Improving Transition: Modular Open Systems Approach (MOSA) & Engineering Enablers

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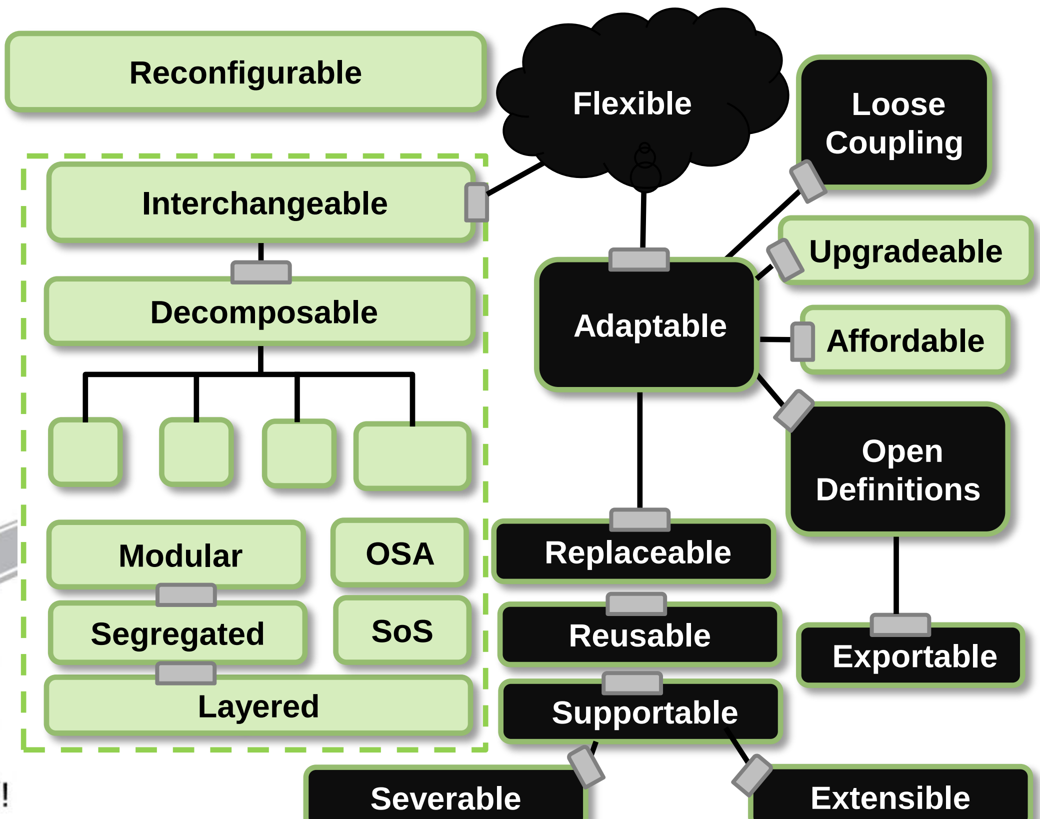
‘Strategic’ Challenges

- **MOSA is not an all or nothing proposition**
  - Must tailor approach to expected MOSA outcomes
  - Permeates all aspects of systems engineering
  - Requires design trades based on near-term and long-term cost benefit
- **MOSA is more than just defining architectures and selecting standards**
  - Technical community
  - Business relationships

- **Governance and leadership matter**
  - Top cover for individual programs to succeed
  - Leadership and engineering where necessary across multiple programs
- **Industry must be an able and willing partner**
  - Design decisions, documentation, specifications, interfaces, tools, etc.

Modular Open Systems Complexity

- **Today's systems are complex in: size, interactions between components and subcomponents, and external interactions**
- **The appropriate use of modular design techniques and open systems standards can achieve the 5 MOSA benefits**
  - Interoperability
  - Technology Refresh
  - Competition
  - Innovation
  - Cost Savings/Cost Avoidance



Modular Open Systems Approaches

Why → **How** → **What**

5 Benefits

- *Interoperability*
- *Tech Refresh*
- *Competition*
- *Innovation*
- *Cost Savings / Cost Avoidance*

Approaches

- **Modular Design**
- **Defined Interfaces**
- **Standards Process**
- **Accessible Data**
- **Open Interfaces**
- **IP Rights**

Modular Technical Design Approaches

- Design severable modules
- Define interfaces between modules
- Publish consensus-based standards
- Establish compliance testing activities
- Define, standardize & describe data models

