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
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

- Closed Standards
- Open Standards

- Widely Used
- Narrowly Used

- Popular
- Consensus

- Proprietary
- Standard Type
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.
Developer can choose any implementation as long as design meets interface specification.
Benefits of Using Open Systems Standards

- Easier technology insertion
- Enables competition
- Reduced life cycle costs
- Better performance
- State-of-the-art systems
- Systems fielded faster

Benefits
Motivation: Shipboard Antenna Growth

Antenna Growth within Ship Acquisition Program

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<th>SHIP</th>
<th>NUMBER OF ANTENNAS</th>
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’80s VINTAGE SHIPS vs. ’90s VINTAGE SHIPS
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
AMRF-C Test-Bed High Level Block Diagram

Navy/Industry Team
- Lockheed Martin
- Northrop Grumman
- Navy & DSR
- Navy
- NRL & ITT
- Raytheon

High Band TX Array
- Waveform Generators
- Az/El Interferometer Receivers
- Comm Modems
- Clock / LO Generators

High Band RX Array
- Analog Beamformers
- NB Digital Receivers
- NB Digital Beamformers

Signal & Data Processing
- Resource Allocation Manager

Real-Time Control Network

Broad Industrial Base Involvement
Multi-Function EW System for DDG - 1000
(4) HPOI / Acquisition elements arranged as 4-element interferometer with 3x LOB accuracy of SLQ-32 at the horizon.

(8) Az PDF elements with 33” baseline provide compliant performance in all sea states, ship maneuvers, and signal polarizations.

(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

≥ $XXM

Unique application / installation

(1-5) Future combatants passive sensors
DDG-1000, CG(X), etc.

(5-30) Back fit SLQ-32 replacement
DDG, CG, etc.

(100-200) Future SLQ-32 V2 replacement
Deep Water National Security Cutter

≤ $YM

Small ship self protection
LCS, Deep Water OPC & FRC

(5-10)

(30-50)
Rx Aperture Options

1 panoramic circular array interferometer

- Acquisition
- Precision DF (< 1° 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° 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
SOLID STATE AMPLIFIER

MILES BELOW DECKS-8 LINKS

COMMERCIAL OPTICAL LINK
MODULES SUPPORTS UP TO 8 SIMULTANEOUS LINKS

COMMON TXRX

MODEM AND MUX/DMUX
USE SAME CARD; DIFFERENT PROGRAM LOADS; CRYPTO CARD USES SAME FPGA & INTERFACES & FORM FIT

4 CHANNEL BASE/BAND CHASSIE INCLUDING SWITCHING NETWORK, CRYPTO, MUX & DMUX

MILES ABOVE DECKS

4 CHANNEL BLOCK UP CONVERTER
4 CHANNEL BLOCK DOWNCORDER

COMMON IF ALLOWS USE OF COMMON TXRX MODULE

4 CHANNEL COSITE AND OPTICAL MODULES 1/4ARRAY 7"X12"X6"
Modular RF System Architecture

- 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

Standardized Interfaces

Vendor A
Vendor B
Vendor C or D
Vendor E or F
User

Up Down Converter
Transceiver
Modem
Crypto
Mux/Demux
Digital Array Radar (DAR)
DAR Open Architecture Radar Specification (OARS)

Modular architecture allows subsystem development by multiple vendors
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