



Naval Open Architecture Overview



24 October 2007

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Director
Naval Open Architecture
PEO IWS**



Today's Agenda

- Our Changing Landscape
- The Enterprise Open Architecture (OA) Initiative
- OA Implementation in the Surface Domain
 - Weapons
 - Combat Systems
- Open Discussion



The Navy must build a fleet where mission systems...



... are modular, interoperable, and affordable to upgrade



At the same time, our landscape is continuously changing

New Threats

Drones, IEDs, Small Arms Fire, Anti-Ship Missiles...

Expanding Missions

GWOT, Natural Disaster, Coalition, Humanitarian...

New Net-Enabled Technologies

High Performance Computing, IPV6, VOIP...

New Solutions Design

Service Oriented Architecture, Model Driven Architecture, Open Source, Open Standards...

New Capabilities

Naval Integrated Fire Control, Single Integrated Air Picture...

New, Modernized Platforms

CVN 21, LCS, DDG 1000...



Leadership has mandated the adoption of **Open Architecture (OA)** practices to meet our challenges

1 Aug 2004 ASN RDA mandates open architecture

THE ASSISTANT SECRETARY OF THE NAVY
 Research Development and Acquisition
 1000 Navy Pentagon
 Washington, DC 20390-3000
 AUG 0 5 2004

MEMORANDUM FOR DISTRIBUTION
 SUBJ: Naval Open Architecture Scope and Responsibilities
 ENCL: (1) Open Architecture Enterprise Team Organization

The purpose of this memorandum is to amplify and expand upon the policy, guidance and direction necessary for the successful implementation of the Navy's Open Architecture (OA) Strategy. This strategy is essential as a key enabler and pillar of DoD's focus on joint architectures and evolutionary acquisition. DODD 5000.1 dated 12 May 2003 states: "Acquisition programs shall be managed through the application of a systems engineering approach that optimizes total systems performance and minimizes total ownership costs. A modular, open systems approach shall be employed, where feasible." This mandate to utilize open systems architectures in order to rapidly field affordable, interoperable systems, is consistent with the Navy's vision of developing a coordinated, integrated business and technical approach implementing open architecture enterprise wide.

In light of this, I initiated an effort to establish open architecture principles as the basis for all war fighting systems development and maintenance during the 16 October 2003 Navy Open Architecture Executive Committee (EXCOMM). The plan was originally based on the foundation of a single Navy OA Technical Architecture, a single Navy OA Functional Architecture and conducting best of breed selection for common services. After reviewing OA progress to date and the results of the OASD (AT&L) Tri-Service Independent Assessment during the second Open Architecture EXCOMM 2 June 2004, I have concluded that modification to this plan is necessary. The approach to develop a single Navy wide Open Architecture will be modified to account for Surface, Air, Submarine, CAI, and Space domain unique requirements.

Effective immediately, PEO IWS is assigned overall responsibility and authority for directing the Navy's OA Enterprise effort. An OA Enterprise Team shall be chartered and led by PEO IWS. The Team shall be comprised of OA domain leads, ASN, OPNAV, and SYSCOM representatives, who will collectively oversee the development and implementation of the processes, business strategies, and technical solutions which support cross Enterprise requirements in addition to domain specific needs. The Enterprise Team shall define an overarching OA acquisition strategy and develop guidance that addresses incentives, intellectual property issues, contracting strategies (i.e. integrator's vs. prime's), and funding alternatives. The acquisition strategy and accompanying guidance will then be utilized in future OA applicable procurements tailored as necessary to incorporate domain specific requirements. In addition, the Enterprise Team shall prepare, staff and promulgate a Navy wide OA business strategy. The primary focus of the business strategy will be to develop an analysis of alternatives process with which to determine return on investment, and thus priorities for adopting OA standards and software reuse practices within and across domains. Upon completion, the

