Surface Navy Combat Systems Engineering Strategy

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PEO Integrated Warfare Systems
4 March 2010

Open Architecture (OA) is a key enabler for meeting the CNO's objectives

Naval OA is a multi-faceted business and technical strategy for acquiring and maintaining National Security Systems (NSS) as interoperable systems that adopt and exploit open-system design principles and architectures

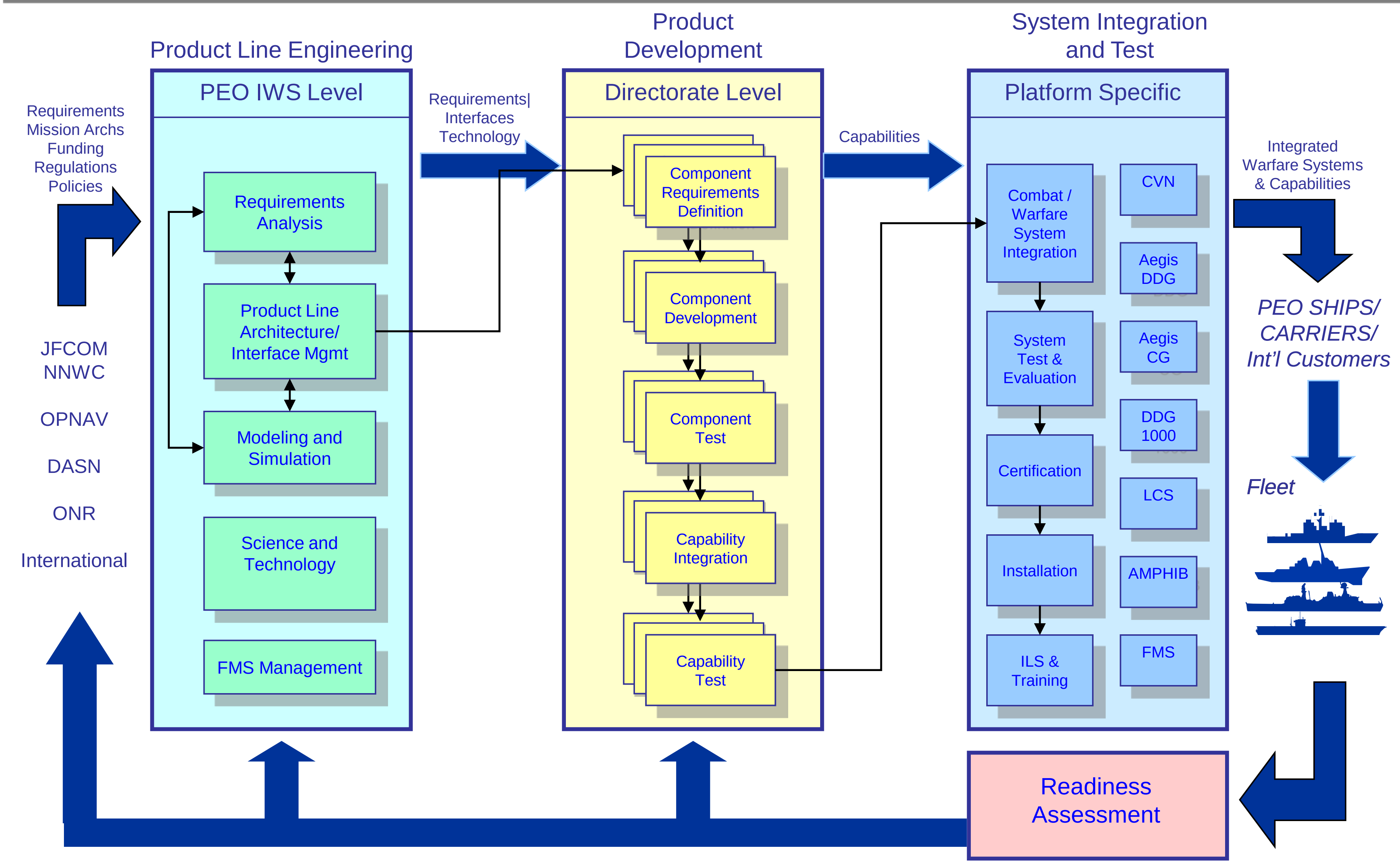
NAVAL OA CORE PRINCIPLES

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

Implementation of OA across the enterprise will yield many benefits

Reduction in Time to Field	◆ Decreased development and acquisition cycle times to field new warfighting capabilities ◆ Faster integration of open standards based systems
Increased Performance	◆ Improved operator performance thru delivery of cutting edge technologies and increased bandwidth capabilities from spiral developments and technology insertions
Improved Interoperability	◆ Use of common services (e.g. common time reference) ◆ Use of common warfighting applications (e.g. track mgr) ◆ Use of published interfaces to standardize collaboration
Reduction in Risk	◆ Leverage proven reusable components ◆ Test early and often in the developmental cycle to minimize risk of delivering non-interoperable products
Cost Avoidance	◆ Cost avoidance from software re-use and use commodity COTS products at optimum prices ◆ Reduced training and streamlined lifecycle support

Top Level Acquisition Process View



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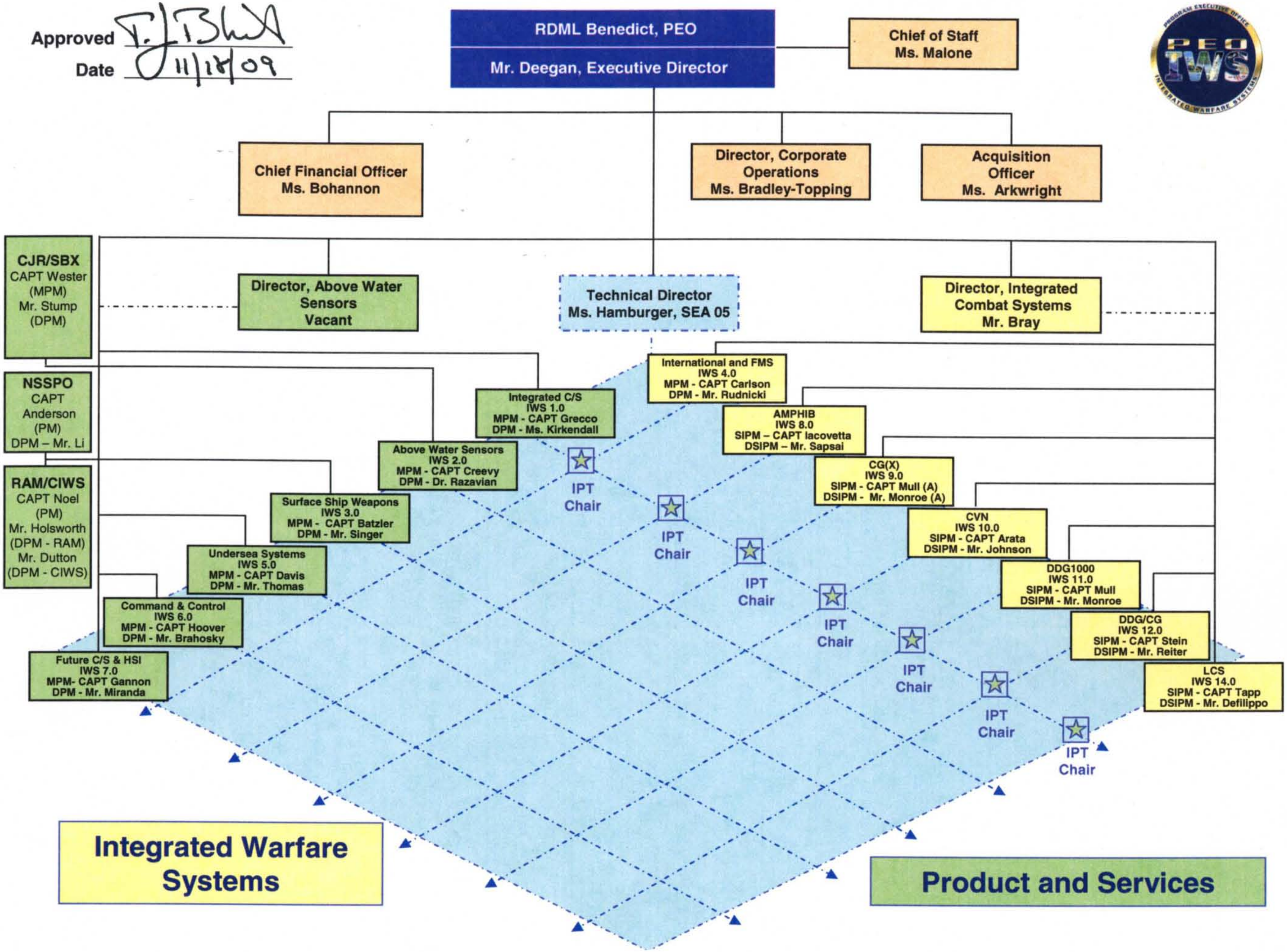
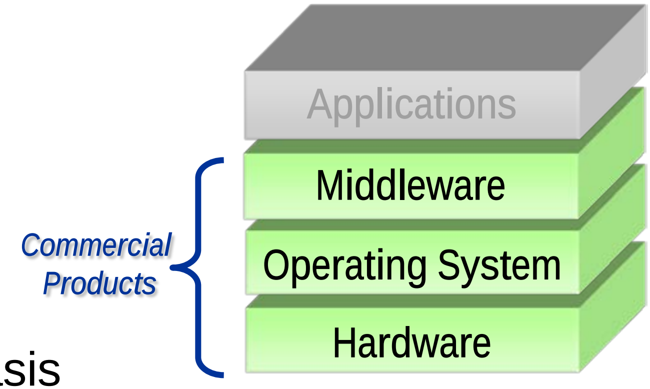
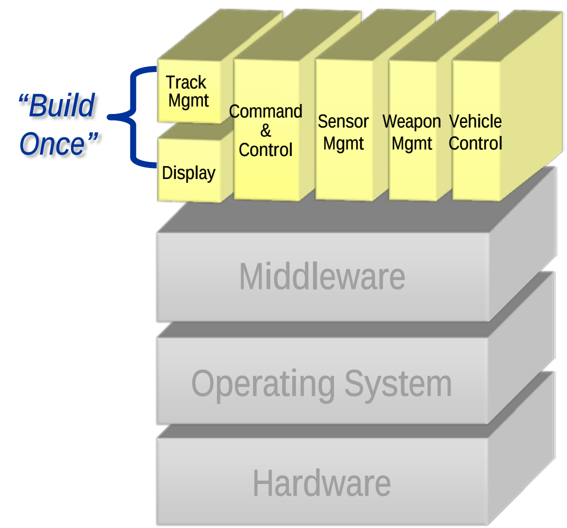


