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

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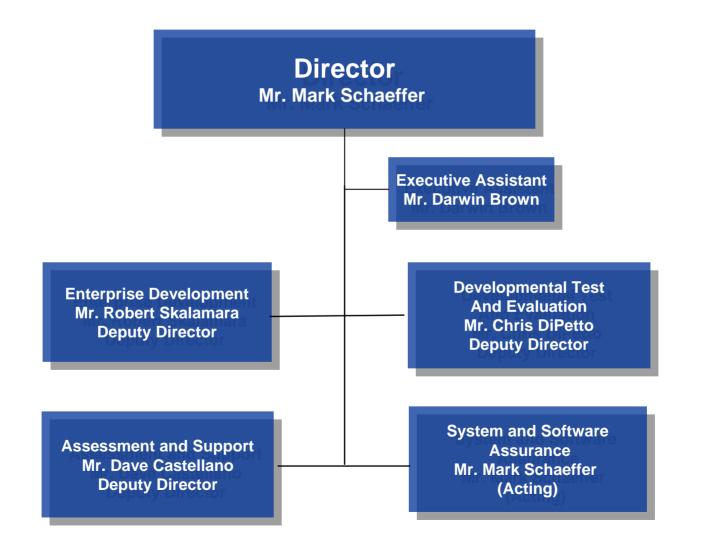**e-mail: glen.logan.ctr@osd.mil**
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USD(AT&L) Systems Engineering Imperative

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
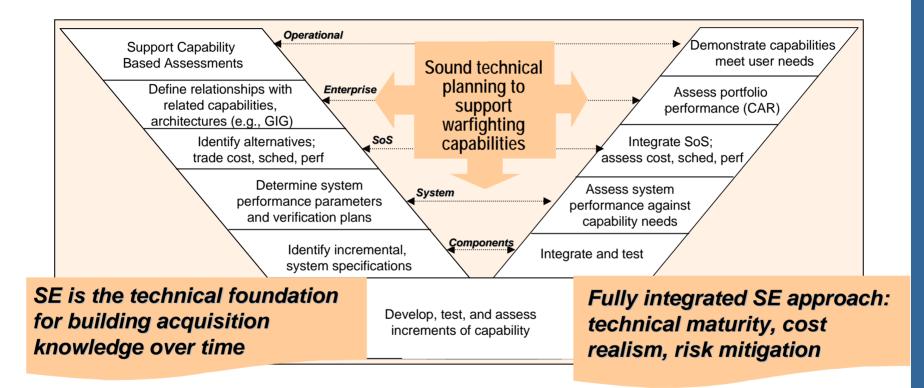
Systems and Software Engineering: *OUSD(AT&L)/SSE*

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Mr. Darwin Brown

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Deputy Director

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Assessment and Support
Mr. Dave Castellano
Deputy Director

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(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)
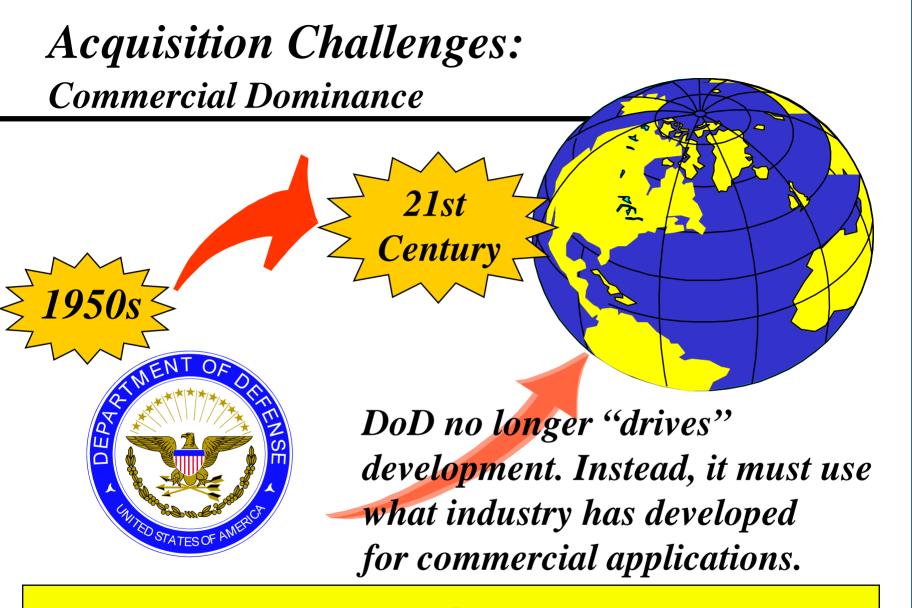
Systems Engineering "V" Model

