



Surface Weapons Open Architecture Goals and Status – What Next?



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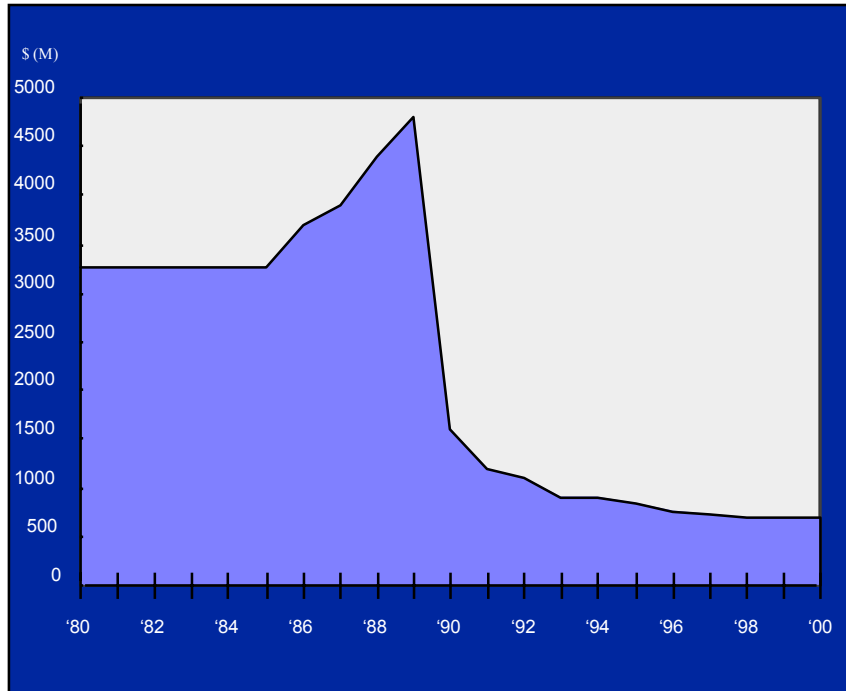
Today's Agenda

- Open Architecture in the Submarine Domain
- Incorporation of OA into weapons
- Using OA to develop new capabilities across Families of Systems
- Future Weapons Development

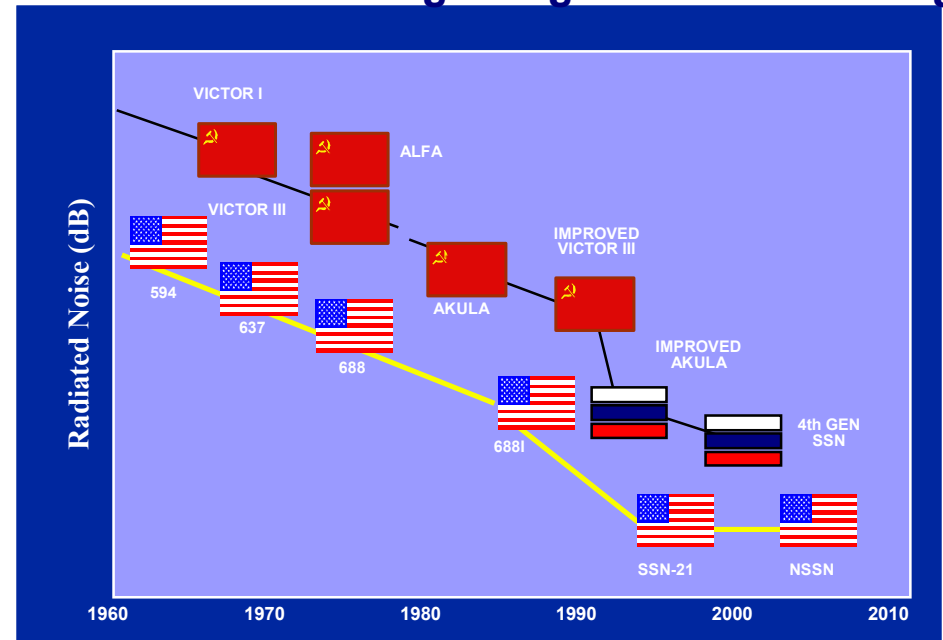


The adoption of open architecture originated in the Sub Domain during the 1990s due to an increasing threat

The Sub R&D decreased significantly...