Open System Business Approaches

- Recognize the relevant technical community
- Establish necessary business practices
- Use standards & specs for interfaces
- Acquire necessary data & IP rights

Supporting the goals for MOSA implementation are methods, processes and tools which underpin the approach

Improve Interoperability

- **Begin with the MOSA End Goal in Mind**
  - Enable systems (and software applications) to access and provide data + services using (open) interface definitions between components
- **Program Objectives**
  - Operational flexibility to support reconfigurable product configurations of existing capabilities to counter threats or enable different missions
  - Share and exchange data consistently between components (and system stakeholders) using defined data models

Flexible

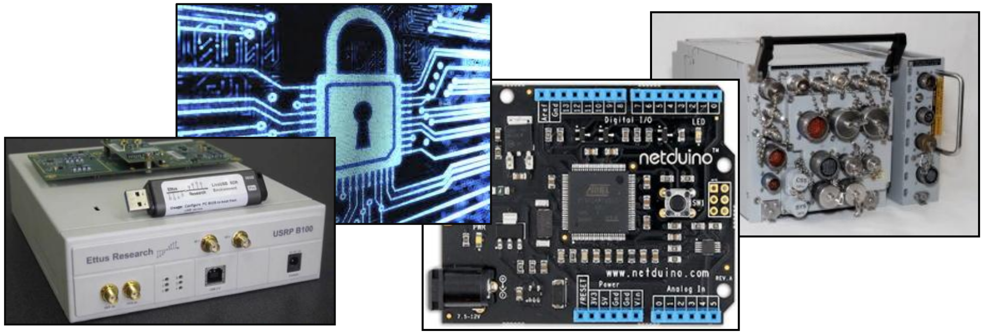
Interchangeable

Reconfigurable

Supportable

Open Definitions

Loose Coupling



Enable Tech Refresh

- **Begin with the MOSA End Goal in Mind**
  - Enable periodic upgrades of technology to assure system supportability
- **Program Objectives**
  - Enable technical flexibility for rapid and effective system upgrades
  - Upgrade technology without changing all components in the entire system

Flexible

Upgradeable

Severable

Replaceable

Adaptable

Loose Coupling

Increase Competition

- **Begin with the MOSA End Goal in Mind**
  - Prevent vendor lock and increase options for replacement/refresh
- **Program Objectives**
  - Platform and vendor independence when hardware (and software) implement open industry standards
  - Ability to openly compete severable modules
  - Compete portable components with open (specifications or standards for interfaces, services, and supporting formats) across a wide range of systems from one or more suppliers

Flexible

Reconfigurable

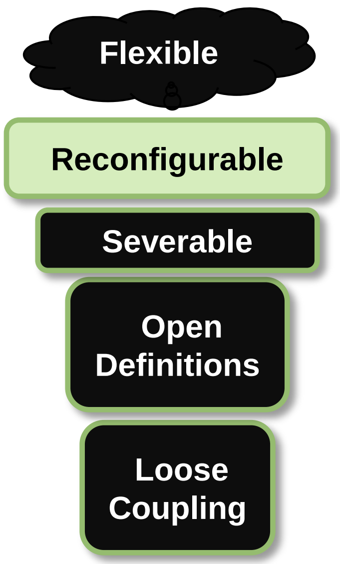
Severable

Open Definitions

Loose Coupling

Incorporate Innovation

- **Begin with the MOSA End Goal in Mind**
  - Insert capabilities that provide technological innovation to the warfighter
  - Use business practices that encourage the relevant technical community to develop and insert new technologies



- **Program Objectives**
  - Take advantage of new advancements in technology
  - Enable technical agility to meet rapidly changing requirements

Improve Cost Savings/Avoidance

- **Begin with the MOSA End Goal in Mind**
  - Enable reduction in cost & time to decrease total cost of ownership
- **Program Objectives**
  - Achieve less expensive technical modifications
  - Additional capabilities and modifications desired without redesigning non-critical hardware or software
  - Ability to reuse previous investments: technology, modules or components across the acquisition lifecycle

What Next?