Implementing Open Architecture: Strategy, Interfaces and Open Standards

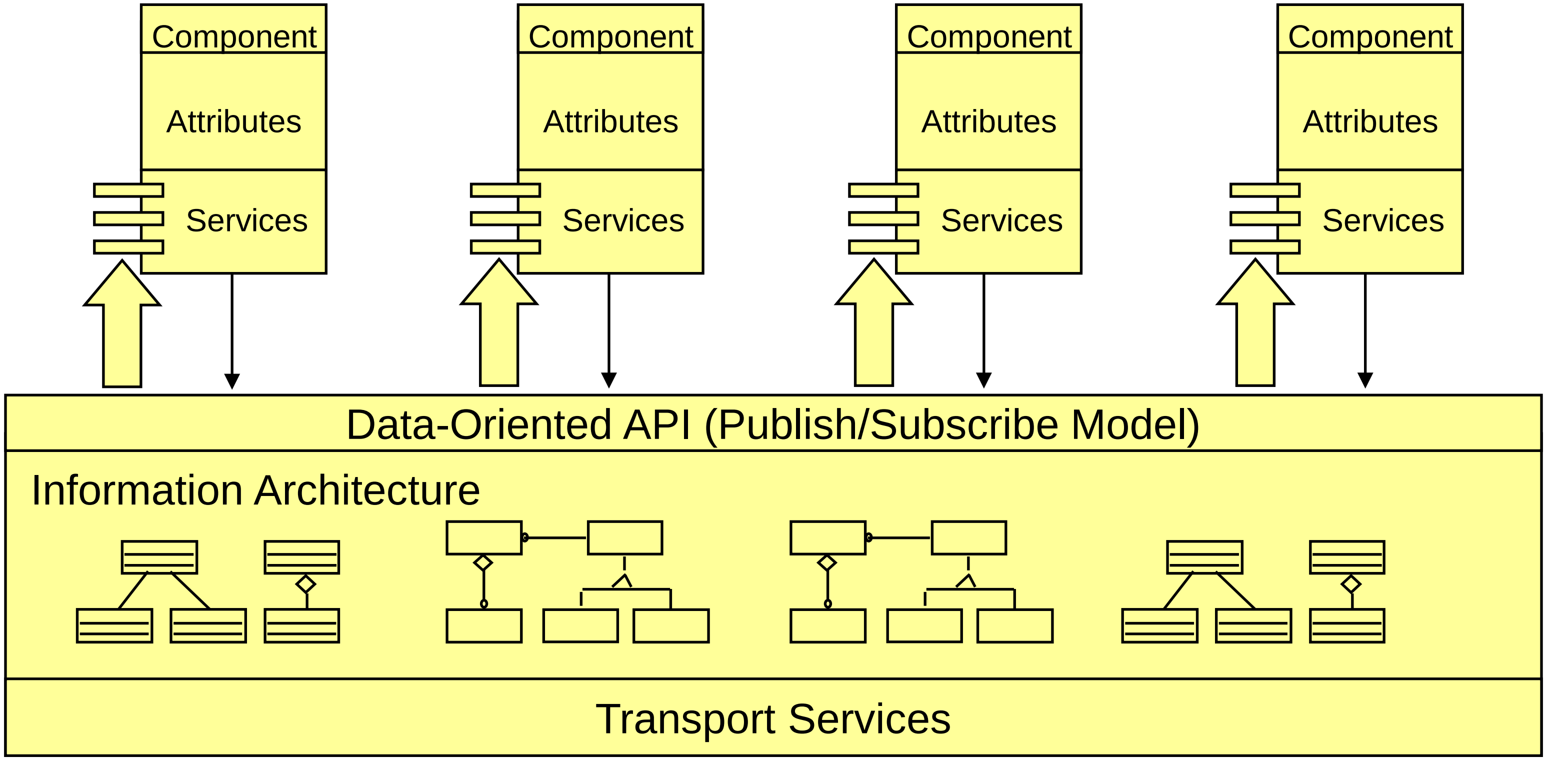
- Treat computing environment as a commodity
  - Select commercial mainstream COTS products that conform to well-established open system interface standards
  - Bundle specific COTS products for a given timeframe and revisit selections on a regular basis
- Isolate applications from high rate-of-change COTS through selection of standard APIs
  - Upgrade H/W and S/W Independently and on different refresh intervals
- Transform application development from single-platform development to multi-platform portfolio
  - Objective architecture defines key interfaces that support extensibility and reuse goals based on common data model
  - Eliminate redundant software development efforts





Information-Oriented Architecture Is Key to Defining Reusable, Extensible Components

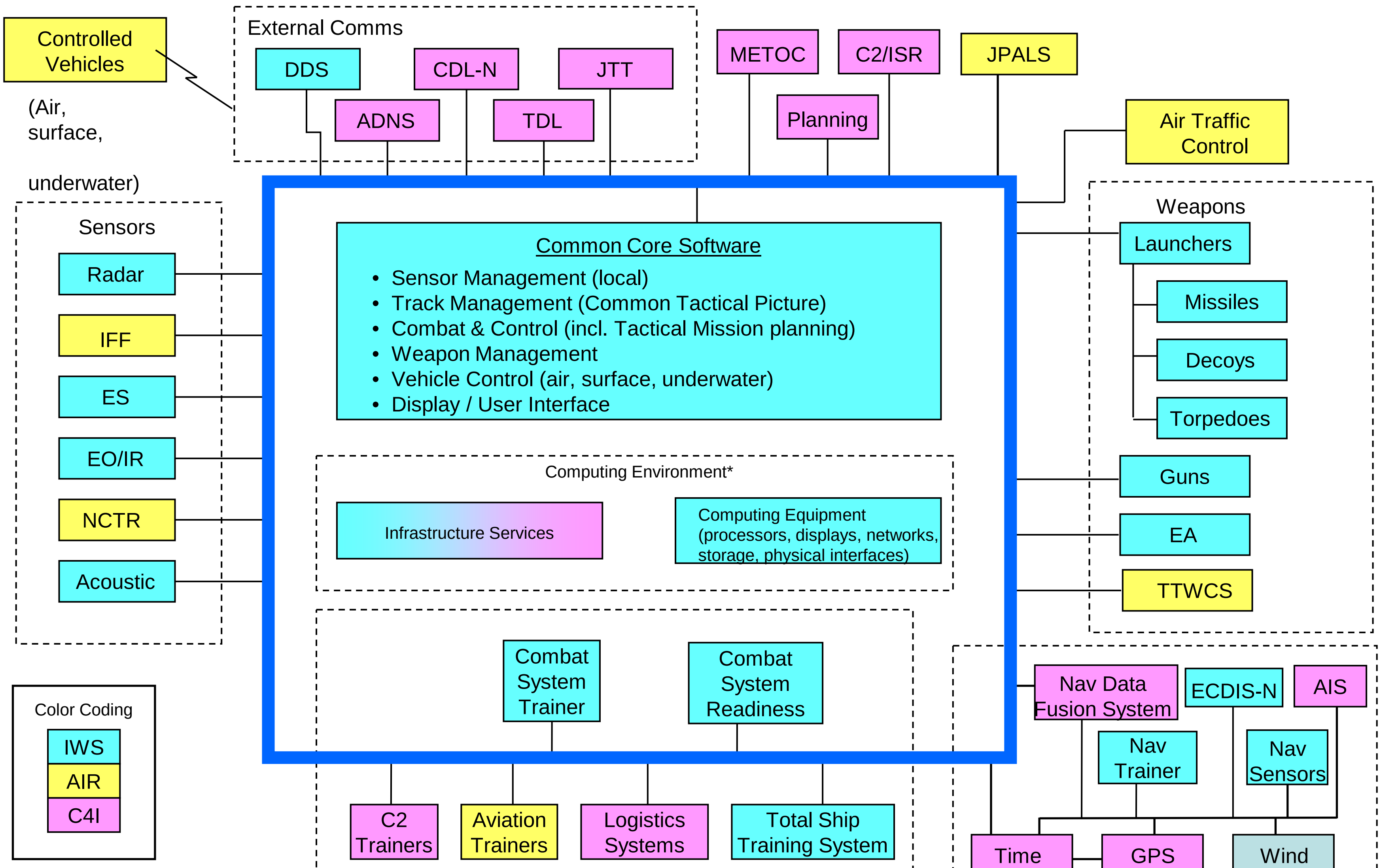
- Define a common data model and information standard
- Component-to-network interfaces, not component-to-component
- Component interfaces are coordinated* and authenticated**
- Expose information and post for any authorized subscriber to access
- Producers of information don't have to be aware of consumers