Naval OA Policy

2 Dec 2005 OPNAV issues OA Requirements letter

DEPARTMENT OF THE NAVY
 OFFICE OF THE CHIEF OF NAVAL OPERATIONS
 2000 NAVY PENTAGON
 WASHINGTON, DC 20390-3000

MEMORANDUM FOR
 SER: NGR7 / 50916276
 23 Dec 05

From: Deputy Chief of Naval Operations (Warfare Requirements and Programs) (N6/N7)
 Subj: REQUIREMENT FOR OPEN ARCHITECTURE (OA) IMPLEMENTATION
 Ref: (a) ASN(RDA) Memorandum on Naval Open Architecture Scope and Responsibilities dated 05 August 04
 ENCL: (1) OA Enterprise Team

1. **Purpose.** This letter establishes the requirement to implement Open Architecture (OA) principles across the Navy Enterprise. To deliver timely, affordable, interoperable warfighting capability to the fleet, made sustainable by the flexible integration of emerging capabilities, we must incorporate OA processes and business practices now.

2. **Background.** Warfare systems include hardware, software and people. Human factors, (i.e. such as training, education and doctrine) factor heavily in warfighting effectiveness. Naval OA transformation must match the rapid evolution in commercial and military technology. Not only must we shorten the kill chain across the family of systems; we must also shorten the time and cost it takes to deliver capability improvements. Our current process takes nearly a decade, costs hundreds of millions of dollars and delivers products that are commercially obsolete and have only incremental improvements in warfighting capability. That is not good enough, and must change in POM08. Acquisition processes and business practices must transition now in order to support POM 08 and implement agile changes that support rapidly evolving requirements.

OA Principles include:

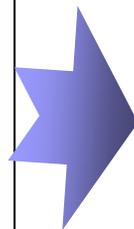
a. Modular design and design disclosure to permit evolutionary design, technology insertion, competitive innovation, and alternative competitive approaches from multiple qualified sources.

Naval OA Requirements

Naval Open Architecture (OA) is the confluence of business and technical practices yielding modular, interoperable systems that adhere to open standards with published interfaces.

OA CORE PRINCIPLES

- Modular design and design disclosure
- Reusable application software
- Interoperable joint warfighting applications and secure information exchange
- Life cycle affordability
- Encouraging competition and collaboration





This requires business, technical, and cultural changes

OA GOALS

1. Change the Naval processes and **business** practices to "utilize open systems architectures in order to rapidly field affordable, interoperable systems."

Provide OA **Technical Systems Engineering** leadership to field common, interoperable capabilities more rapidly at reduced costs

3. Change the Naval and Marine Corps **Cultures** to Institutionalize OA Principles

OA PRACTICES

Disclose design artifacts
Negotiate appropriate data rights
Foster enterprise collaboration
Institute Peer Reviews of solutions
Develop new open business models
Change contracts / increase competition

