A sunset over the ocean with a ship silhouette. The sun is low on the horizon, casting a golden glow across the sky and reflecting on the water. A dark silhouette of a ship is visible on the horizon line.

Modular Open System Approach (MOSA)

NDIA DoD Technology Exposition

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Modular Open Systems Approach

- An integrated business and technical strategy that employs a modular design and defines key interfaces using widely supported, consensus-based standards that are published.
- Modular open architecture approach enables an acquisition strategy where:
 - Components may be acquired from multiple sources
 - Total system can be provided by multiple vendors
 - Multiple vendors may provide the replacement parts across the system over life cycle including upgrades

Goal is an Open RF Architecture Over Life Cycle



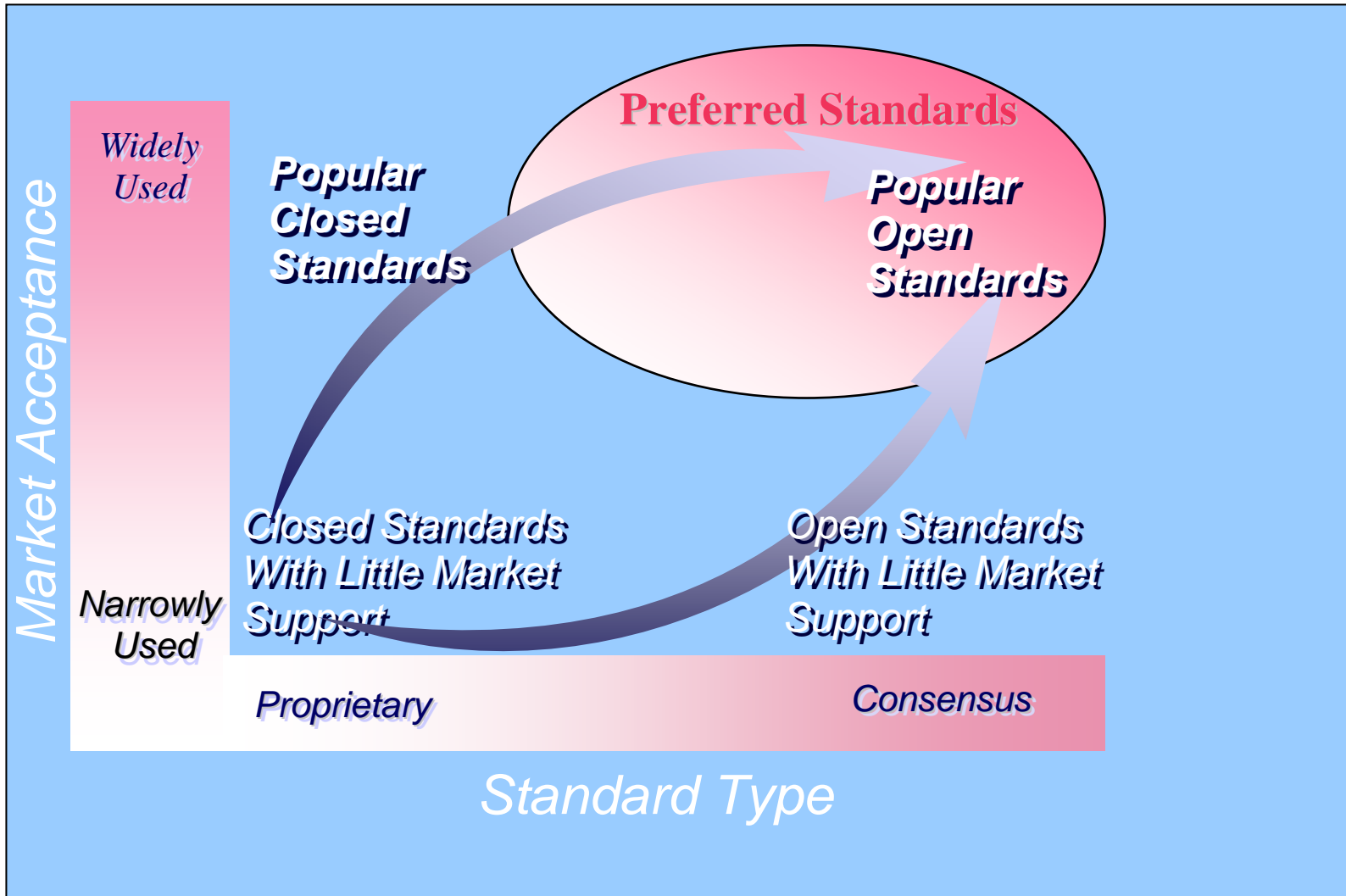
Public Law 104-113

- **With regard to non-government standards, Section 12d states:**

“(1) IN GENERAL. - Except as stated in paragraph (3) [exceptions] of this section, all Federal Agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments.