...as Russians were gaining acoustic advantage



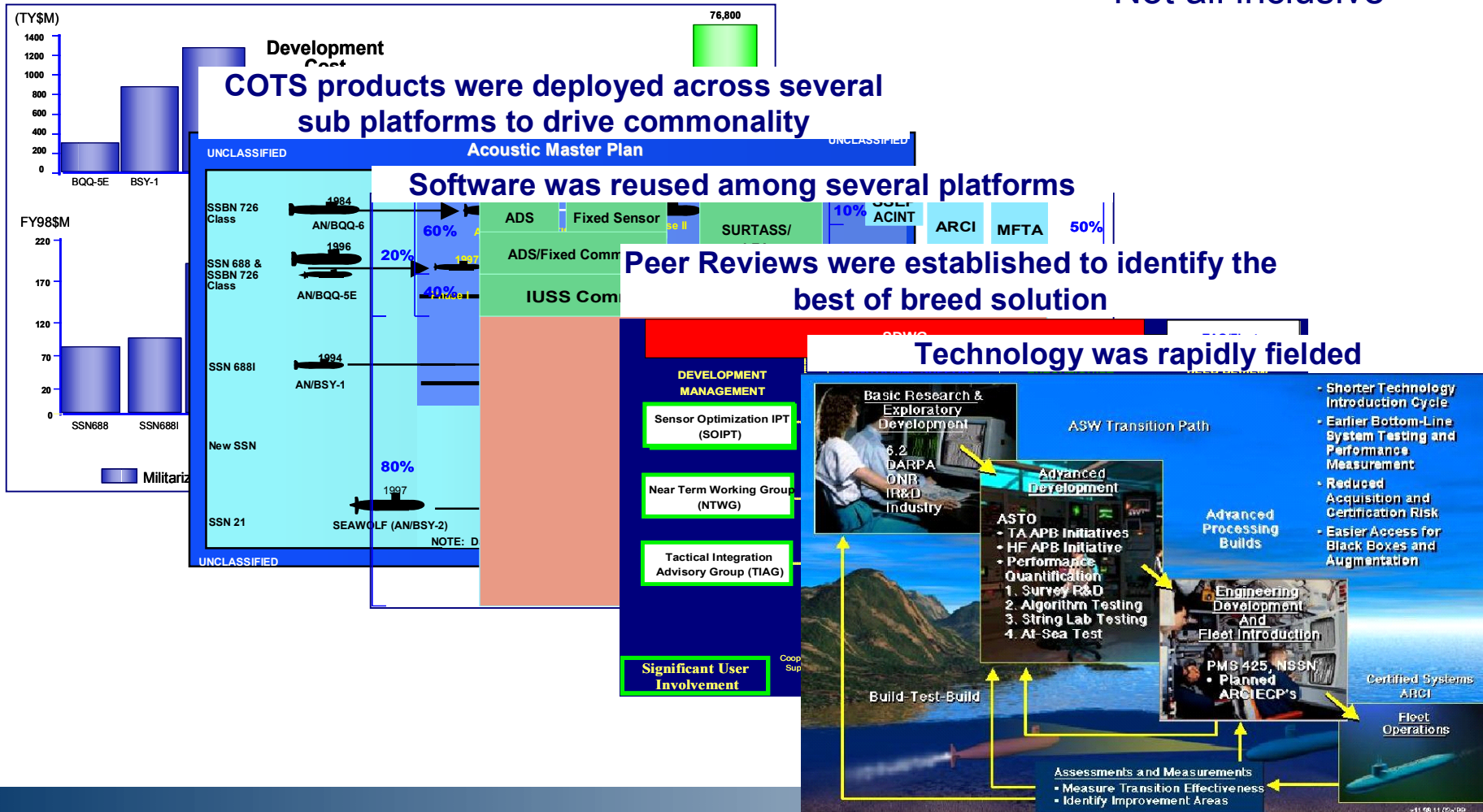
New capabilities were needed faster at economical prices



Radical changes in the business and technical approach to building systems were made to address problems

COTS products were used to increase signal processing capability at reduced costs