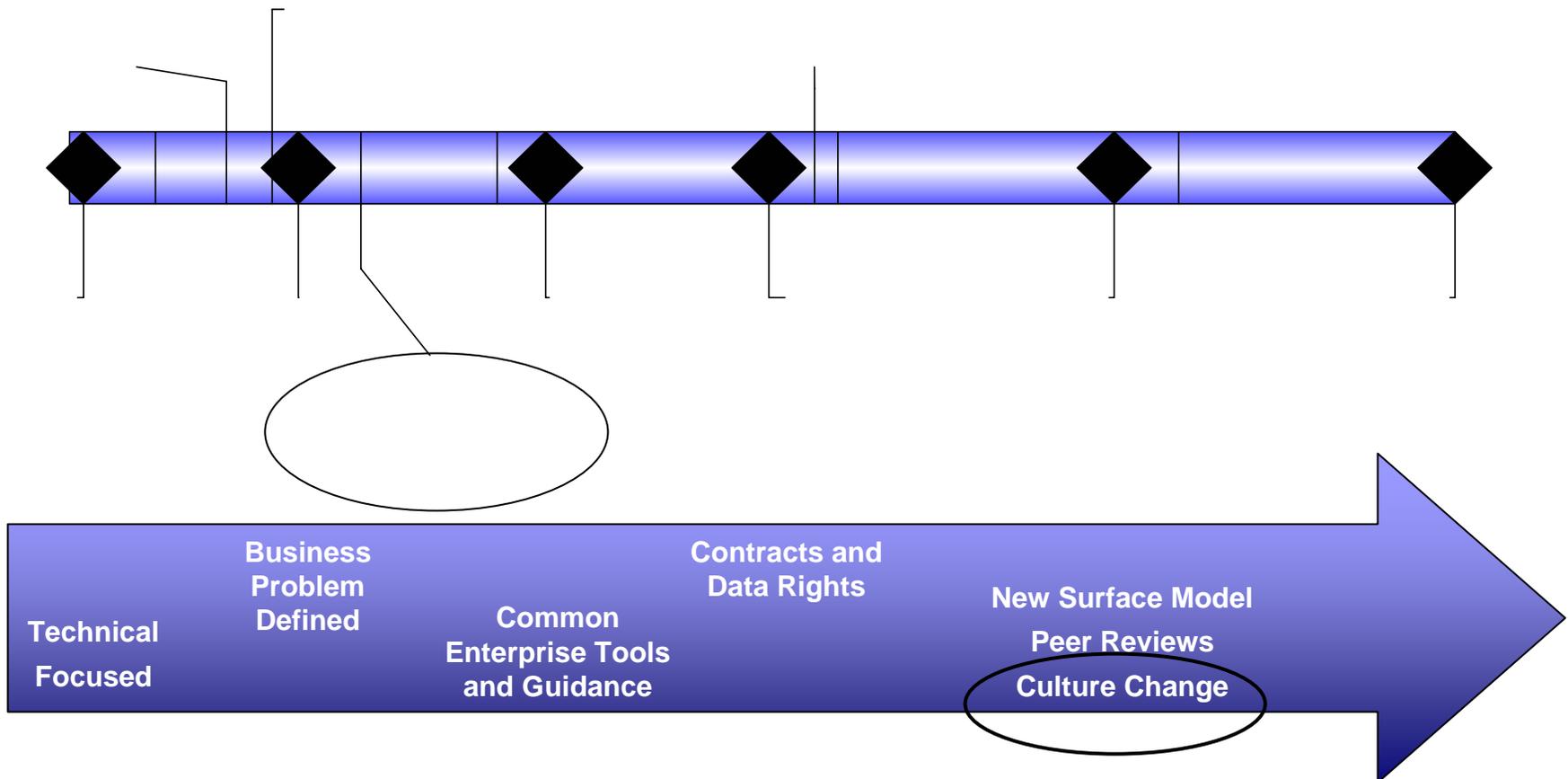
Publish interfaces
Isolate proprietary components
Use widely adopted standards
Modularize systems
Reuse software products
Build interoperable applications

OA Training
Outreach - Symposias & Industry Days
Research



In the last four years, attention has shifted increasingly to the business practices and culture change

OPEN ARCHITECTURE EXCOMM Timeline





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The mandate to adopt OA is being driven from the top down

Chief of Naval Operations



N6

N8

SYSCOMS

OA CROSS
FUNCTIONAL
BOARD

- Provide Naval requirements and POM/PR guidance to acquisition community
- Identify requirements for rapid, cost-effective, interoperable warfighting improvements with the objectives of supporting OA

Assistant Secretary of the Navy for Research, Development & Acquisition



PEO-IWS leads the OA Council



OA Lead Council

OA Enterprise Team

AIR

SURFACE

C4I

SUB

SPACE

MARINE
CORPS

- Lead the enterprise to OA implementation
- Oversee the development and implementation of the processes, business strategies, and technical solutions for implementing OA
- Provide OA Systems Engineering Leadership to PEOs, Warfare Centers, Industry, etc.