Preferred Standards

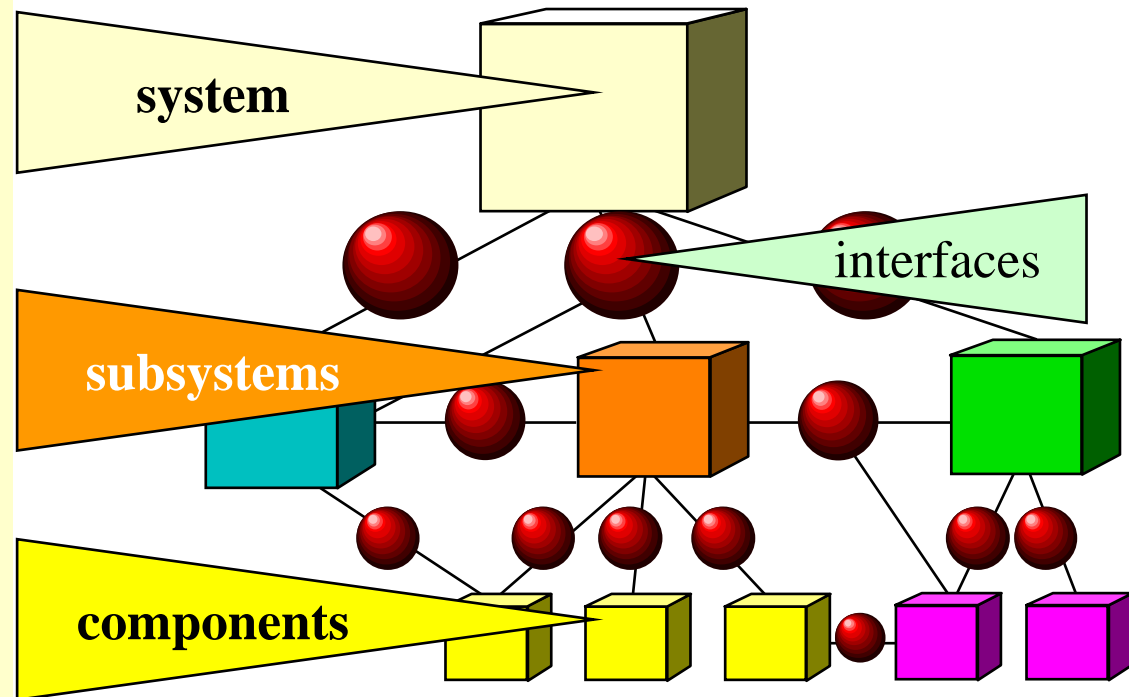


Definitions

A **system** -
is a collection of
interacting...

...**subsystems** -
which are collections of
interacting...

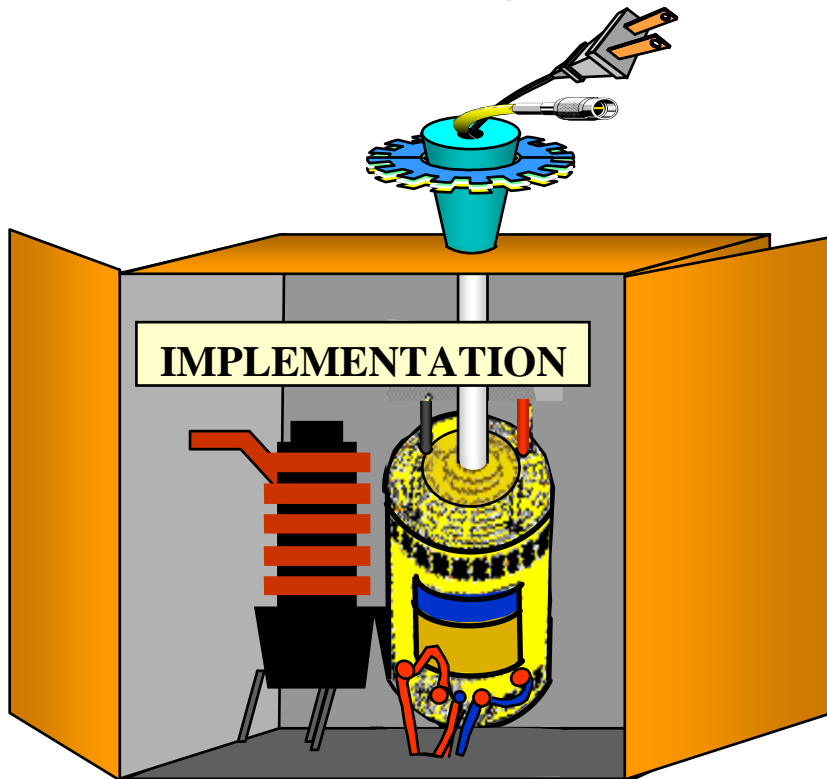
...**components** -
either hardware,
software, or human, ...