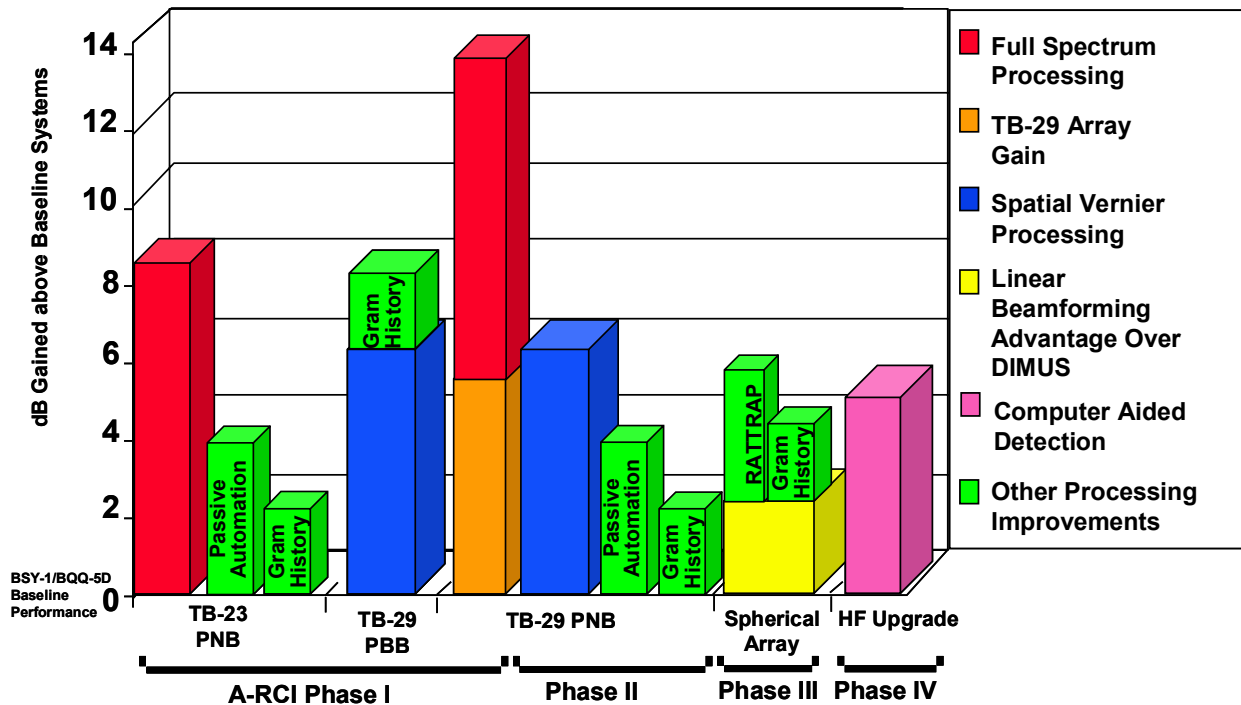
Not all inclusive





Over the course of time, performance gains were achieved and costs were significantly reduced

Demonstrated Performance Gains



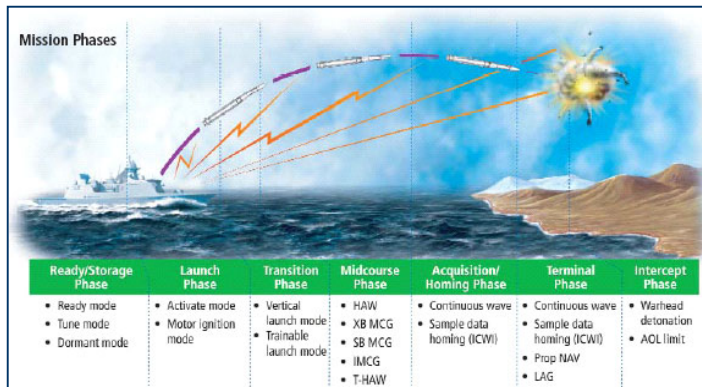
Results

- ☐ \$4 B cost savings over 10 years using the Acoustic Rapid COTS Insertion model
- ☐ Seven-fold increase in towed array sensor performance
- ☐ Exploitation of new technologies
- ☐ Use of SBIRs
- ☐ Increased interoperability
- ☐ Annual software upgrades
- ☐ Hardware refresh every 2 years



