with Federal funds and in part at private expense, except in any case in which the Secretary of Defense determines, on the basis of criteria established in the regulations, that negotiation of different rights in such technical data would be in the best interest of the United States.
    - (G) MAJOR SYSTEM INTERFACES DEVELOPED EXCLUSIVELY AT PRIVATE EXPENSE OR WITH MIXED FUNDING.— Notwithstanding subparagraphs (B) and (E), the United States shall have government purpose rights in technical data pertaining to a major system interface developed exclusively at private expense or in part with Federal funds and in part at private expense and used in a modular open system approach pursuant to section 2446a of this title, except in any case in which the Secretary of Defense determines that negotiation of different rights in such technical data would be in the best interest of the United States. Such major system interface shall be identified in the contract solicitation and the contract. For technical data pertaining to a major system interface developed exclusively at private expense for which the United States asserts government purpose rights, the Secretary of Defense shall negotiate with the contractor the appropriate and reasonable compensation for such technical data.

Modular Open Systems Approach Considerations
(FY17 NDAA Sec 805-809)

- **(Sec 809) AMENDMENTS RELATING TO TECHNICAL DATA RIGHTS**
  - GOVERNMENT-INDUSTRY ADVISORY PANEL AMENDMENTS (Sec 813) — (f) GOVERNMENT-INDUSTRY ADVISORY PANEL AMENDMENTS.—Section 813(b) of the National Defense Authorization Act for Fiscal Year 2016 (Public Law 114– 92; 129 Stat. 892) is amended — (2) in paragraph (3)— (B) by inserting after subparagraph (C) the following new subparagraph (D): ‘‘(D) Ensuring that the Department of Defense and Department of Defense contractors have the technical data rights necessary to support the modular open system approach requirement set forth in section 2446a of Title 10, United States Code, taking into consideration the distinct characteristics of major system platforms, major system interfaces, and major system components developed exclusively with Federal funds, exclusively at private expense, and with a combination of Federal funds and private expense.”

MOSA and Standardization at Major System Interfaces

- **Describing and documenting major system interfaces is necessary for implementing MOSA**
  - To include the hardware, software, logical, and functional interface characteristics
- **MOSA and standardization should be used at major system interfaces**
  - The major system interfaces should comply with or conform to widely supported consensus-based standards that are validated, published, and maintained by recognized standards organizations to the maximum extent practicable
  - These major system interfaces are shared boundaries
    - between a major system platform and a major system component,
    - between major system components, or
    - between major system platforms,
      - defined by various physical, logical, and functional characteristics, such as electrical, mechanical, fluidic, optical, radio frequency, data, networking, or software elements; and
      - is characterized clearly in terms of form, function, and the content that flows across the interface in order to enable technological innovation, incremental improvements, integration, and interoperability

Why the need for MOSA Frameworks?

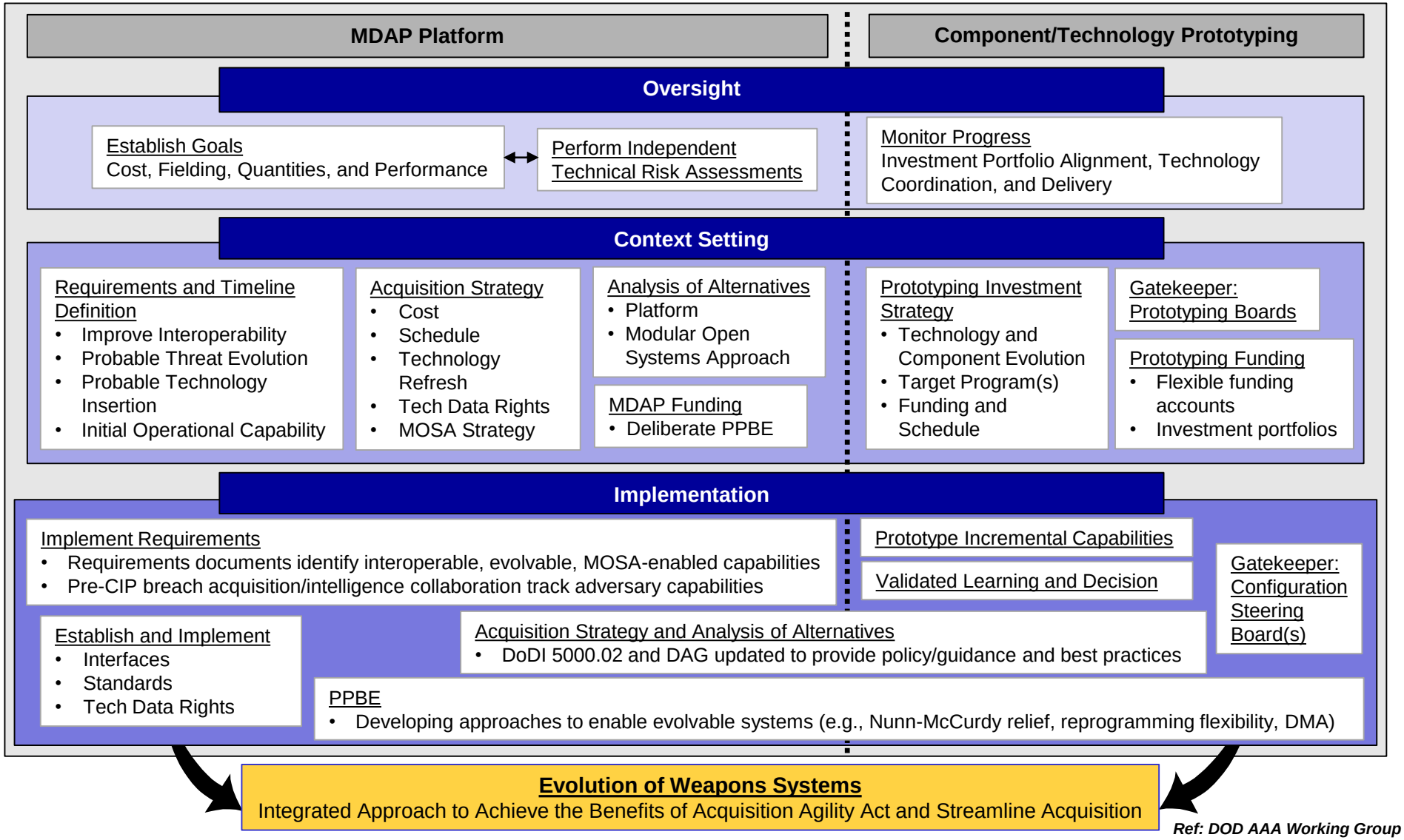
- **Every program, every system, every process has an architecture – the question is, "how is it documented?"**
  - To successfully implement MOSA, architectures should consider external interface definition, support growing scale and functionality and accommodate technology insertion opportunities
  - In addition, the architecture and design documents should capture the diverse or dissimilar mix of other systems (hardware, software, and human) with which the system needs to exchange information
- **Implementing MOSA requires the right documentation and getting the right data**
  - MOSA supports the creation of a modular, layered architectures, but documenting these reference and solution architectures is imperative
  - MOSA should be used at major system interfaces, but describing and documenting the physical, logical, and functional characteristics is necessary for implementing MOSA