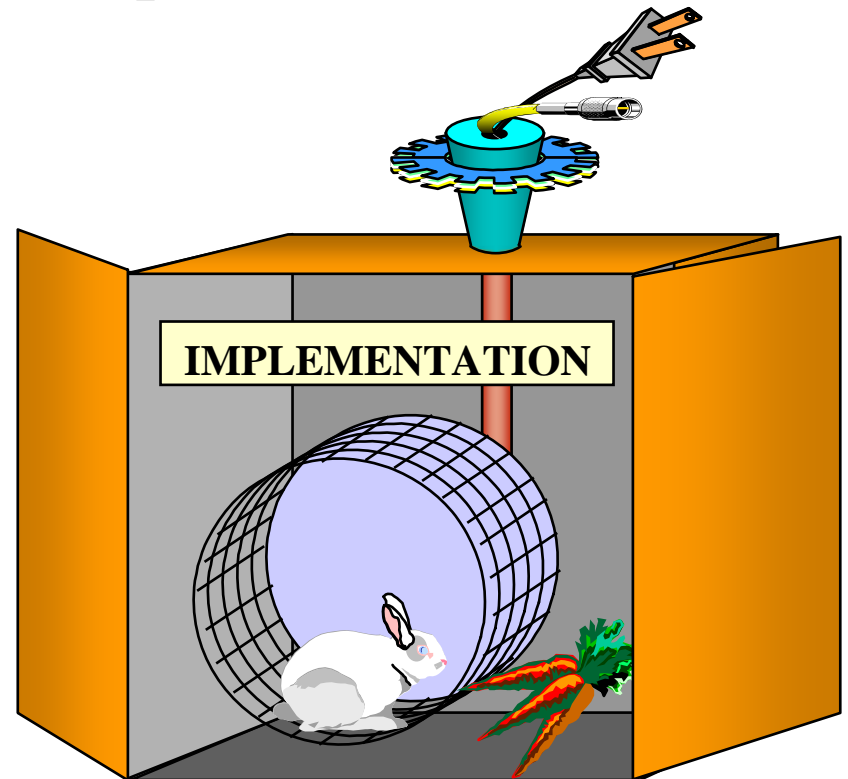
...that are connected by **interfaces** -
to support the interchange of information, activity, or material essential
to the functioning of the system.

Intellectual Property

Developer can choose any implementation as long as design meets interface specification.