*Coordinated = fully-specified IDD, Gov't CM via ICWG

**Authenticated = interface compliance test before acceptance

Surface Combat System Network-Based Architecture



* Computing environment could be combat system specific or total ship

Transitioning to Objective Architecture Based Combat System

2008

- Aegis designed as an integrated combat system
- Aegis ACB 08 / TI 08 decoupled hardware from software
- SSDS designed with federated combat system network and hardware decoupled from software
- SSDS ACB 08 adds open standard middleware
- Future capability improvements planned for both programs through Advanced Capability Build (ACB)

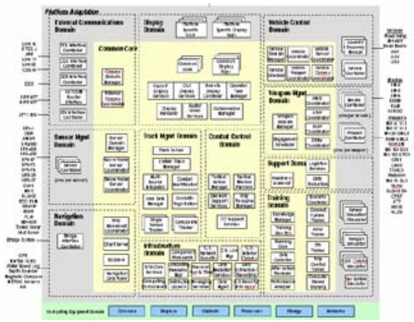
2012

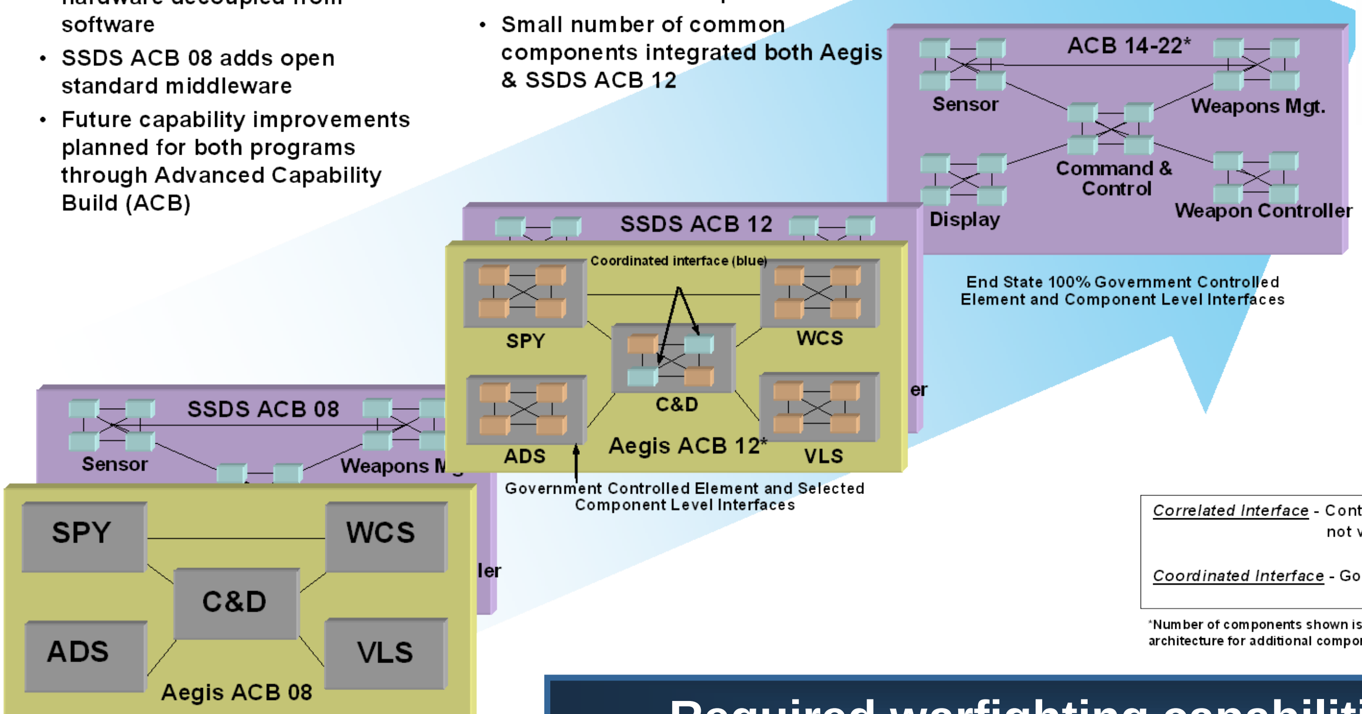
- Aegis modernization (ACB 12) component level interfaces delivered at CDR (1Qtr FY10) and with each delivered computer program build
- SSDS interfaces already documented at component level
- Small number of common components integrated both Aegis & SSDS ACB 12

2014-2022

- Number of common components will increase with each ACB moving to a common software core for all Surface Navy Combat System

Objective Architecture





Correlated Interface - Contractor described & controlled; not vetted through government coordination process

Coordinated Interface - Government Controlled and Validated

*Number of components shown is limited for illustrative purposes. Refer to ADD or top level objective architecture for additional component decomposition

Required warfighting capabilities determine components modified

Aegis Weapon System Hardware Architecture Roadmap

	Pre-Aegis	B/L 1/2/3/4/5 DDG 51-78 CG 47-73	B/L 6 Ph I/II/III DDG 79-90 CG 66 & 69	B/L 7 Ph I DDG 91-112	ACB 08/TI 08 Advanced Capability Build (ACB) Technology Insertion (TI)	ACB 12/TI 12	ACB 16/TI 16
Year	1960	1980	1994	2002	2009	2012	2016

Weapon System	MIL Spec Design	MIL Spec Design	Mixed COTS and MILSpec Design	Mission Critical Enclosure (MCE) All COTS computers	(MCE) A Scaleable Pool of Interchangeable Processors	Common Processing System (CPS) & MCE A Scaleable Pool of Interchangeable Processors	Common Processing System (CPS) & MCE A Scaleable Pool of Interchangeable Processors
Processors	UYK-7 →	UYK-7 UYK-43 UYK-20 UYK-44 →	UYK-43/44+ Adjunct COTS →	COTS SMP's →	COTS Blades →	COTS Blades →	COTS TBD
Normalized Equivalent Capability	2 UYK-43 →	4 UYK-43 →	120 UYK-43 →	270 UYK-43 →	875 UYK-43 →	~2500 UYK-43 →	TBD
Displays	UYH-4	UYH-4 UYQ-21 (TGC)	UYQ-21/UYQ-70	Thin Client Displays	Thin Client Displays	Common Display Systems (CDS)	
Connectivity	All NTDS	Point-to-Point	Point-to-Point	Point-to-Point		All Network Pub Sub	All Network Pub Sub

Increased computing power and network-based performance will enable significant combat system warfighting improvements