MOSA frameworks can be used to capture architectural patterns used to implement MOSA across domains

MOSA FRAMEWORKS TIGER TEAM

PROBLEM STATEMENT	The Department is unable to swiftly adapt, develop, and integrate systems to maintain technological advantage.
TIMELINE & BATTLE RHYTHM	Bi-Weekly Meetings from 4 Apr to 31 Oct 2018
SCOPE	Department of Defense ACAT programs and prototyping
GOALS & OBJECTIVES	**GOALS** - Assist programs in reducing cost and time of new and existing capabilities throughout the acquisition lifecycle - Define a MOSA Framework to facilitate the use of system architectures that allows for incremental addition and replacement of capabilities - Educate, influence, and inform acquisition activities in program planning when modernizing capabilities. **OBJECTIVES** - Identify proper application of MOSA tenets and principles during the acquisition lifecycle - Define a DoD Strategy for ensuring frameworks are properly applied and used in a coordinated manner - ID and define the core elements of a MOSA Framework to facilitate program implementation
TASKS & DELIVERABLES	**TASKS** - ID DoD Modular Open Systems Approach Frameworks currently in use throughout the DoD - Develop guidance for usage of identified MOSA frameworks to address hardware, software, data and functional areas of concern. **DELIVERABLES** - DoD MOSA Framework guidance document - MOSA Reference Framework guidance and best practices - Proposed updates to other guidance documents
EXPECTED IMPACT	Improved integration of new and existing capabilities in ACAT programs as evidenced by successful program milestone reviews Effective use modular architectures and frameworks in acquisition program planning and decision making Streamlined modular approaches for cost effective modernization and refresh of technologies Enable the rapid delivery of new capabilities using MOSA in the development of weapon systems

AAA Implementation Framework
Evolution of Weapon Systems



Evolution of Weapons Systems
Integrated Approach to Achieve the Benefits of Acquisition Agility Act and Streamline Acquisition

Ref: DOD AAA Working Group

MOSA Frameworks
Element Considerations

Technical CONSIDERATIONS

- **Technical Reference Framework**
  - ❑ Reference architecture and technology configuration to include system layout and structure
  - ❑ Depicts the modular components that define common architectures for families of related warfighting systems
  - ❑ Data and application architecture
- **Technical Standard**
  - ❑ Standardization and specs that can be used individually or combined within an architecture
- **Physical Architecture Model**
  - ❑ Describes system elements, physical and logical interfaces
    - HW elements (electrical, mechanical, etc.) and cabling
    - System and SW logical interfaces
    - Space, Weight and Power (SWAP)
- **Data Management**
  - ❑ Data Interfaces, Asset Management
  - ❑ Data Rights/Intellectual Property

Business CONSIDERATIONS

- **Contracting Guidance**
  - ❑ RFP language and contract considerations for data rights
  - ❑ Acquisition & Open Systems Management Considerations
  - ❑ Evaluation criteria
- **Business & Stakeholder Guidance**
  - ❑ Business Context
    - ❑ Reuse strategies and commonality approaches
      - ❑ Acquisition Strategies and Management of core assets
    - ❑ Relevant Policies and Regulations
    - ❑ Architecture Governance
  - ❑ Stakeholder Considerations
    - People, processes, and organizational use
- **Compliance Guidance**
  - ❑ Criteria, process, and tools

Modular Open Systems Approach Considerations
(FY17 NDAA Sec 805-809)

- **(Sec 855) MISSION INTEGRATION MANAGEMENT**
  - RESPONSIBILITIES OF MISSION INTEGRATION MANAGEMENT (MIM) — The mission integration management activities for a mission area section shall include:
    - Development of technical infrastructure for engineering, analysis, and test, including data, modeling, analytic tools, and simulations
    - The conduct of tests, demonstrations, exercises, and focused experiments for compelling challenges and opportunities
    - Overseeing the implementation of section 2446c of Title 10, United States Code
    - Sponsoring and overseeing research on and development of (including tests and demonstrations) automated tools for composing systems of systems on demand
    - Developing mission-based inputs for the requirements process, assessment of concepts, prototypes, design options, budgeting and resource allocation, and program and portfolio management
    - Coordinating with commanders of the combatant commands on the development of concepts of operation and operational plans

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