PEOs

- Identify architectures unique to domains and implement a process to ensure OA compliance

SYSCOMS

- Provide technical, financial management and contracting support to PEOs
- Establish OA technical processes
- Monitor and assess compliance with OA standards and processes

(Continued)

Repositories for Design Disclosure and Reuse

- Develop common end-user licensing agreement to access repositories and use assets
- Publish Interfaces of mission systems



- Domain **Surface** pilot repository underway (SHARE)
 - 143 registered users (85 government / 58 contractors)
 - 61 assets contributed (e.g. design, code, data models)
 - 246 requests for assets, 132 processed
 - First redeposit of changed assets--a third-party contractor returned modified AEGIS code to the repository for future reuse



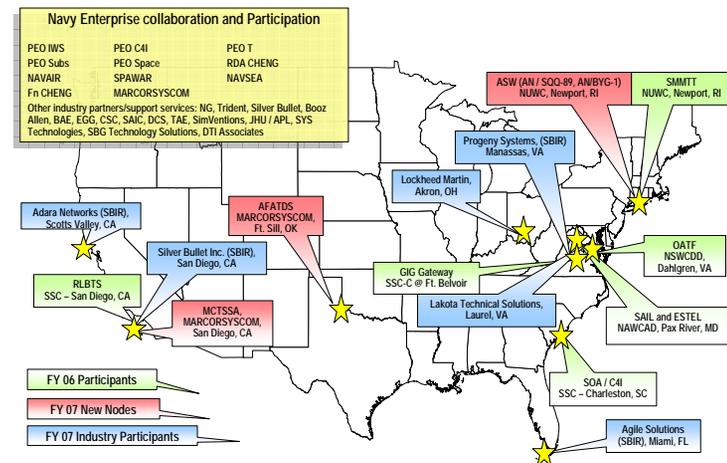
- Domain **C4I** Collaboration Site (NESI)
 - 731 registered users to date
 - 73 projects in NESI



(Continued)

Conduct Experiments to facilitate reuse, build common data models and increase interoperability

- 7 DoD Players/Nodes & 8 Industry/Academia Players developed a common data model for 5 systems and composeable FORCENet
- Track Data was shared across 5 Domains in an Service Oriented Architecture to produce a common operating picture
- Several COTS and GOTS products were reused across domains to reduce cost of experiment (e.g. common data model, software modules, network components, and simulation tools)
- Output of experiment will contribute the common data model (CDM) with ASW extensions to the Joint Track Management (JTM) EA Working Group & ASW Community of Interest to jump start implementation of the CDM shared core data model for JTM EA



(Continued)

Build Communities of Interest to Promote Enterprise Collaboration

- ASW Community of Interest
- Significant reuse across 8 ASW platforms
- ~40 organizations participating (Fleet, OPNAV, Acquisition)
- ASW Data Strategy in development (Command and Control)
 - Alignment with JFCOM Joint C2 Capability Portfolio
 - Pilot Demos for C2, Sensors & Sensor Performance Prediction
- Metrics in development





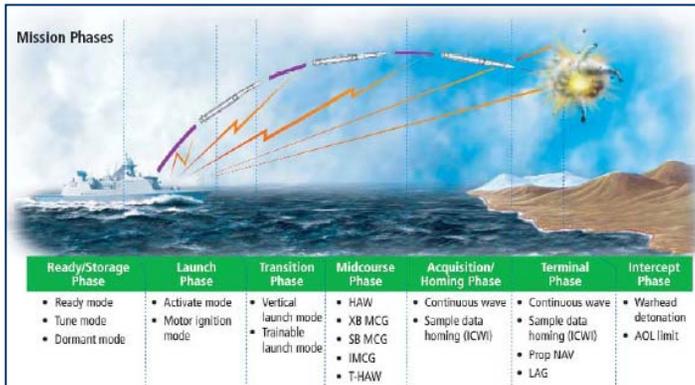
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The application of OA principles are being applied in weapons today

Evolved SeaSparrow Missile (ESSM) is an international cooperative upgrade of the RIM-7 SeaSparrow Missile. ESSM provides self-defense battlespace and firepower against high-speed, highly maneuverable anti-ship missiles.