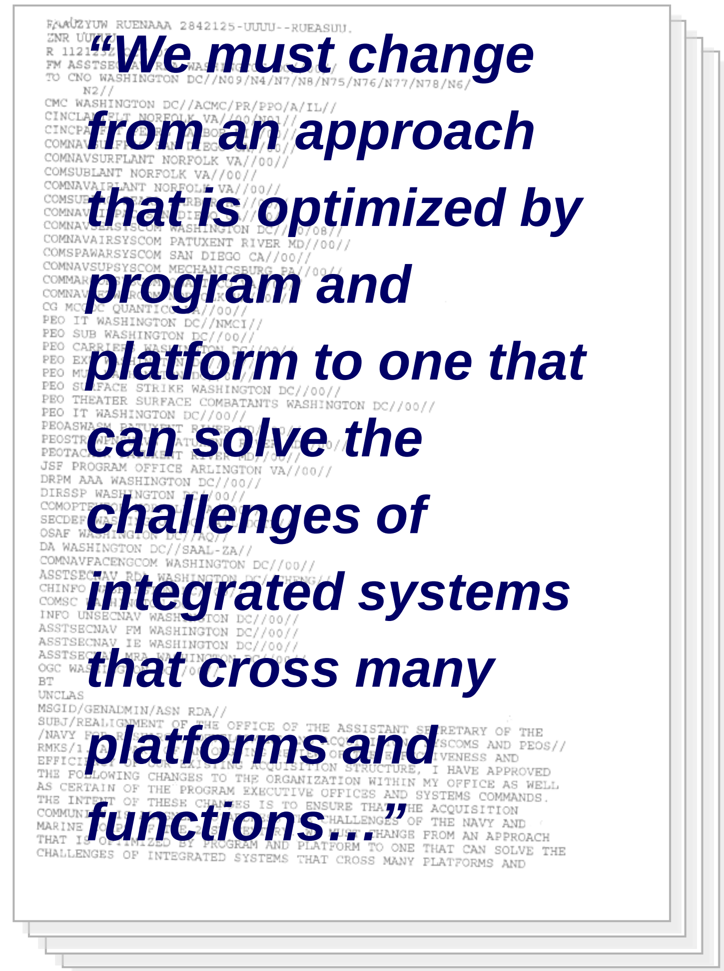
Evolution of Open Architecture

We are now focused here

	COTS Infrastructure	Component-Based Software	Open Business Model	Common Core Architecture
	I	II	III	IV
Characteristics:	• Separation of Application/ Infrastructure • Commercial Standards • Commodity Products	• Component-Based Designs • NetworkedApplications • Configurable Test Environments	• Open Business Practices • Rapid Transition of New Capabilities to Systems • Open Disclosure / Data Rights	• Common Objective Architecture / Interfaces • Common Components, Frameworks, Services • Common Precepts/ Patterns/Standards
Key Engineering Activities:	• COTS Performance Characterization • Prototypes / EDMs • Planned Refresh Cycles	• Multi-Level Test and Evaluation • KPP Validation • Increased Reuse	• 3rd Party Developers • Peer Reviews and Independent Assess • Mentoring • Fleet Involvement	• Align Existing Arch / Roadmaps • Establish/Publish "Objective Arch" • Establish/Publish Common Data Model
Benefits/ Evidence:	✓ Increased Performance / Bandwidth ✓ Reduced Cost	✓ Decreased Dev Time ✓ Improved Testability ✓ Reduced Cost (Reuse) ✓ Scalability, Extensibility, Testability, …	o Increased Number of Vendors/Opportunities o Improved Transition of S&T to Fleet	o Improved Interoperability o Cost Avoidance o Reduced Training/Support

PEO IWS Responsible for Achieving OA Objectives for Combat Systems

- Coordinate architecture and overarching interface principles for developing combat systems
- Oversee design, construction and maintenance of all ship combat systems
- Coordinate combat system acquisition programs across PEOs
- Leverage combat system software components across programs

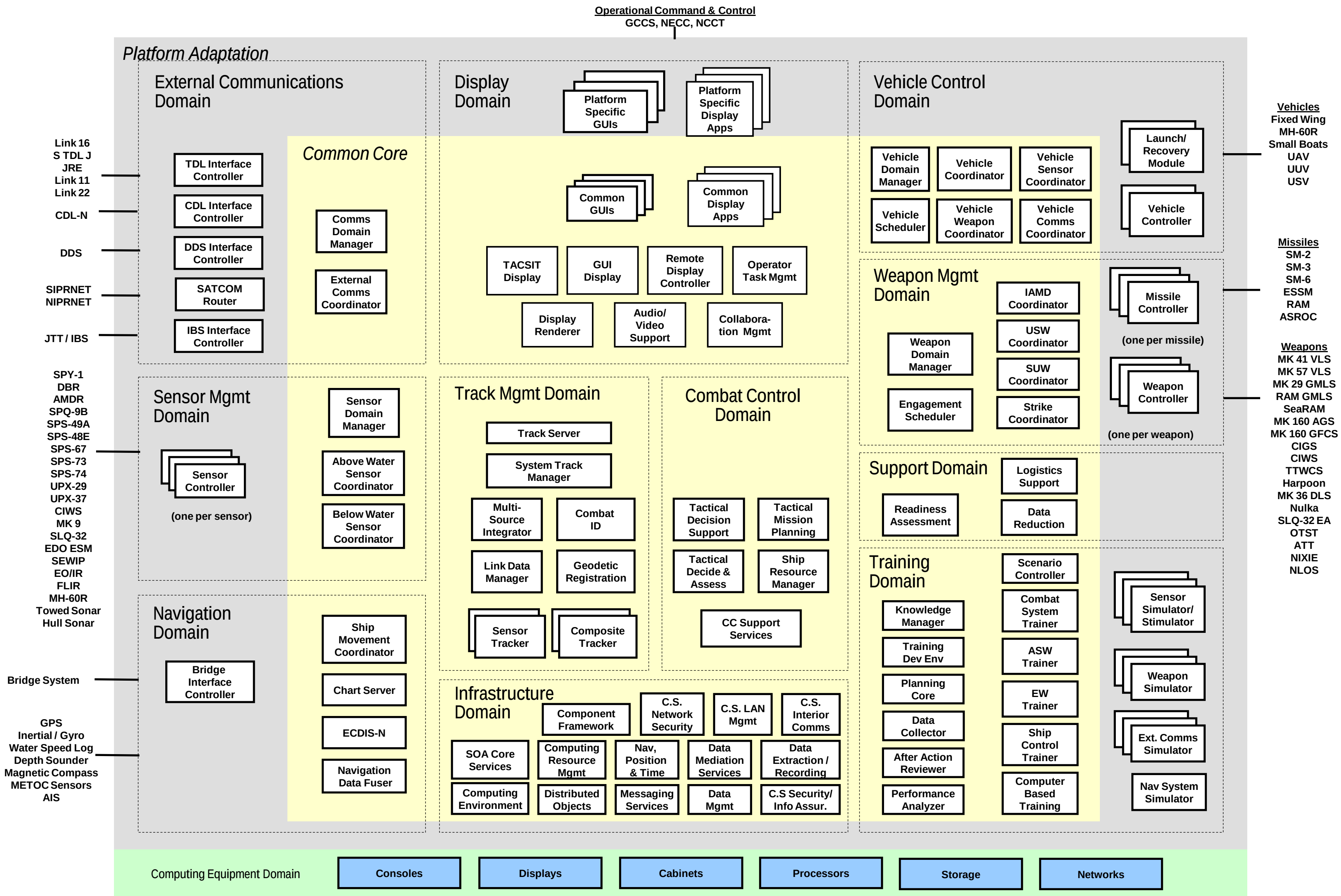


"We must change from an approach that is optimized by program and platform to one that can solve the challenges of integrated systems that cross many platforms and functions..."

– ASN(RDA) MSG DTG 112123ZOCT02

We are transforming to a product line acquisition approach

Surface Combat System
Top Level Objective Architecture



Navy Technical Reference Model

User Groups

Application Services

- Support Systems
- Aviation Systems
- ISR
- Command & Control
- Ship Control
- Combat Systems
- Platform Training

Common Services

- Basic Services
- SOA Core Services (Tactical Edge)
- Enterprise Services

Common Computing Environment

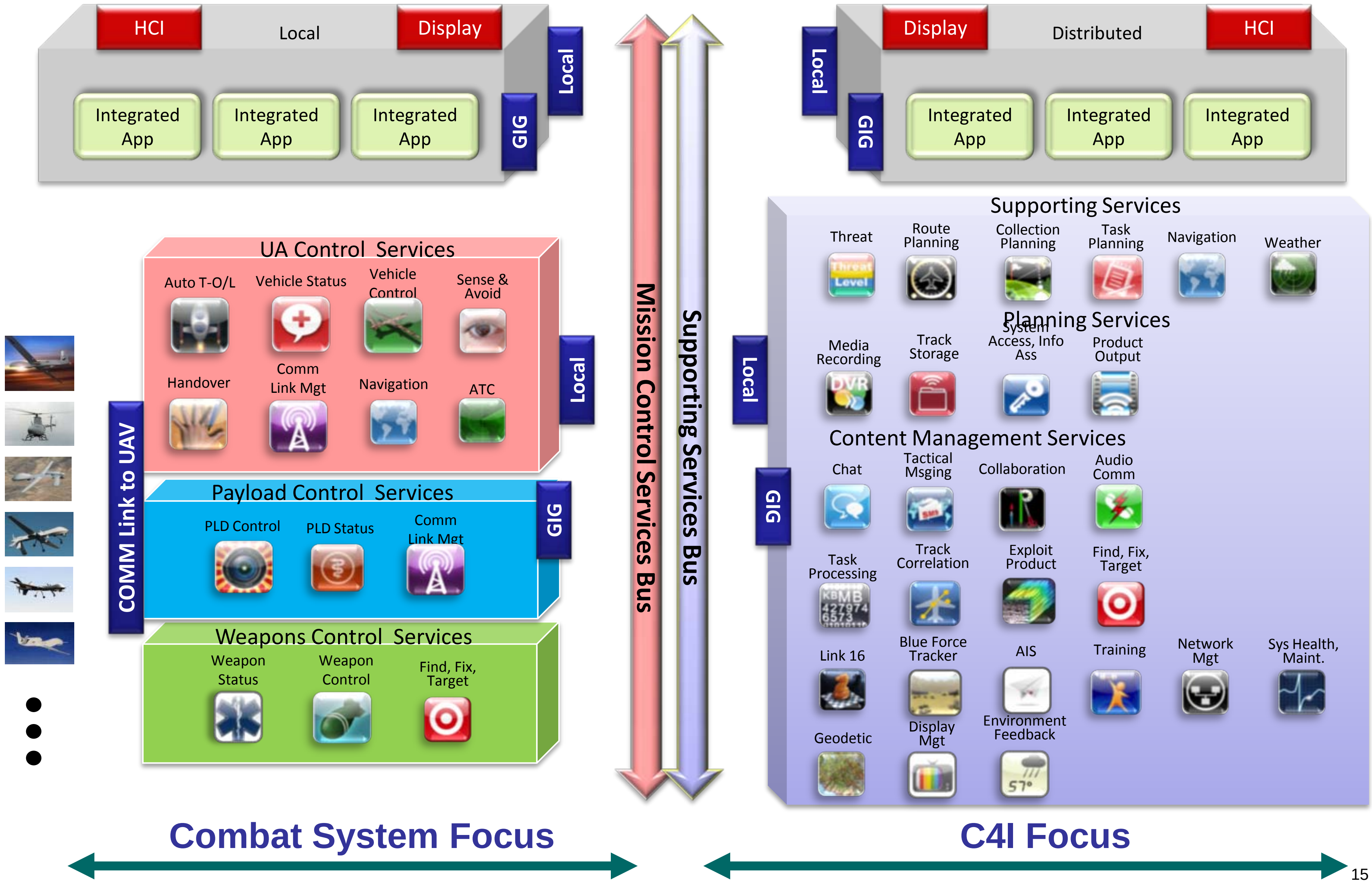
- Hosting Environment
- Computing Hardware

