The Modular Open Systems Approach (MOSA) and Its Impact on Systems Engineering Revitalization

**Presented at NDIA’s**

*44th Targets, UAVs and Range Operations Symposium*

*Panama City, FL*

*31 October 2006*

Glen T. Logan
Senior Systems Engineer

Systems & Software Engineering Directorate
Enterprise Development
(703) 602-0851 X112, FAX 602-3560,
e-mail: glen.logan.ctr@osd.mil
www.acq.osd.mil/ osjtf
I should note ... that we have taken important steps that will help us to produce improved capability on time and within budget by re-energizing our approach to systems engineering. This critical discipline has always contributed significantly to effective program management at every level and will receive sustained emphasis during my tenure.

Testimony of The Honorable Kenneth J. Krieg, USD(AT&L), before Senate Committee on Armed Services, September 27, 2005
Systems and Software Engineering:
OUSD(AT&L)/SSE

Director
Mr. Mark Schaeffer

Executive Assistant
Mr. Darwin Brown

Enterprise Development
Mr. Robert Skalamara
Deputy Director

Developmental Test
And Evaluation
Mr. Chris DiPetto
Deputy Director

Assessment and Support
Mr. Dave Castellano
Deputy Director

System and Software
Assurance
Mr. Mark Schaeffer
(Acting)
Systems Engineering Revitalization

• The Need:
  – Many past acquisition problems are traceable to poor engineering planning and execution

• The Response:
  – USD(AT&L) has issued policy on systems engineering: “All programs, regardless of ACAT, shall apply an SE approach and shall develop a Systems Engineering Plan (SEP)”
  – Technical reviews to be event driven, include entrance and exit criteria, and use independent subject matter experts
  – Established Senior SE Forum to exploit and coordinate SE initiatives across components
  – With DAU, SSE is updating SE curricula for engineers and for key enabling disciplines (e.g., PMs, contracts, finance)
  – Several SE additional guides in work (e.g., SoS Engineering, Integrating Systems Engineering in Contracting for Systems Acquisition)
**Systems Engineering “V” Model**

- **Support Capability Based Assessments**
- **Define relationships with related capabilities, architectures (e.g., GIG)**
- **Identify alternatives; trade cost, sched, perf**
- **Determine system performance parameters and verification plans**
- **Identify incremental, system specifications**

---

**Operational**

**Sound technical planning to support warfighting capabilities**

---

**Enterprise**

- **SoS**
- **System**
- **Components**

---

**Demonstrate capabilities meet user needs**

- **Assess portfolio performance (CAR)**
- **Integrate SoS; assess cost, sched, perf**
- **Assess system performance against capability needs**
- **Integrate and test**

---

**SE is the technical foundation for building acquisition knowledge over time**

- **Develop, test, and assess increments of capability**
- **Fully integrated SE approach: technical maturity, cost realism, risk mitigation**

---

**Driving systems engineering back into programs**
The Department’s Vision for Open Architectures

“... we are moving from a framework that focuses in the past on known threats, to a more flexible framework based on capabilities to defend ourselves from shifting and uncertain threats ... from a focus simply on programs and platforms, to a focus on results ... from segmented information and closed information architecture, to network information and open architectures ... ... and from what is called “deliberate planning” ... to ... “adaptive planning.”

Source: DepSecDef Keynote on Transformation to The Heritage Foundation, 27 Feb 2004

“A modular, open-systems approach shall be employed, where feasible.” (DoDD 5000.1)
Acquisition Challenges:
Commercial Dominance

DoD no longer “drives” development. Instead, it must use what industry has developed for commercial applications.
Military Trends:
Losing Market Leverage

Declining Defense Spending

Defense Outlays As a Share of Gross Domestic Product

DOD Budget (as % of GDP) Near Its Lowest Level Since After WWII!

Source: Air Force Magazine, April 2006 (data from US Department of Defense)

Decreasing Market Share

2003 Total Worldwide Merchant Semiconductor Usage
Total $140.7 Billion

- Computer 53%
- Consumer 17%
- Communications 15%
- Auto 5%
- Industrial 9%
- Military <1%

Source: Semiconductor Industry Association

• DoD Has Reduced Impact in the Electronics Industry
• Obsolescence is Market Driven
  – It Won’t Go Away
  – We Can’t Change The Environment
• Results in Unaffordable Non-Recurring Engineering (NRE) costs
Commercial Technology Trends:
Reduced Cost & Cycle Time

Technology Evolution

Device Density (Transistors Per Die)

Technology Growth:
- Doubles Every 2 Yrs
- Cost/Part Decreases
- 10,000:1 in 20 Yrs

Source: Dataquest Inc.