The application of OA principles learned in the Sub Domain 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



For example, the SM-6 Missile is reusing components, sharing designs, and increasing lifecycle affordability

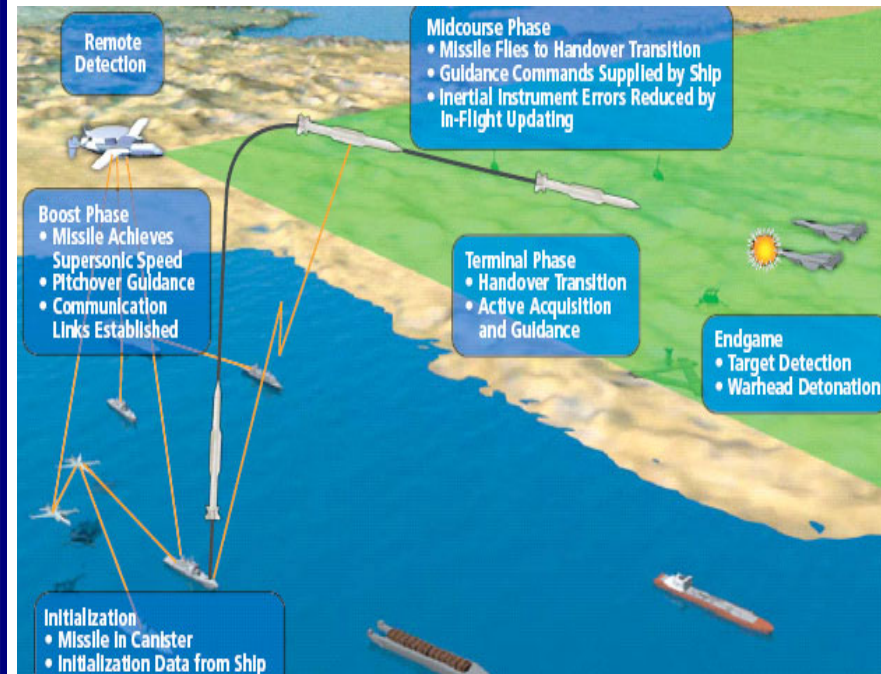
The **SM-6 Extended Range Active Missile (ERAM)** will provide an extended range, overland cruise missile defense capability

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





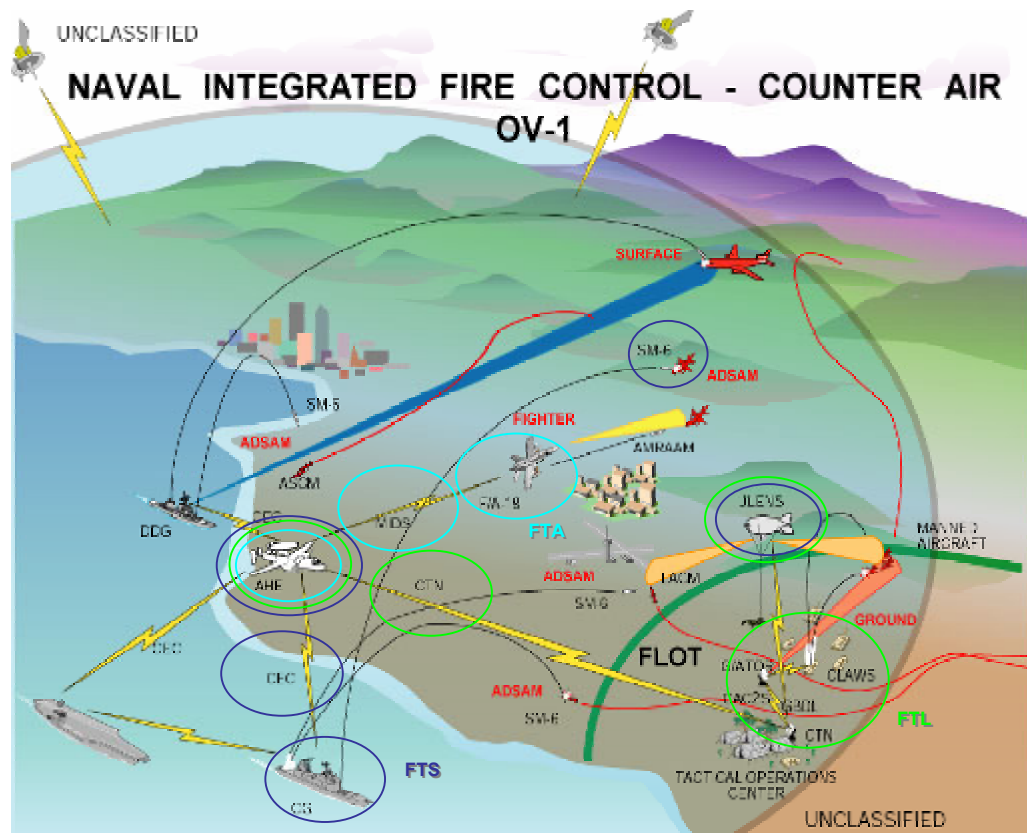
Open architecture is enabling us to develop new capabilities from Families of Systems (FoS)