Communications & Networks

- WANs
- SATCOM
- LANs
- Wireless
- Network/ Circuit Mgmt
- Security

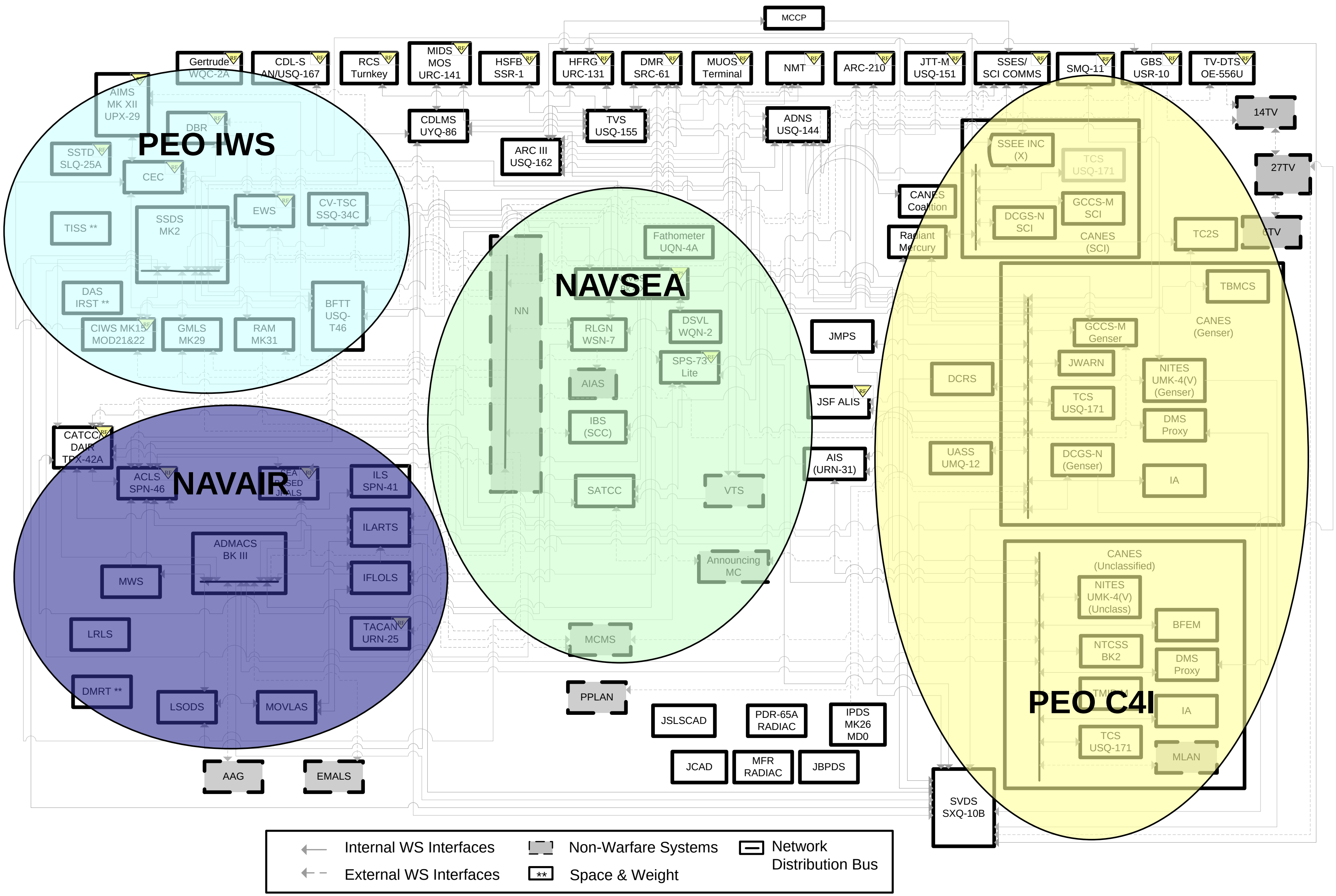
Quality of Service (QOS)
Information Assurance (IA)
Data Architecture

Notional Joint UAS Control Segment Software Framework



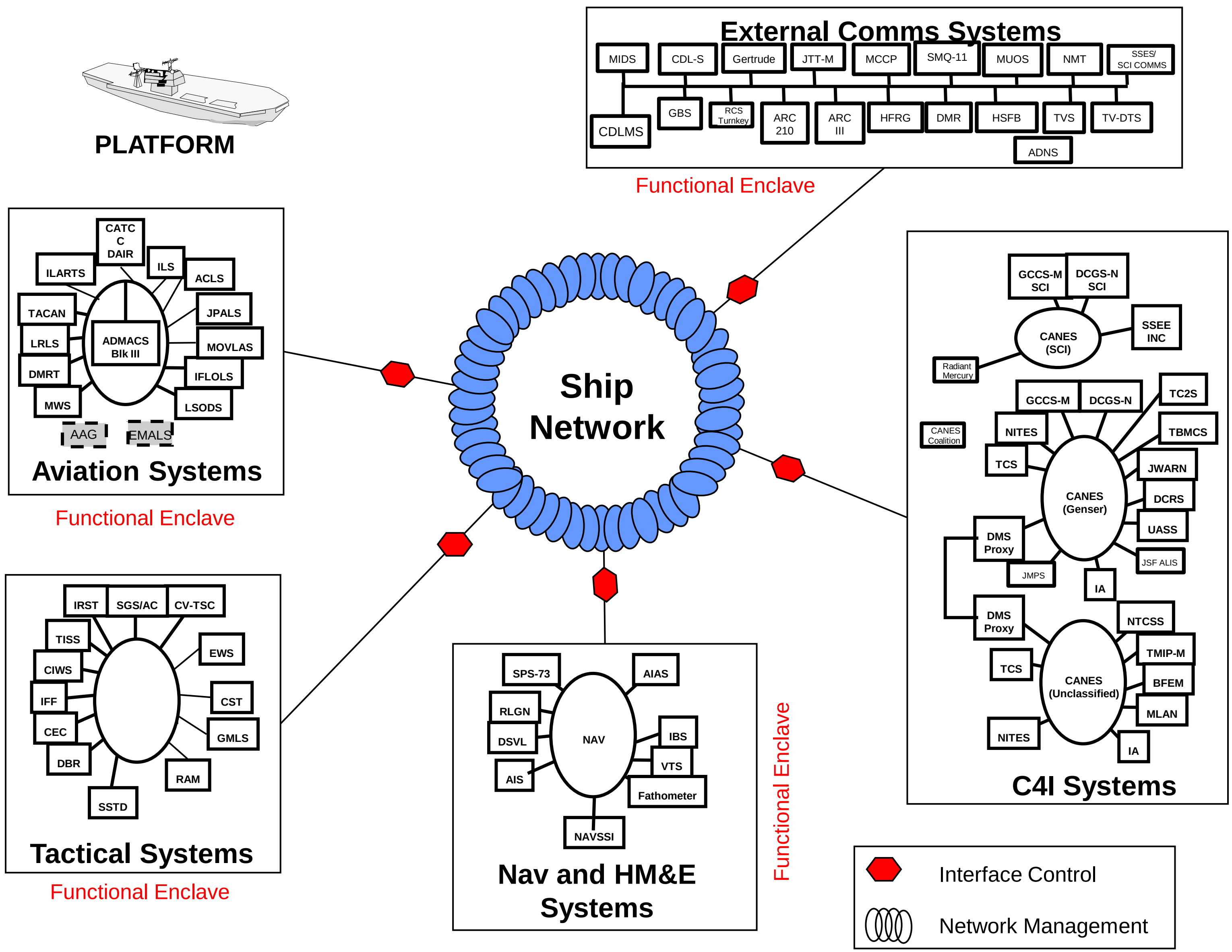
Today's Shipboard Environment

(Direct interfaces, unique solutions, weak cross-domain integration)