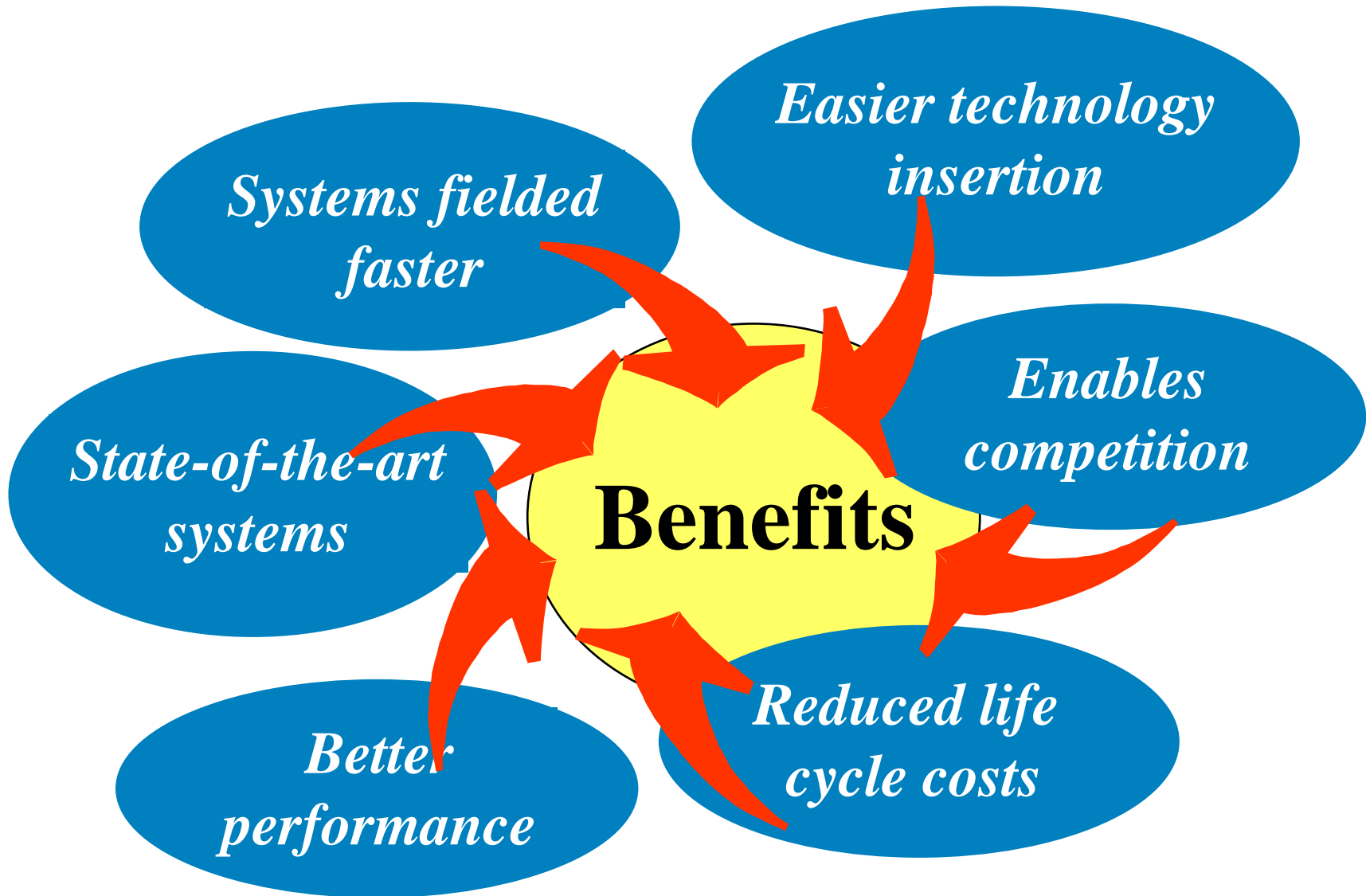
Component A



Component B

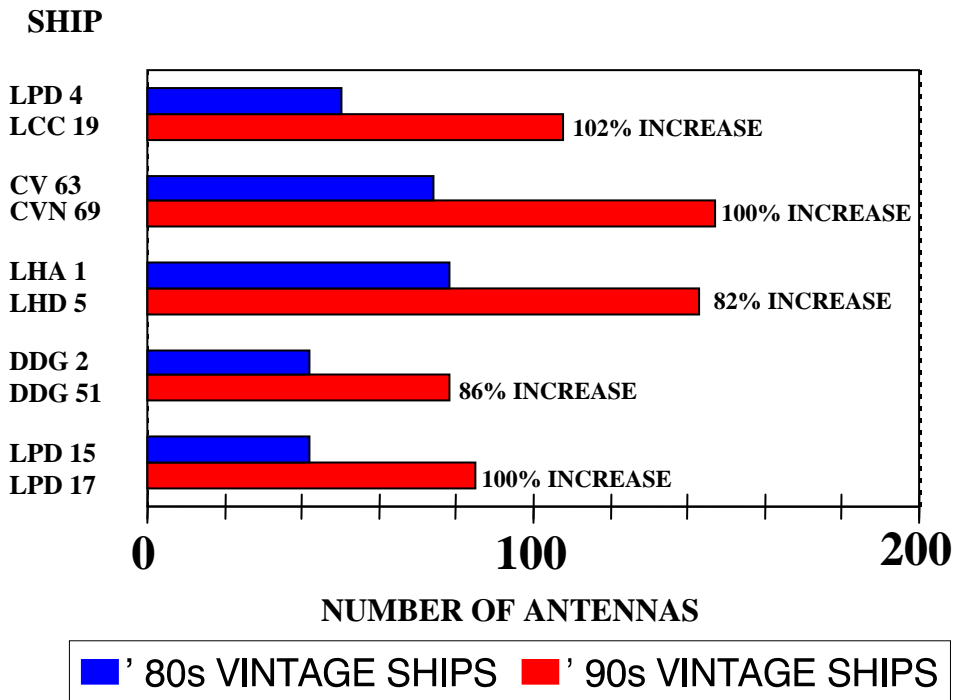


Benefits of Using Open Systems Standards

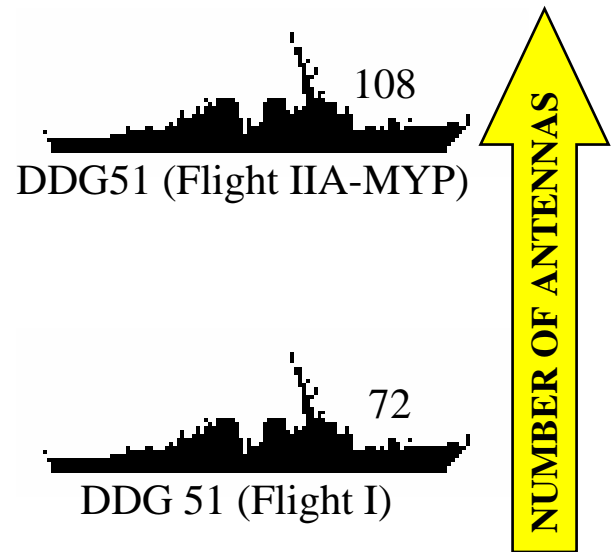




Motivation: Shipboard Antenna Growth



Antenna Growth within Ship Acquisition Program





Integrated Topside (IT) Objective

- Develop and demonstrate an integrated, multi-function, multi-beam top-side aperture construct that has:
 - A scalable family of EW & communications capability to support multiple classes of ships
 - Shared apertures for multiple functions
 - Software defined functionality
 - Cost effectiveness over the life cycle
 - Increased operational capability
 - Spiral development to reduce risk and costs and have high probability for transition of technology to the fleet
 - Modular open design (apertures and electronics) to facilitate competition



Next Steps

- Reviewed industry responses to NDIA questionnaire and issued RFI for industry to define strategies for developing specific architectures and interfaces (responses due 20 April 2007)
- Implement a management IPT that includes services, SECNAV, OPNAV, acquisition community
- Prepare for contract(s) in early FY08
- Continue coordination with other potential users (Army, Air Force, NAVAIR)

Prepare to initiate IT Program in earnest when funding available.