Support Capability Based Assessments	*Operational* → Demonstrate capabilities meet user needs
Define relationships with related capabilities, architectures (e.g., GIG)	*Enterprise* → Assess portfolio performance (CAR)
Identify alternatives; trade cost, sched, perf	*SoS* → Integrate SoS; assess cost, sched, perf
Determine system performance parameters and verification plans	*System* → Assess system performance against capability needs
Identify incremental, system specifications	*Components* → Integrate and test
	Develop, test, and assess increments of capability

Sound technical planning to support warfighting capabilities

SE is the technical foundation for building acquisition knowledge over time

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 **<u>focuses in the past on known threats</u>**, 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

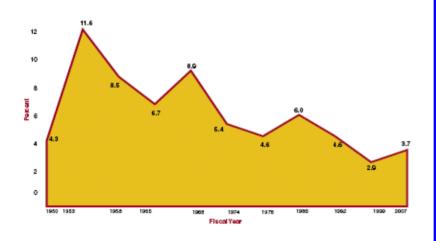"A modular, open-systems approach shall be employed, where feasible." (DoDD 5000.1)

Acquisition Challenges:
Commercial Dominance

1950s

21st Century

DoD no longer "drives" development. Instead, it must use what industry has developed for commercial applications.

DEVELOPER & PRODUCER ➡ **BUYER & INTEGRATOR**

Military Trends:
Losing Market Leverage
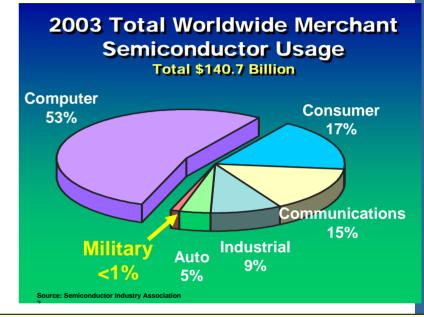
Declining Defense Spending

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)

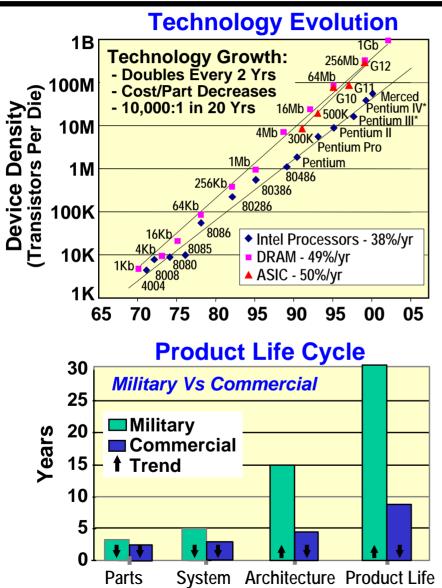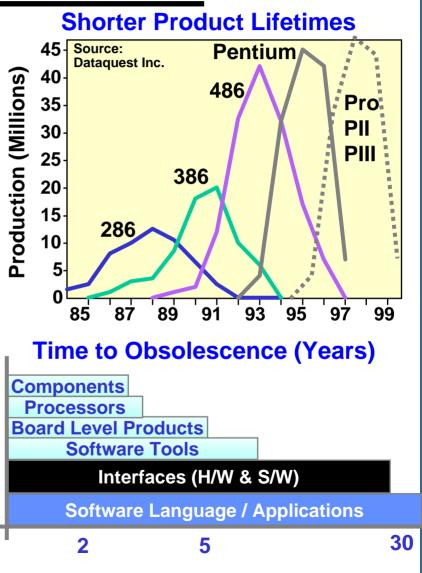### Decreasing Market Share