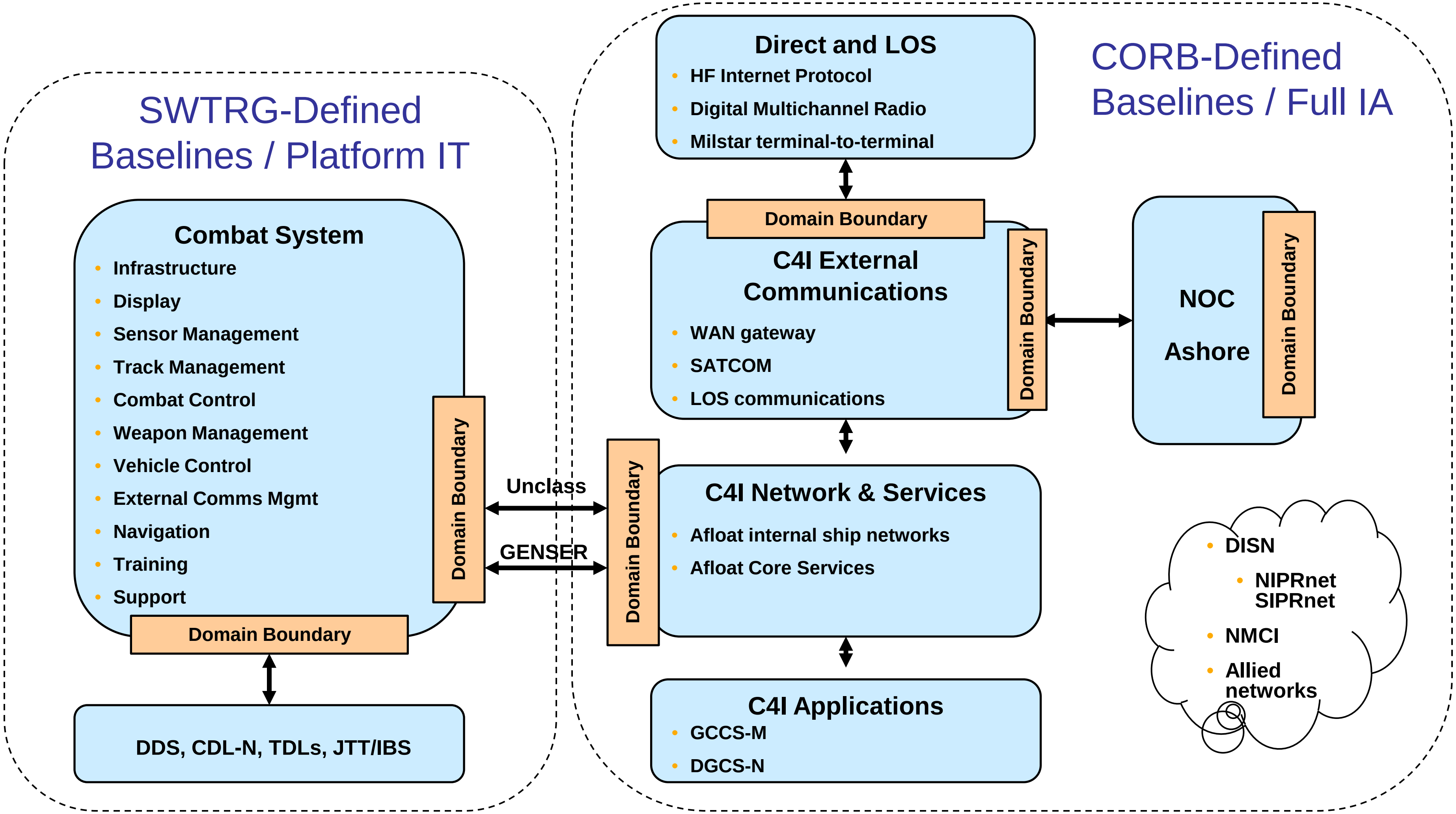


Desired Shipboard Environment

(Networked interfaces, common/interoperable solutions, significant cross-domain integration)

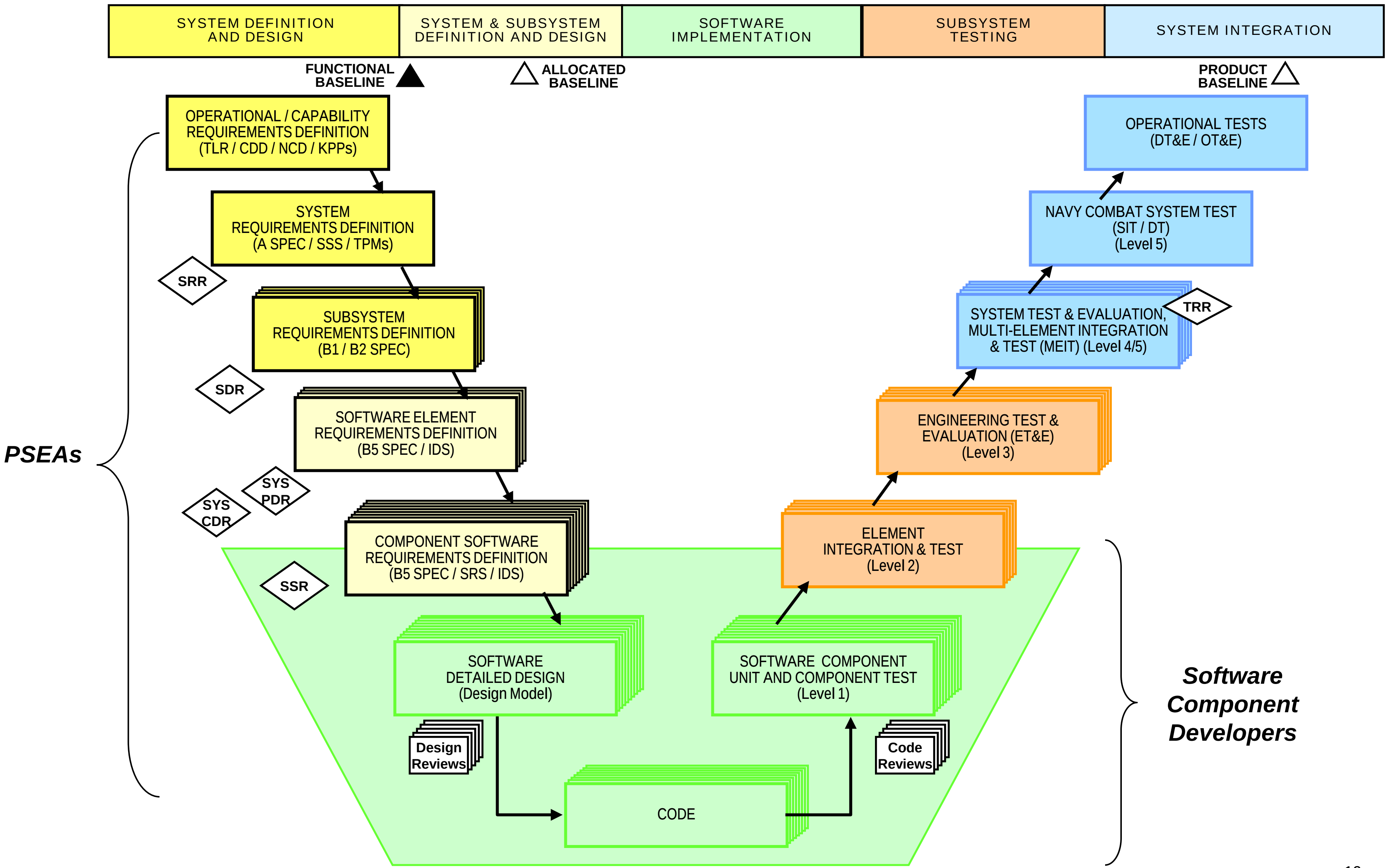


CANES Services supports CS data exchange with C2 Applications (whether onboard and offboard)