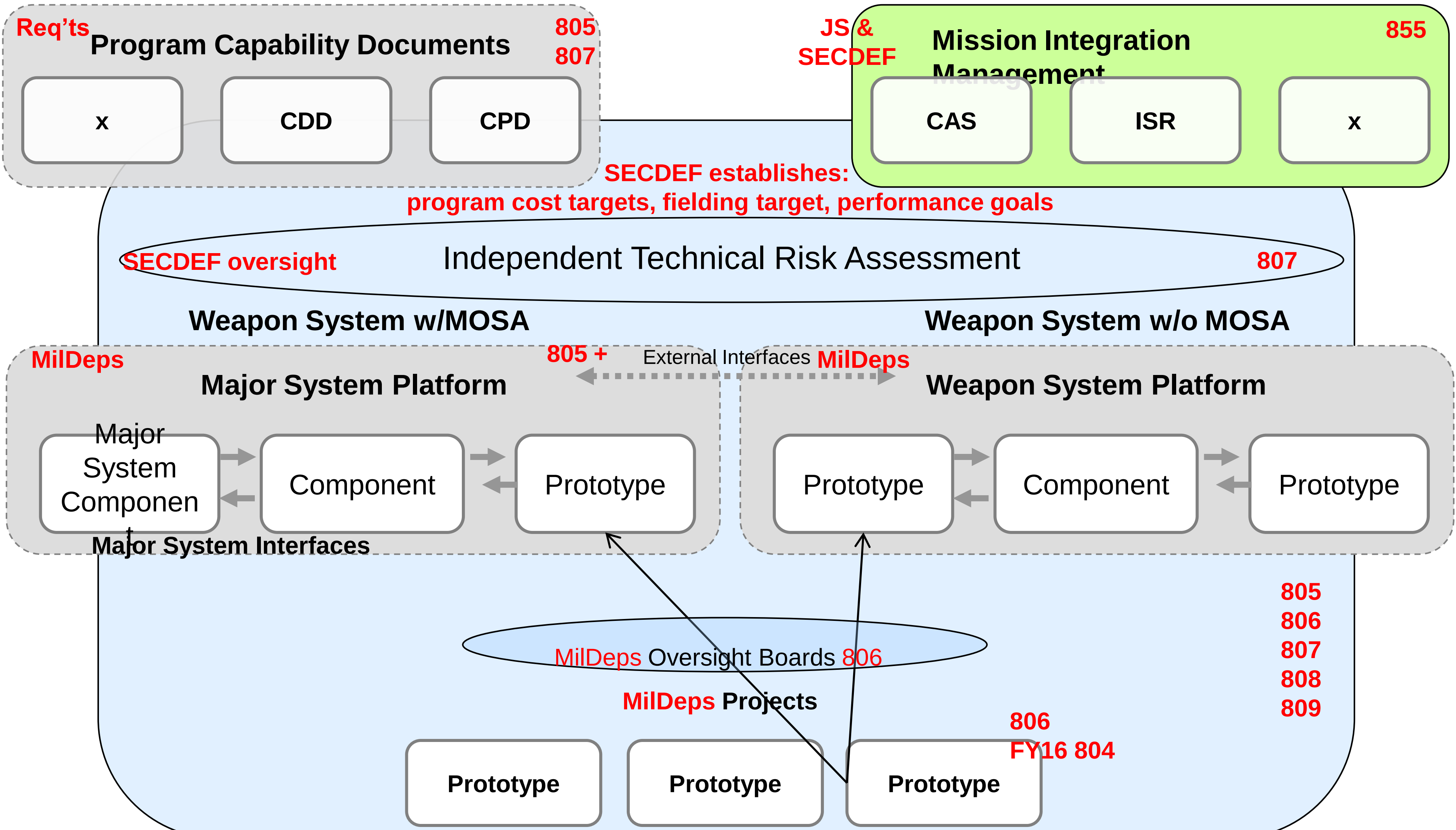
- Define modularity and openness (technical and programmatic) in the context of an ecosystem
- Address MOSA for component obsolescence and cases where there is a loss of critical suppliers
- Address how to plan for technology insertion and upgrades in tightly coupled, highly integrated systems
- Quantify the costs, benefits, and risks of MOSA across multiple dimensions (e.g. using tradespace exploration)
- Map beneficial elements of MOSA strategies to appropriate acquisition processes that encourage adoption
- Implement FY17 National Defense Authorization Act Sections 805-809