2003 Total Worldwide Merchant Semiconductor Usage
Total $140.7 Billion

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

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
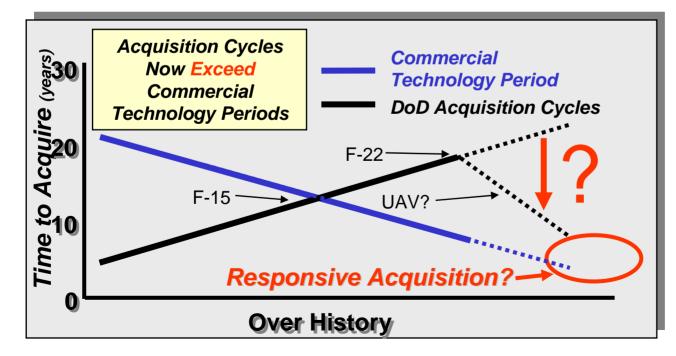- **Results in Unaffordable Non-Recurring Engineering (NRE) costs**

Commercial Technology Trends:
Reduced Cost & Cycle Time

Technology Evolution

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

Device Density (Transistors Per Die)

- 1B — 1Gb
- 100M — 256Mb, G12, 64Mb, G11, Merced, Pentium IV*, Pentium III*
- 10M — 16Mb, 500K, Pentium II, 4Mb, 300K, Pentium Pro
- 1M — 1Mb, Pentium, 80486
- 100K — 256Kb, 80386, 64Kb, 80286, 8086
- 10K — 16Kb, 8085, 4Kb, 8080, 1Kb, 8008
- 1K — 4004

Legend:
- ◆ Intel Processors - 38%/yr
- ■ DRAM - 49%/yr
- ▲ ASIC - 50%/yr

X-axis: 65 70 75 80 85 90 95 00 05

Shorter Product Lifetimes

Source: Dataquest Inc.

Production (Millions): 0 5 10 15 20 25 30 35 40 45

Curves labeled: 286, 386, 486, Pentium, Pro PII PIII

X-axis: 85 87 89 91 93 95 97 99

Product Life Cycle

Military Vs Commercial

Years: 0 5 10 15 20 25 30

Legend:
- ▢ Military
- ▢ Commercial
- ↑ Trend

X-axis: Parts, System, Architecture, Product Life

Time to Obsolescence (Years)

- Components
- Processors
- Board Level Products
- Software Tools
- Interfaces (H/W & S/W)
- Software Language / Applications
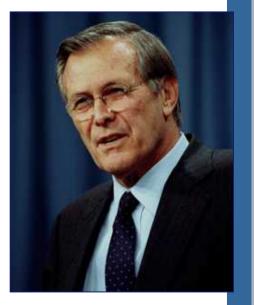
X-axis: 2, 5, 30

Acquisition Cycle Time:
Reversing the Trend

"Now, when I was secretary of defense . . . a quarter of a century ago . . . the reality was that the <u>acquisition period was about half of what it is today</u> . . . <u>technology is advancing about four times as fast as it used to</u>. Now how in the world can we expect to live in a circumstance like that?"
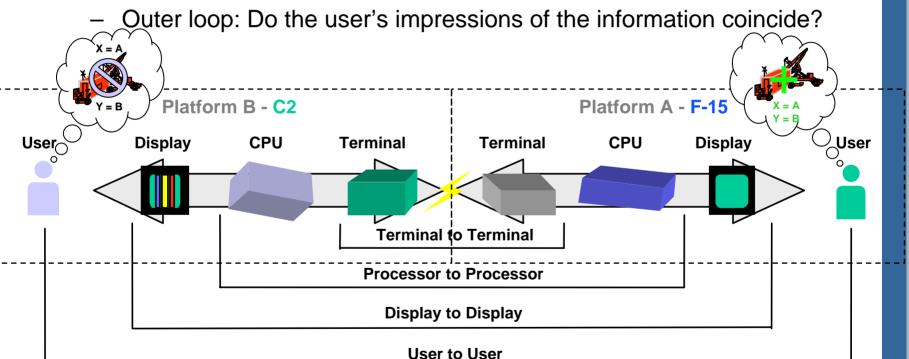
31 Jan 2002
National Defense University