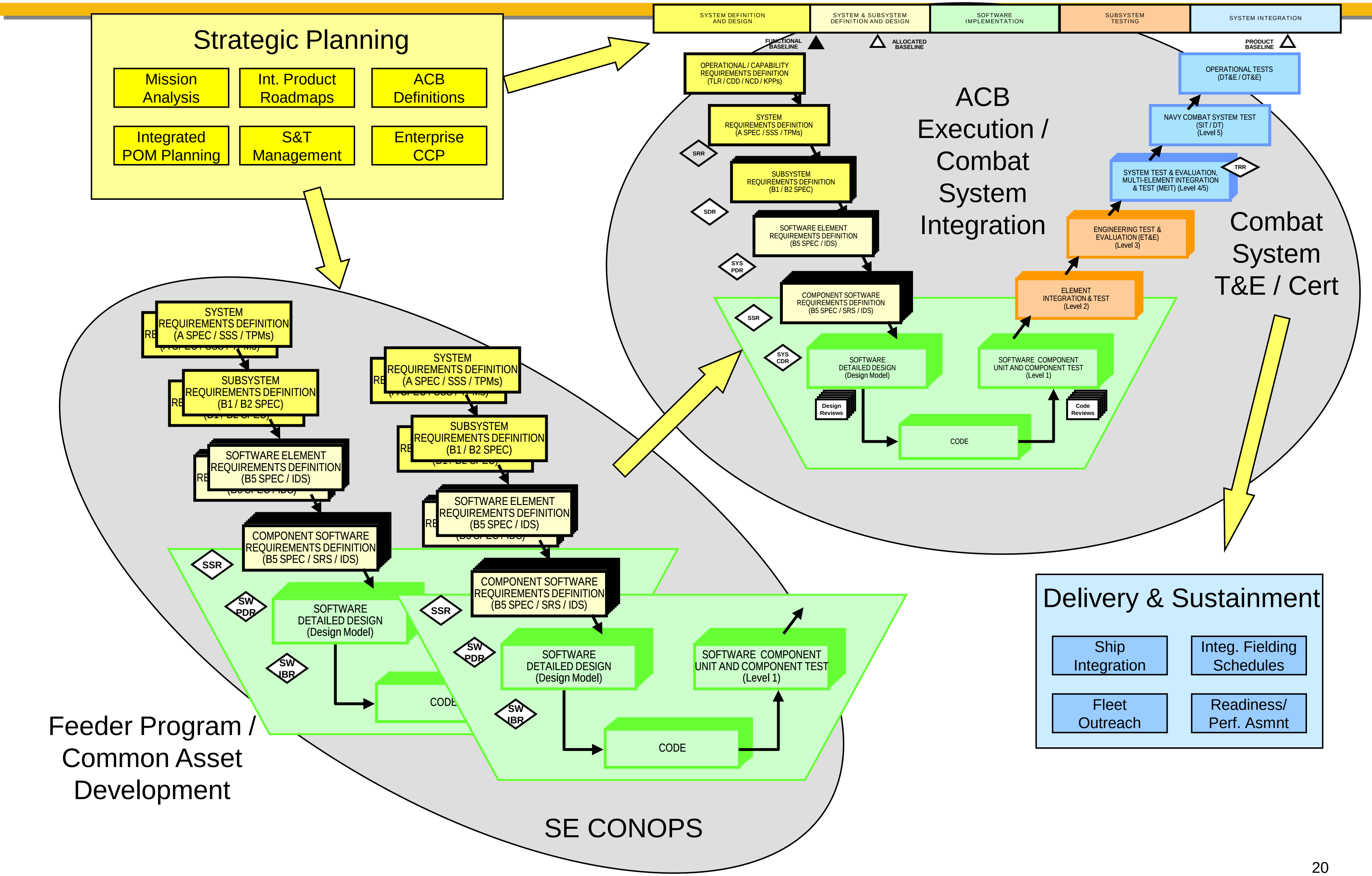


Information Assurance is a Significant Hurtle to Resolve:
PEO IWS and C4I will coordinate inputs to consolidated C&A activity

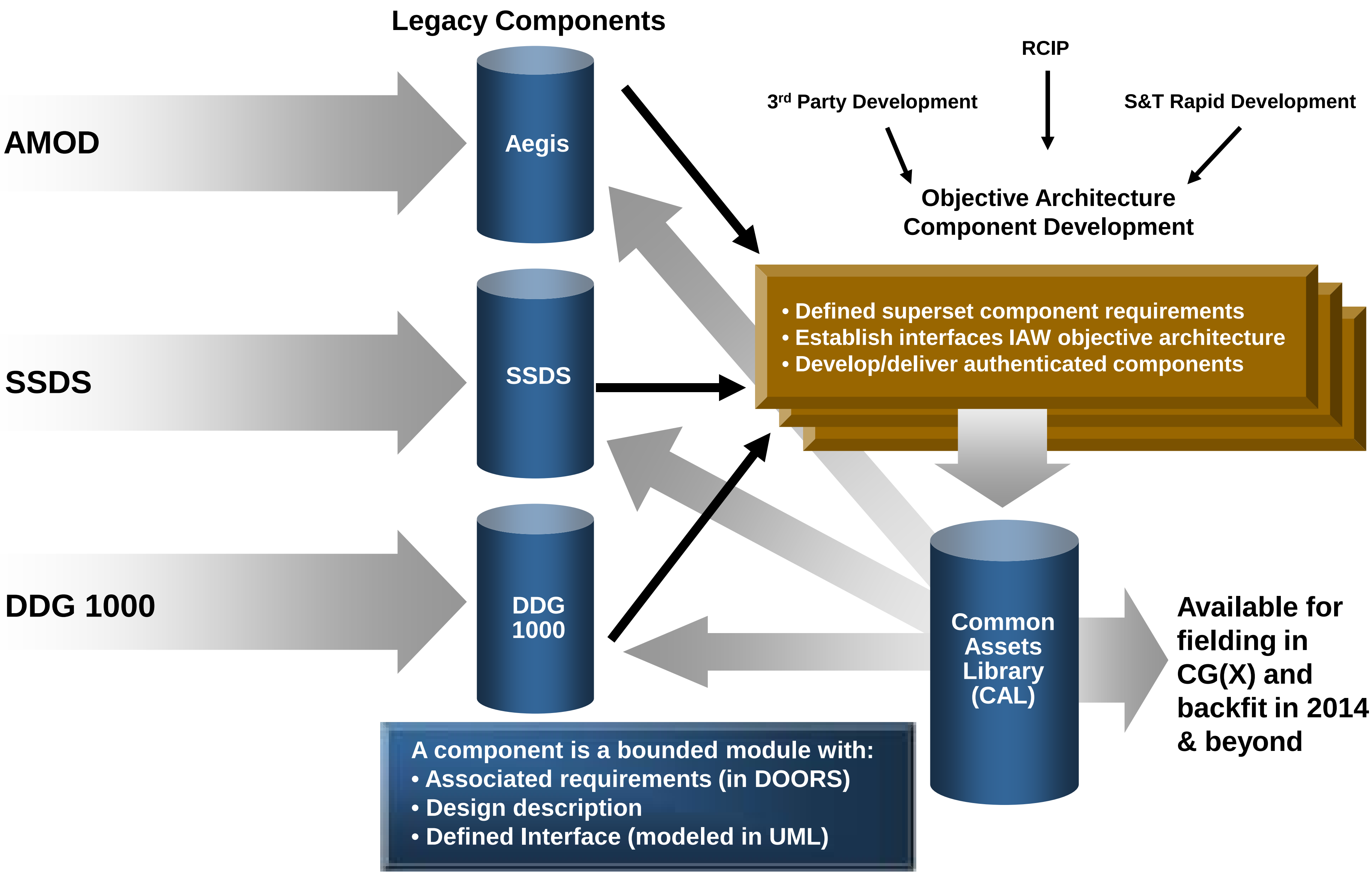
Common Component Requirements Flow from Combat System Requirements – PSEAs Involved



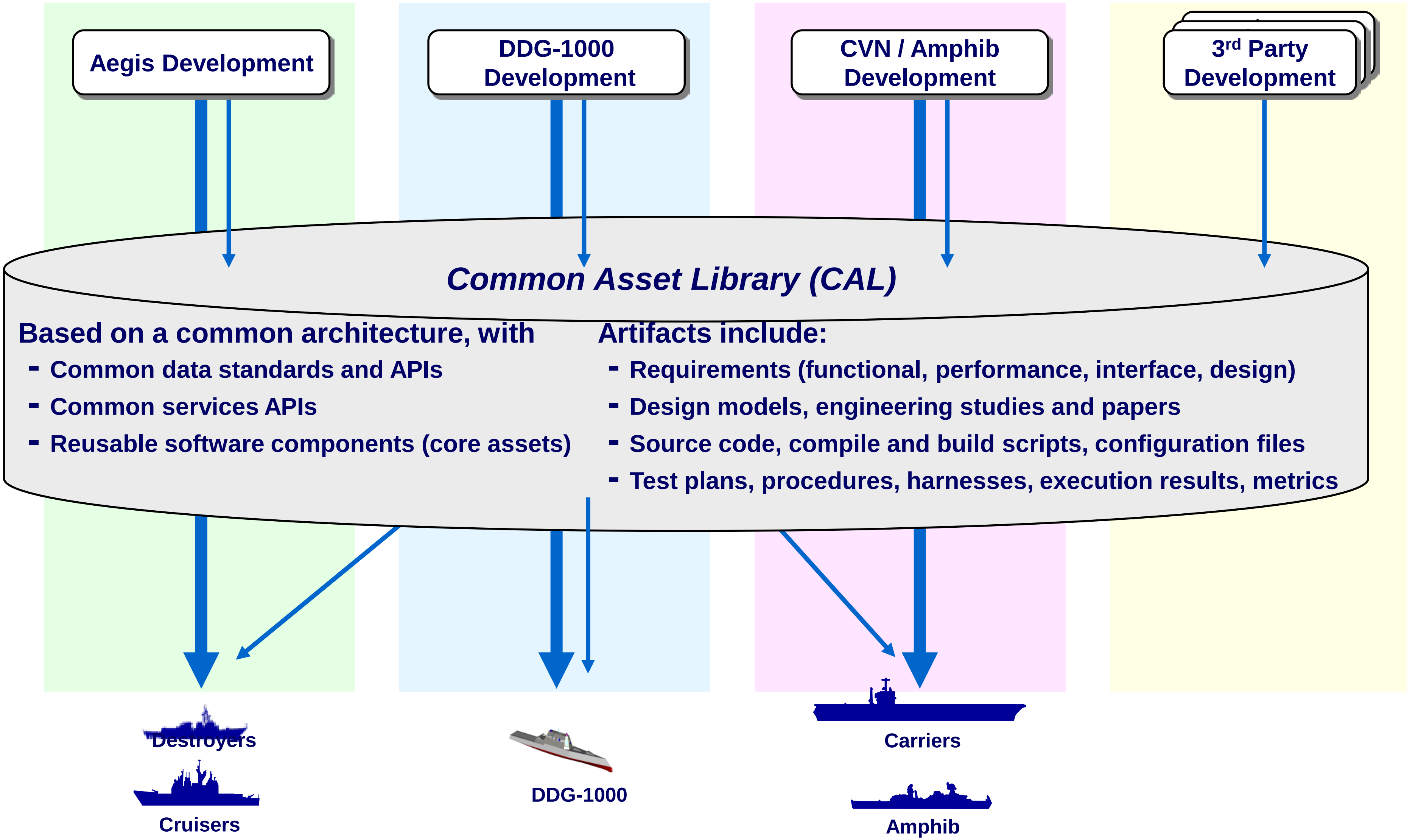
Process Definitions Needed for Each Phase from Strategic Planning to Delivery / Sustainment