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)



The NIFC-CA capability spans three different kill chains

- **Develop three different kill chains that include** an active missile, elevated sensor(s), a sensor network, and a weapon control system

From-The-Sea (FTS)



- Aegis Weapon System
- Advanced Hawkeye (E-2D)
- Standard Missile (SM-6)
- Cooperative Engagement Capability (CEC)
- Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

From-The-Air (FTA)



- E-2D
- F/A – 18 E/F
- Advanced Medium Range Air-to-Air Missile (AMRAAM)

From-The-Land (FTL)

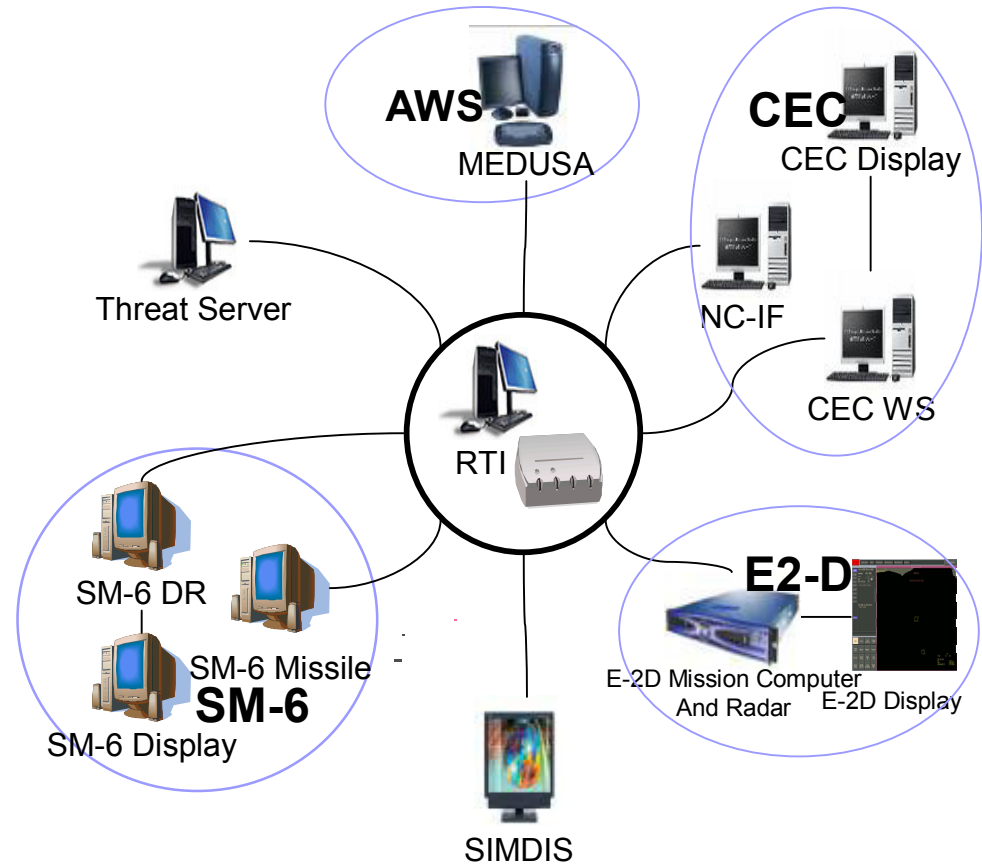


- E-2D
- JLENS
- Surface Launched AMRAAM (SLAMRAAM)