Interoperability Considerations

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

X = A
Y = B

Platform B - **C2**   Platform A - **F-15**

X = A
Y = B

| User | Display | CPU | Terminal | | Terminal | CPU | Display | User |

Terminal to Terminal

Processor to Processor

Display to Display

User to User

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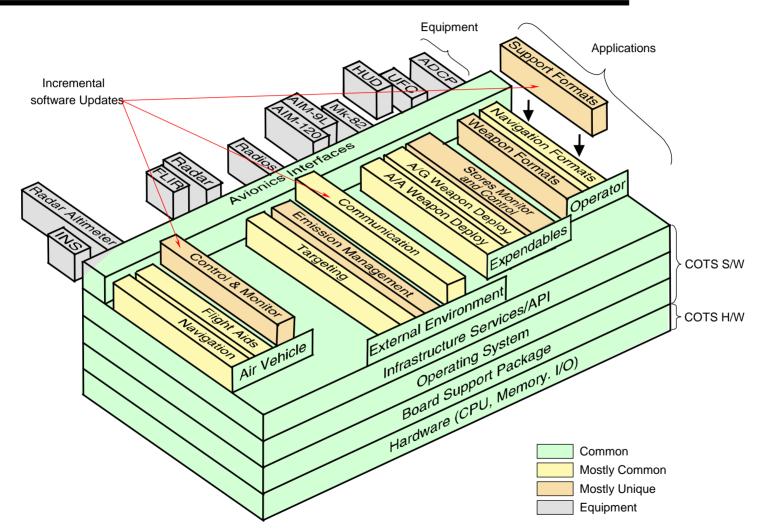
MOSA Defined

An <u>integrated</u> 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:
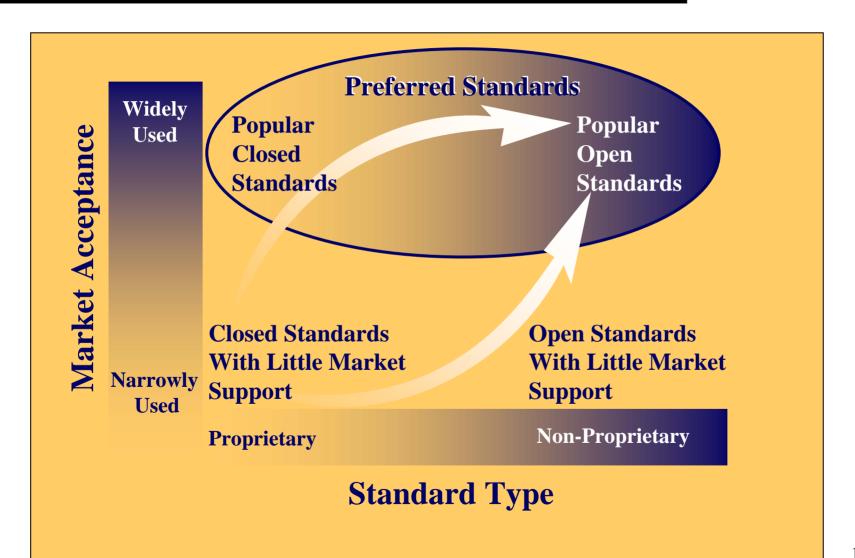- Enhanced Interoperability
- Reduced Life cycle Costs
- Reduced Cycle Time

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

Widely Used

Narrowly Used

Preferred Standards

Popular Closed Standards

Popular Open Standards

Closed Standards With Little Market Support

Open Standards With Little Market Support

Proprietary

Non-Proprietary

Standard Type
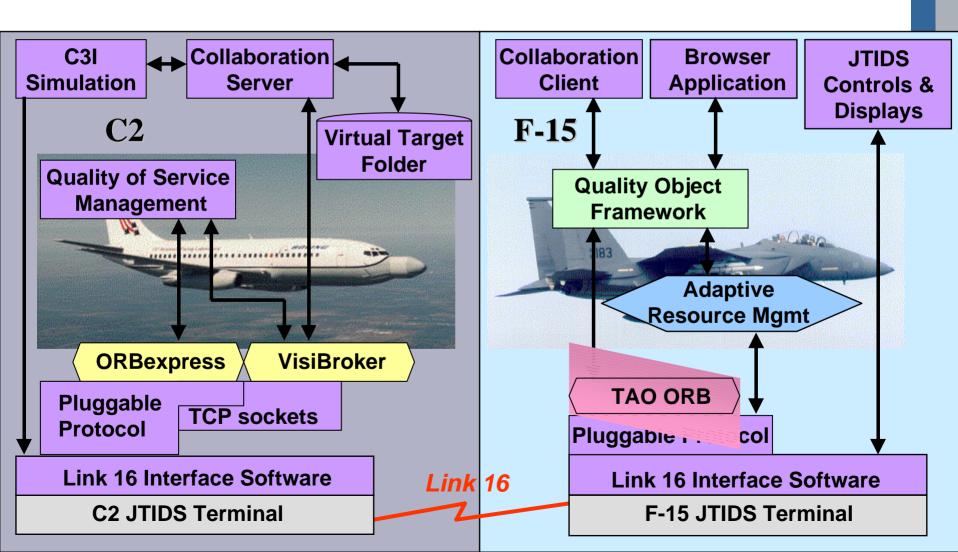
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Consensus Standards Bodies and Consortia