Combat System Objective Architecture Component and Interface Definition



PEO IWS Product Line Approach for Surface Combat Systems



Benefits of Componentized Objective Architecture

- Common allocations and interfaces allow components to be reused across Combat Systems
  - Reuse reduces integration and test costs for new development
  - Improves interoperability and eases operator cross-decking
- Componentization localizes changes
  - Reduces Test / Cert costs for subsequent upgrades for component level changes
- S&T and new developers know how and where their products can fit in
  - Improved transition of new technology into Programs-of-Record
- Extensible to accommodate upcoming new warfighting capabilities:

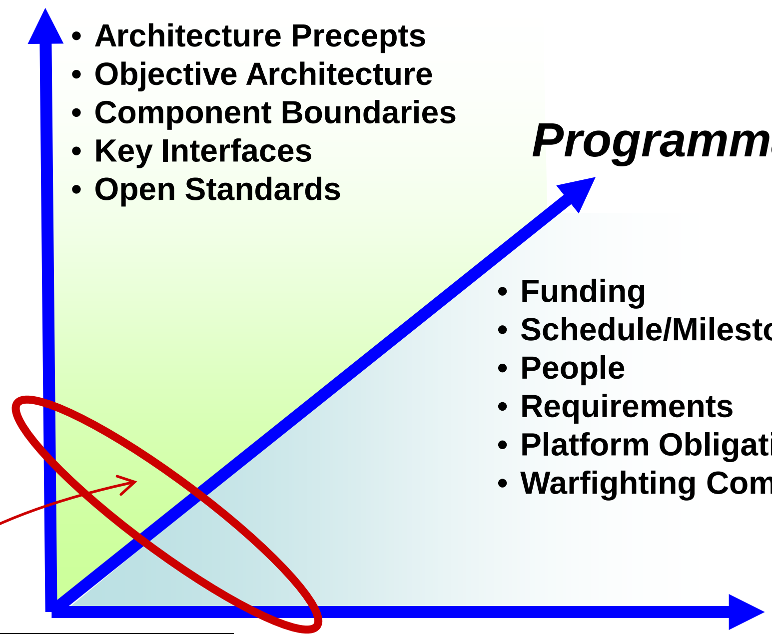
- Threat-D
- MH-60R Integration
- Netted Surface Tracking
- Ship Protection Systems
- Improved Surface and Underwater Pictures
- Net-centric Services
- Joint IFC / DWC
- Hardkill / Softkill Coordination
- Common Air Control
- Fleet Synthetic Training
- Distance Support
- Maintenance Free Operating Periods
- Optimized Manning Initiatives

Product Line Approach
Way Ahead Perspectives

Technical Precepts
- *Architecture*
  - *Component Based*
  - *Common Data Model*
  - *Network-based interfaces*
  - *Common framework for reqmts allocation*
- *Design for reuse / extensibility*
- *Extensive use of M&S and automated code, documentation and test tools & techniques*

Arch. Description Doc. (ADD) V1.0 July 2009

Technical



- **Architecture Precepts**
- **Objective Architecture**
- **Component Boundaries**
- **Key Interfaces**
- **Open Standards**

Programmatic

- **Funding**
- **Schedule/Milestones**
- **People**
- **Requirements**
- **Platform Obligations**
- **Warfighting Commitments**

Acquisition

- **Number/Types of Participants**
- **Contracting Approaches**
- **Peer Review Processes**
- **Roles and Responsibilities**
- **Incentivizing "Enterprise" Behavior**

Governance (Formalized)

- **IWS Systems Engineering Board**
  - **Cross-Program Coordination**
  - **Approval and Decision Process**
- **Architecture and Interface Control**
- **Enterprise Configuration Management**
- **Open Peer Review Process**
- **Common Asset Mgmt & Reuse Library**
- **Facilitate Information Transfer**
- **S&T Roadmaps and Transition Plans**
- **Org. Roles and Responsibilities**

Sys Engr Mgmt Concept of Ops April 2010

Programmatic Precepts
- *Spiral evolution process*
  - *Bi-annual Advanced Capability Builds (ACBs)*
- *Decouple new capability development from ACB dates*
- *Rapid transformation to common core software*
- *Rapid Capability Insertion Process (RCIP) development*
- *Integrated POM Inputs and program roadmaps*
- *Product Line Tasking & Funding to field activities*

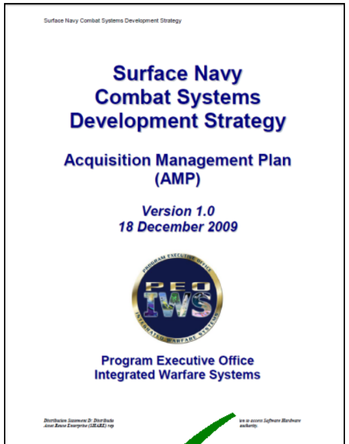
Acq Mgmt Plan (AMP) V1.0 Dec 2009

Acquisition Precepts
- *Open Business Model*
- *Data Rights and OA incentives*
- *3rd party development of components and capabilities*
- *Platform System Engineering Agents (PSEAs) for end-to-end C.S. engineering*
- *Competition at all levels*

Business Characteristics of OA

OPEN BUSINESS MODEL CHARACTERISTICS	OPEN SYSTEM MODEL CHARACTERISTICS
☑ OA language in contracts ☑ Appropriate Data Rights ☑ Design artifacts disclosed ☑ Design artifacts published in repositories ☑ Collaboration / Peer Reviews ☑ Continuous competition ☑ Rapid capability insertion process (RCIP) ☑ Fleet involvement	☑ Modular architecture ☑ Widely accepted/supported standards ☑ Use of commodity COTS ☑ Published Interfaces ☑ Isolated proprietary components

PEO IWS System Engineering Guidance


Surface Navy Combat Systems Development Strategy

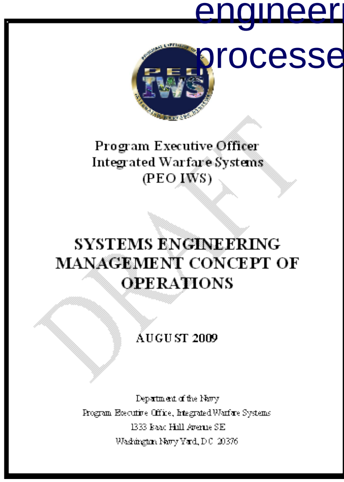
Surface Navy Combat Systems Development Strategy

Acquisition Management Plan (AMP)

Version 1.0
18 December 2009

Program Executive Office
Integrated Warfare Systems

Executive plan to build and maintain Open Architecture Combat Systems Provides objectives for stake holder alignment


Program Executive Officer
Integrated Warfare Systems
(PEO IWS)

SYSTEMS ENGINEERING MANAGEMENT CONCEPT OF OPERATIONS

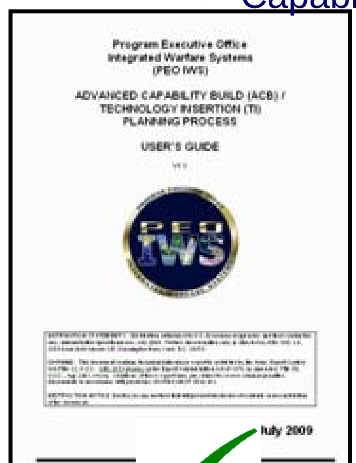
AUGUST 2009

DRAFT

Department of the Navy
Program Executive Office, Integrated Warfare Systems
1333 Isaac Hull Avenue SE
Washington Navy Yard, DC 20376

April 2010

Product line systems engineering processes

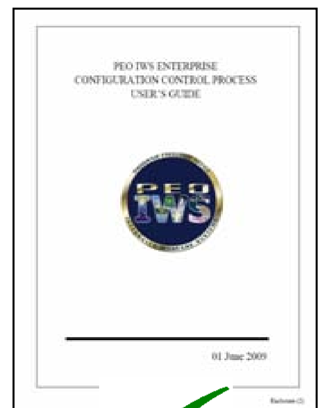

Program Executive Office
Integrated Warfare Systems
(PEO IWS)

ADVANCED CAPABILITY BUILD (ACB) / TECHNOLOGY INSERTION (TI) PLANNING PROCESS

USER'S GUIDE

July 2009

Process for planning and specifying combat system upgrades for bi-annual Advanced Capability Builds


PEO IWS ENTERPRISE
CONFIGURATION CONTROL PROCESS
USER'S GUIDE

01 June 2009

Integrated configuration management of overall portfolio of


SURFACE NAVY COMBAT SYSTEMS
SOFTWARE PRODUCT LINE ARCHITECTURE

ARCHITECTURE DESCRIPTION DOCUMENT

VERSION 1.0
31 July 2009

Describes software architecture for combat system product line with focus on Combat Management software