Adopted OA Principles

- ✓ **Design Disclosure** – interfaces are shared among 10 different countries
- ✓ **Reusable software** – several components from the SeaSparrow Missile are reused
- ✓ **Interoperable joint warfighting applications-** data exchanged among several applications
- ✓ **Lifecycle affordability-** lifecycle costs are significantly reduced by sharing resources among the consortium
- ✓ **Collaboration** – 10 countries are collaborating to improve the performance of the SeaSparrow Missile



The SM-6 Missile is reusing components, sharing designs, and increasing lifecycle affordability

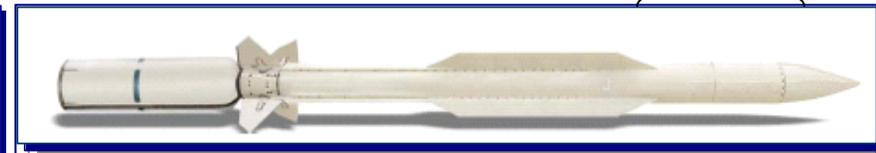
The **SM-6 Extended Range Active Missile (ERAM)** will provide an extended range, overland cruise missile defense capability

AIM-120 Advanced Medium Range Air-to-Air Missile



Adopted OA Principles

- ✓ **Design Disclosure** – Interfaces are shared between companies and Army & Air Force
- ✓ **Reuse** – active seeker from AMRAAM, airframe from SM-2 Block IV
- ✓ **Interoperable joint warfighting applications**- Shift from a “Threat-Based” Design & Integration to a “Needs-Based” Design & Integration
 - ✓ Broke the “hard link” design between weapon and specific fire control system
 - ✓ Weapon doesn’t care who the data provider is
- ✓ **Lifecycle affordability**- lifecycle costs are significantly reduced by reusing components, leveraging inter-service support and maintenance facilities and employing portable Built in Test (BIT) philosophy





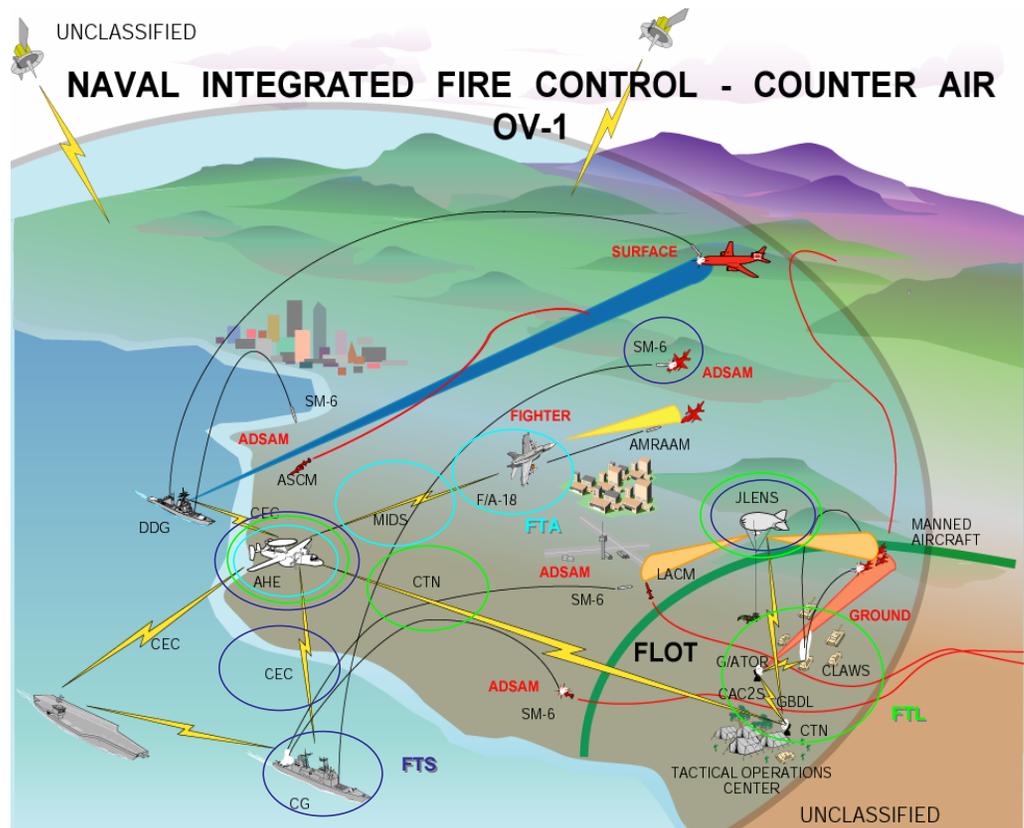
Open architecture is also enabling us to develop new capabilities from Families of Systems (FoS)