Shorter Product Lifetimes

Time to Obsolescence (Years)

- Components
- Processors
- Board Level Products
- Software Tools
- Interfaces (H/W & S/W)
- Software Language / Applications

Military Vs Commercial

Product Life Cycle

Years

- Parts
- System
- Architecture
- Product Life

Reduced Cost & Cycle Time

- 2
- 5
- 30

- Military
- Commercial
- Trend

- 1B
- 100M
- 10M
- 1M
- 100K
- 10K
- 1K

Board Level Products

- Processors

- Components

- Software Tools

- Interfaces (H/W & S/W)

- Software Language / Applications

Pentium

Pentium Pro

Merced

Pentium III

Pentium II

Merced

Pentium IV

Pentium Pro

80286

80386

80486

8086

8085

8080

8088

4004

286

386

486
“Now, when I was secretary of defense . . . a quarter of a century ago . . . the reality was that the acquisition period was about half of what it is today . . . technology is advancing about four times as fast as it used to. Now how in the world can we expect to live in a circumstance like that?”
Interoperability Considerations

- Multiple aspects of end-to-end interoperability
  - Inner loop: Do the terminals recognize each other's signals?
  - Outer loop: Do the user’s impressions of the information coincide?

Interoperability: Ability to exchange information so as to enable cooperative actions for mission accomplishment
MOSA Defined

An integrated business and technical strategy that:
- provides an enabling environment,
- employs a modular design and, where appropriate,
- defines key interfaces,
- using widely supported, consensus-based (i.e., open) standards that are published and maintained by a recognized industry standards organization
- and uses certified conformant products.

A foundation for effective systems engineering for rapid delivery of enhanced combat capability to the Warfighter:
- Enhanced Interoperability
- Reduced Life cycle Costs
- Reduced Cycle Time
Modular, Open Interfaces Isolate Hardware and Software Components

The layered, modular design provides savings by facilitating reusable applications and permitting software changes and hardware updates with minimal retesting.
Open Standards Selection

Market Acceptance

Preferred Standards

Popular Standards

Popular

Open

Preferred Standards

Closed Standards

Closed Standards

With Little Market Support

With Little Market Support

Open Standards

Proprietary

Non-Proprietary

Widely Used

Narrowly Used

Standard Type
Consensus Standards Bodies and Consortia

Participation per Public Law 104-113, Section 12d(1-3)
Weapon System Open Architecture Demonstration: Technology Insertion for Collaborative Time Critical Target Prosecution

C2

C3I Simulation
Collaboration Server
Quality of Service Management
Virtual Target Folder

C2 JTIDS Terminal

Link 16 Interface Software
ORBexpress
VisiBroker
Pluggable Protocol
TCP sockets

F-15

Collaboration Client
Browser Application
 JTIDS Controls & Displays

F-15 JTIDS Terminal

Link 16 Interface Software

Quality Object Framework
Adaptive Resource Mgmt

Link 16
A Real-World MOSA Example

- **What**
  - Predator UAV was augmented with Hellfire missile in just over 30 days for rapid deployment in Afghanistan.

- **How**
  - Critical target tracking software was easily rehosted from LOSAT (Line of Sight Anti-Tank) computing environment to Predator’s because it was built upon the Army’s open Weapon System COE API.
  - The WSTAWG COE specifies common services for managing the 1553 bus and for handling digital video.

**Resulted in:**
- A New Capability - fielded rapidly
- Significant Cost Avoidance - 75% of typical software development costs
- Enhanced Interoperability - by re-using a proven weapon systems product

**Enabled by MOSA using:**
- Modular Design
- Key Interfaces
- Open Standards
MOSA in a “Nutshell”

**Vision**
- MOSA is an integral part of all acquisition strategies to achieve affordable, evolutionary, and joint combat capability

**Principles**
- Establish Enabling Environment
- Employ Modular Design
- Designate Key Interfaces
- Select Open Standards
- Certify Conformance

**Benefits**
- Ease of Change
- Reduced Total Ownership Cost
- Reduced Cycle-Time
- Enabling Joint Integrated Architectures and Interoperability
- Risk Mitigation

**Indicators**
- Business
- Technical
Conclusion

• The Systems and Software Engineering Directorate supports each ACAT 1D program as it goes through DAB process … but is a resource for all programs.

• Use it!
Questions?

44th Annual NDIA Targets, UAVs and Range Operations Symposium and Exhibition