Modeling and Simulation (M&S) techniques are an enabler for open collaboration processes

- Integrate Program of Record federates to assess the From-The-Sea capability in an operationally realistic environment
- Support risk mitigation by providing the ability to perform end-to-end analysis
- Support predictive analysis for the Integration and Test events and validate the Federation



M&S enables the development of the NIFC-CA capability family of curves without dozens of live fire tests. Projected cost savings are \$150 million.



As new threats emerge, OA allows a flexible and agile approach to rapidly improve development of our weapons

Exploratory and advanced development in **Strike Technology** is focused on guidance and control for air and surface weapons including:

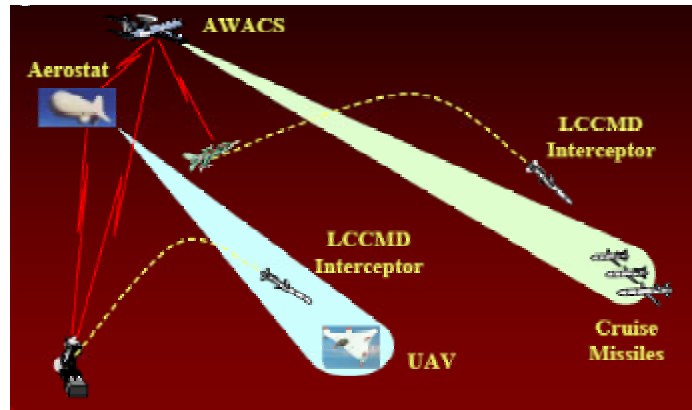
- ❑ seeker development
- ❑ signal and image processing
- ❑ ordnance technology (warheads, fuzing, safe and arm devices, and energetic materials)
- ❑ aero/structures (steady and unsteady aerodynamics associated with axi- and non-axisymmetric missile airframe shapes as well as the use of composite materials for missile structural components)
- ❑ propulsion technology (solid rocket propulsion and airbreathing propulsion for missiles as well as propulsion for gun-launched projectiles)
- ❑ fire control/targeting/mission planning for both air-launched and ship-launched weapons



Source: ONR



Affordability is a key aspect of development – adopting OA will allow 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, we must continuously apply the principles of open architecture in our programs and across the Navy

We must:

- Ensure our systems are **modular in design** to enable rapid upgrades to components or to reuse components across several Programs
- **Disclose our design artifacts** to improve interoperability, and facilitate reuse
- **Reuse** components across Programs to build new capabilities and reduce costs
- **Collaborate** across the enterprise to build best of breed solutions
- **Increase competition** to drive affordability
- Use commercial products to improve **lifecycle affordability**
- Develop **joint warfighting applications** to counter tomorrow's threats



Back Up



Total Cost Savings

- Top Down Comparison of the Budget Allocations

- 1983-1993 (Traditional Model)
Budget Allocation Across SCN,
OPN, O&MN, RDT&E, MilCon

- **\$ 7,633,638,065**

2.1:1 Less Budget
Allocated for COTS
Based Submarine
Acoustics

- 1996-2006 (A-RCI Model)
Budget Allocation Across SCN,
OPN, O&MN, RDT&E, MilCon

- **\$ 3,613,920,085**

- Bottoms-Up Comparison from Contract Data and VAMOSOC Database

- 1983-1993 (Traditional Model)
Development and Production

- **\$7,363,960,752**

6:1 Less Contract
Dollars for COTS Based
Submarine Acoustics

- 1996-2006 (A-RCI Model)
Development and Production

- **\$1,243,396,610**

- 2005 (Traditional Model)
Operating and Support Costs

- **\$482,779**

8:1 Less Operation and
Support Dollars per Ship
Year for COTS Based
Submarine Acoustics

- 2005 (A-RCI Model) Operating
and Support Costs

- **\$61,177**