Advance Multi-Function RF Concept



AMRFC Site Today



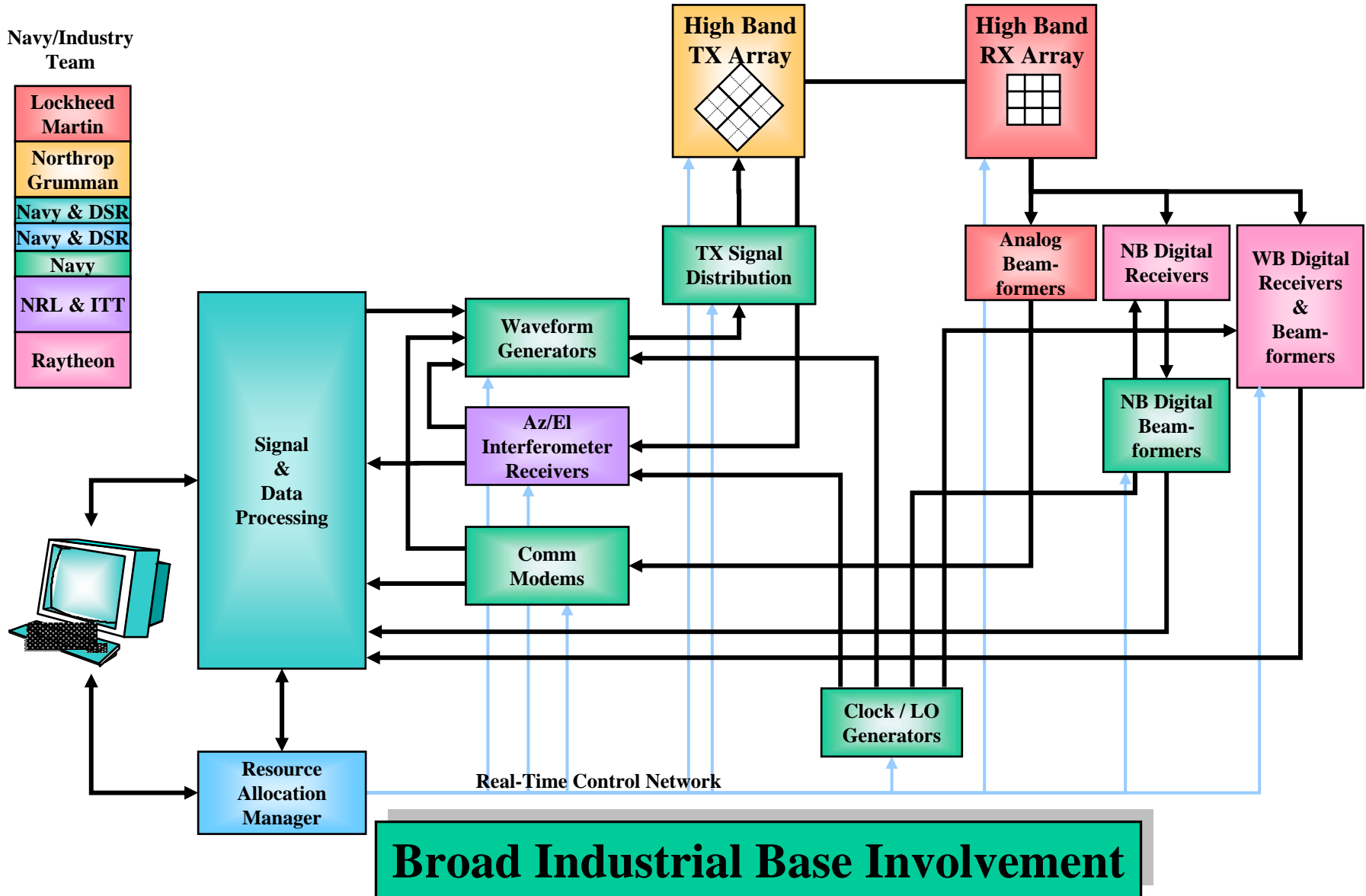
08 20 2004



AMRF-C Test-Bed High Level Block Diagram

Navy/Industry Team

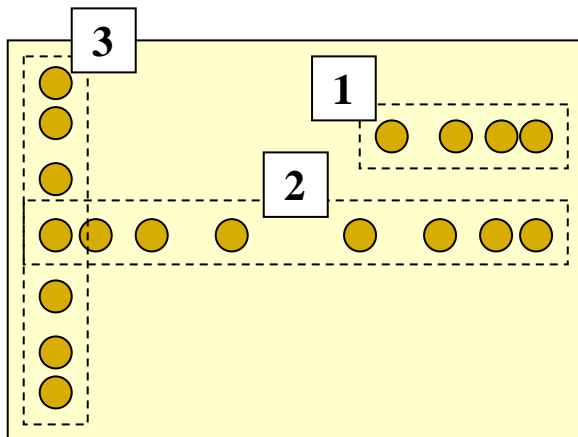
- Lockheed Martin
- Northrop Grumman
- Navy & DSR
- Navy & DSR
- Navy
- NRL & ITT
- Raytheon





Multi-Function EW System for DDG - 1000

MFEW Passive Arrays for DDG - 1000



- 1** (4) HPOI / Acquisition elements arranged as 4-element interferometer with 3x LOB accuracy of SLQ-32 at the horizon.
- 2** (8) Az PDF elements with 33" baseline provide compliant performance in all sea states, ship maneuvers, and signal polarizations.
- 3** (7) El PDF elements provides compliant performance in all but worst case conditions but may exceed top hat height restrictions.









Other Ship Classes

- DEEP WATER
 - SMALLER SHIPS (PATROL CRAFT, ETC):
 - NATIONAL SECURITY CUTTER: SLQ-32 REPLACEMENT
 - POTENTIAL FOR MISSION/CAMPAIGN BASED EQUIPMENT LOADS
- LCS
 - REDUCED SIZE/WEIGHT COMPARED TO SLQ-32
 - INCREASED COST ABOVE CURRENT FLIGHT 1 SOLUTIONS OFFSET BY INCREASED CAPABILITY AND REDUCED LOGISTICS COSTS
- BACK FIT SHIPS
 - SLQ-32 REPLACEMENT SIMPLIFIED BY USING ESE
 - SCALABLE FROM “SLQ-32 LITE” TO DD(X) PERFORMANCE
- CG(X)
 - DD(X) CONFIGURATION
- CVN-21, LHA
 - SEVERE SPACE LIMITATIONS ON ISLAND
 - INVESTIGATE P/S OR 4 QUADRANT INSTALLATIONS OFF ISLAND

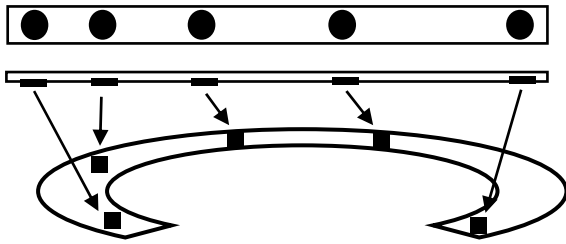


Multi-Function EW System

One System - Modular & Scalable

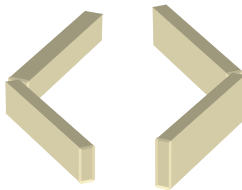
MF (EA)	\geq \$XXM		(1-5)	Unique application / installation
ES SA PDF SEI			(5-30)	Future combatants passive sensors DDG-1000, CG(X), etc.
		(100-200)	Back fit SLQ-32 replacement DDG, CG, etc.	
		(5-10)	Future SLQ-32 V2 replacement Deep Water National Security Cutter	
	\leq \$YM		(30-50)	Small ship self protection LCS, Deep Water OPC & FRC
				