Requirement:

- ❑ Provide an Engage On Remote (EOR) and Over The Horizon (OTH) air defense capability that expands the battle space to the maximum kinematic range of active missiles

Acquisition Options:

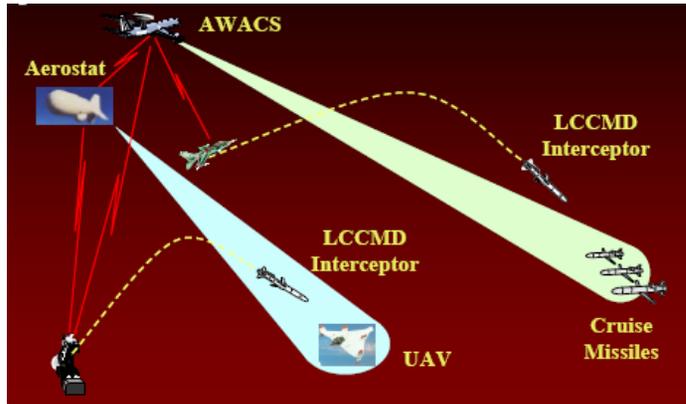
1. Develop capability from new start
2. Integrate existing capabilities and technologies across multiple platforms (Aegis, E-2D, SM-6, cooperative engagement capability)



Naval Integrated Fire Control – Counter Air (NIFC-CA)



Affordability is a key—adopting OA allows the Navy to hold fair competition and see what the market will bear



The Defense Advanced Research Projects Agency will design, develop, demonstrate and transition an **affordable** electronically scanned array (ESA) seeker using commercial hardware for use on a missile interceptor system to defeat unsophisticated air vehicles. The **Low Cost Cruise Missile Defense (LCCMD)** Program will employ emerging and existing technologies to develop and demonstrate an affordable missile interceptor.



ONR is working to improve the **Tomahawk Land Attack Missile TLAM** technology including a focus on guidance, fusing, energetic materials, aerodynamics, materials, propulsion technology, fire and **affordability**.



ONR's **Affordable Weapons program** uses commercially-based equipment to build a "cruise-like" missile with good performance at a price ten times less than the norm.

Key lessons learned in S&T will also be rapidly inserted for greater technology advancements



In summary, the Navy is adopting OA practices to change the way we build systems today

- Business Practices
 - Disclosing design artifacts
 - Negotiating appropriate data rights
 - Fostering enterprise collaboration
 - Instituting Peer Reviews of solutions
 - Developing new open business models
 - Changing contracts / increase competition

- Technical Practices
 - Publishing interfaces
 - Isolating proprietary components
 - Using widely adopted standards
 - Modularizing systems
 - Reusing software products
 - Building interoperable applications



Questions?