Weapon System Open Architecture Demonstration:
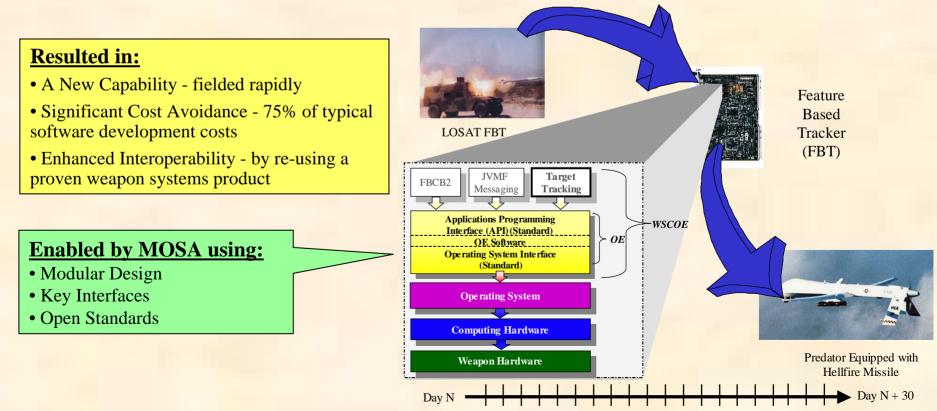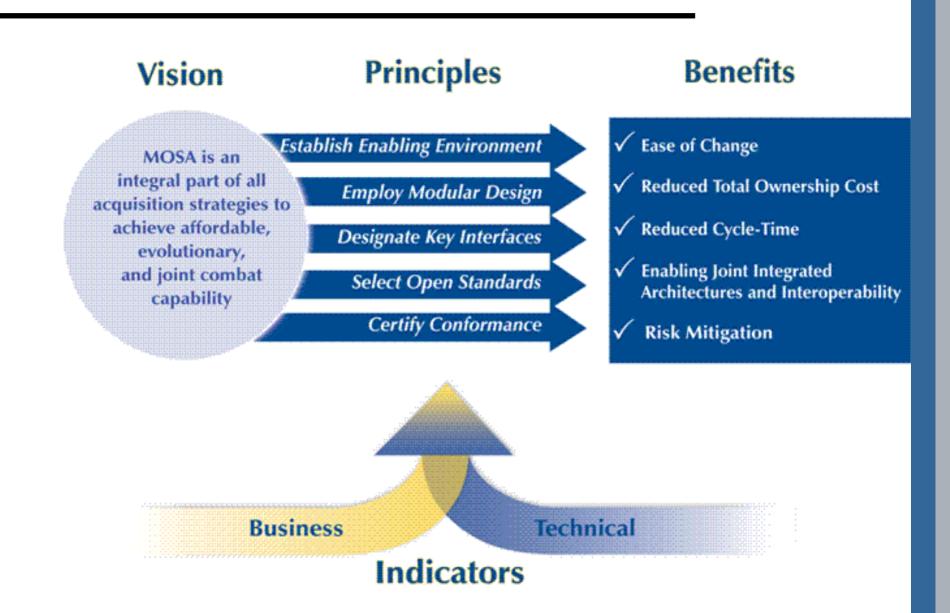## Technology Insertion for Collaborative Time Critical Target Prosecution

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

LOSAT FBT

Feature Based Tracker (FBT)

FBCB2	JVMF Messaging	Target Tracking

Applications Programming Interface (API) (Standard)
OE Software
Operating System Interface (Standard)

OE

WSCOE

Operating System

Computing Hardware

Weapon Hardware

Predator Equipped with Hellfire Missile

Day N ———————————————→ Day N + 30

MOSA in a "Nutshell"

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