Rx Aperture Options



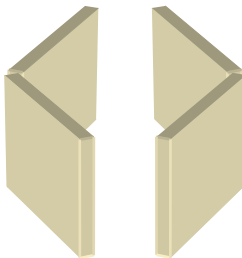
**1 panoramic circular array
interferometer**

- Acquisition
- Precision DF ($< 1^\circ$ AOA)
- SEI
- EA techniques



**4-element interferometer
per quadrant**

- Acquisition
- Medium DF (1° LOB)
- SEI
- EA techniques



**14-element interferometer
per quadrant**

- Acquisition
- Precision DF ($< 1^\circ$ AOA)
- SEI
- EA techniques



Modular Integrated Link Electronics System (MILES)

MILES

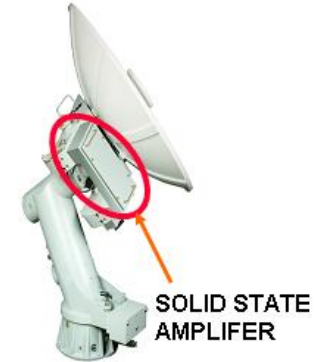
CDL-S EQUIPMENT SINGLE LINK



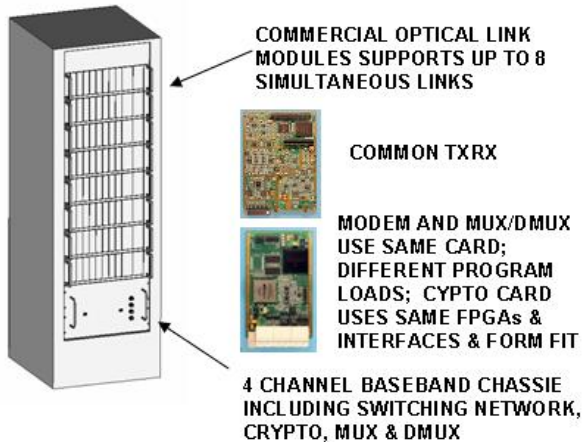
EHF SATCOM SYSTEM SINGLE LINK

BELOW DECK

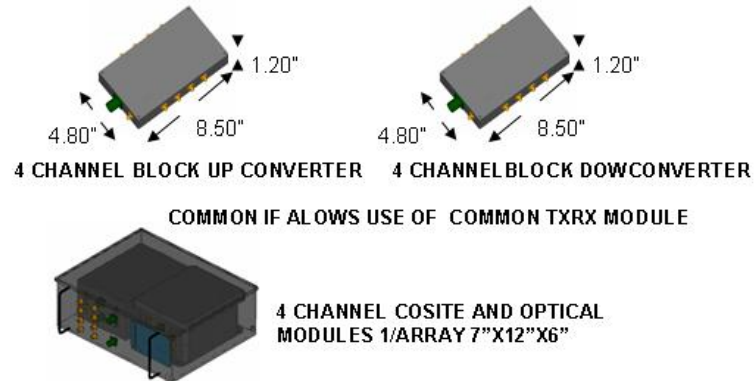
- PDU
- DISPLAY
- KEYBOARD
- EHF DRAWER
- GROWTH
- GROWTH



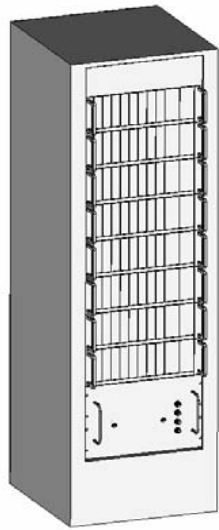
MILES BELOW DECK-8 LINKS



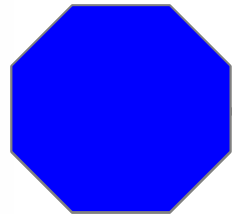
MILES ABOVE DECKS



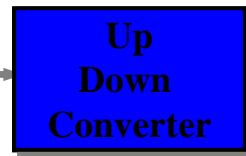
Modular RF System Architecture



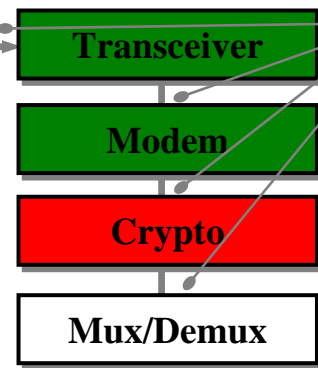
Vendor A



Vendor B



Vendor C or D



Standardized Interfaces

Vendor E or F

User

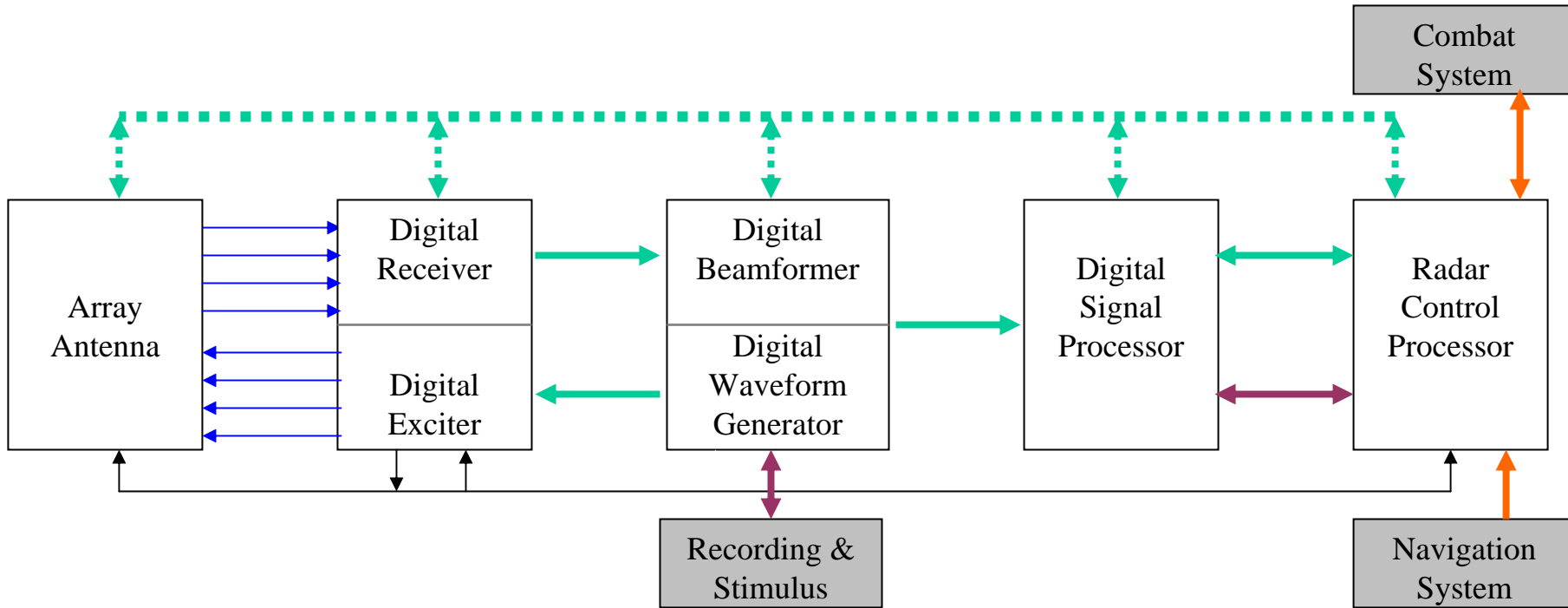
- Procure Up / Down-converter with Array to a Common Set of IF Frequencies
 - All Arrays Have a Standard RF Interface to Support Electronics
- Defined Interfaces Between Back-End Electronics Subsystems
- Common architecture for ground / airborne terminal applications
- Migrate to Digital Data Interface From Array To Below Decks Electronics



Digital Array Radar (DAR)



DAR Open Architecture Radar Specification (OARS)



- Analog Signal Lines
- Digital Messages (defined in DAR Interface Control Document)
- Digital Messages (defined elsewhere, but referenced by DAR ICD)
- Digital Messages to be defined in future
- Clock lines
- DAR Subsystems
- External Subsystems

Modular architecture allows subsystem development by multiple vendors



Summary

Objective is to develop concept for RF Modular Open System Architecture to:

- Provide for RF systems that can be scalable across multiple platforms
- Enable multiple vendors to provide best of breed for the subsystems
- Enable rapid, innovative upgrades over the systems life cycle
- Cost effectiveness over the life cycle