Acquisition Agility

2017 NDAA Sections 805-809

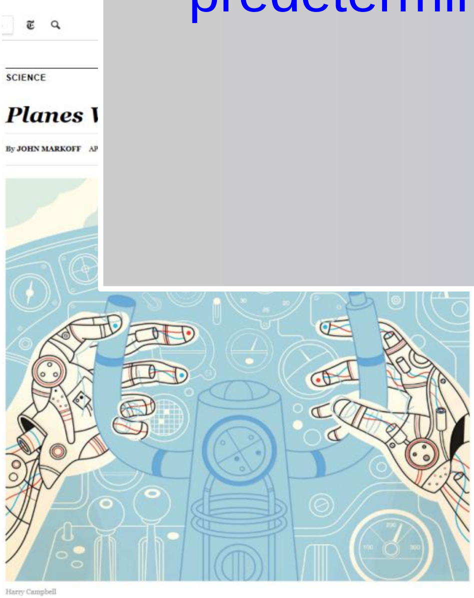
- **Improve our ability to evolve weapon systems**
  - Requirement documents designate where Major Defense Acquisition Programs (MDAPs) should evolve to meet changing threats, enhance interoperability, and rapidly employ new tech
  - (MDAPs) use MOSA, where practical, to enable that evolution, including cost savings, competition, and technology refresh
  - Military Services establish prototyping investments targeted to mature technologies suited to meet program evolution needs
  - Independent risk assessments confirm that technical and manufacturing risks are low
  - Improve technical data rights, for government purposes, suitable for MOSA
  - Reaffirms SECDEF role in establishing cost, schedule, and performance goals for MDAPS
  - Establishes new milestone reports to be provided by Milestone Decision Authorities to Congress for greater transparency

NDAA FY17 view of Acquisition Agility

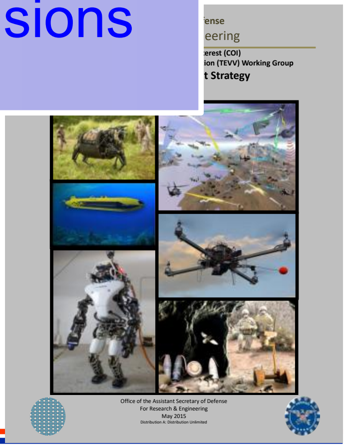


Moving From Automation to Autonomy

Automation	Autonomy
limited operator involvement limited to specific actions well-defined tasks predetermined responses	intelligence-based responds in unanticipated situations not pre-programmed self-government self-directed behavior human's proxy for decisions



From AFRL Autonomy S&T Strategy
Adopted by OSD Autonomy COI
TEV&V strategy



Engineering Challenges In Transitioning Autonomy

- **Challenge**
  - Lack of experience in the engineering and acquisition communities
  - Inconsistent terminology and expression
  - Inability to test and evaluate autonomy
  - Need for in-situ T&E
  - Lack of comprehensive HSI approaches
  - Need for rapid evolution
  - Vulnerabilities of computer-based technologies
- **Opportunity**
  - Focused experimentation; Body of Knowledge, WF competencies & training
  - Establish ontology and lexicon
  - Invest research in SE approaches for testing
  - Establish SE practices for in-situ T&E architectures
  - Engage HSI community alongside Engineering
  - Base functionality in SW & MOSA
  - Establish cyber practices for autonomous computing

Autonomy Test, Evaluation, Verification & Validation S&T Goals

1. **Methods, Metrics, and Tools Assisting in Requirements Development and Analysis:**
   - Precise, structured standards to automate requirement evaluation for testability, traceability, and consistency
2. **Evidence-Based Design and Implementation**
   - Assurance of appropriate decisions with traceable evidence at every level to reduce the T&E burden
3. **Cumulative Evidence through Research, Development, and Operational Testing:**
   - Progressive sequential modeling, simulation, test, and evaluation to record, aggregate, leverage, and reuse M&S/T&E results throughout engineering lifecycle
4. **Run-time Behavior Prediction and Recovery:**
   - Real time monitoring, just-in-time prediction, and mitigation of undesired decisions and behaviors
5. **Assurance Arguments for Autonomous Systems:**
   - Reusable assurance case-based on previously evidenced “building blocks”

Systems Engineering: Critical to Defense Acquisition










Defense Innovation Marketplace
http://www.defenseinnovationmarketplace.mil

DASD, Systems Engineering
http://www.acq.osd.mil/se