Tri-Service Convergence:

An Open Architecture for Embedded System Development

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Problem Statement

- **Years of quick reaction solutions have resulted in proprietary systems that are expensive to procure, maintain, and modify**
  - Redundant hardware exceeds the size, weight and power available on tactical platforms
  - Integration challenges result in compatibility concerns and degraded performance
- **The threat is evolving faster than our architectures and processes can adapt**
  - The issue is NOT a lack of innovation, but the inability of our systems to rapidly exploit innovation to restore combat advantage
- **Cost growth for sensors is outpacing our ability to pay for them**

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DoD Open Architecture Initiatives

- **HOST**
  - Hardware Open Systems Technologies standard
  - Initiated by US Navy's Naval Air Systems Command (NAVAIR) Patuxent River MD ~2014
- **CMOSS**
  - Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) / Electronic Warfare (EW) Modular Open Suite of Standards
  - Initiated by US Army's Communications-Electronics Research, Development and Engineering Center (CERDEC) at Aberdeen Proving Grounds MD ~2013
- **SOSA**
  - Sensor Open System Architecture Standard
  - Initiated by US Air Force's Life Cycle Management Center (AFLCMC) at Wright-Patterson AFB, Ohio as an Open Group committee
    - Incubated in the Future Airborne Computing Environment (FACE) Consortium in ~2015
    - Stood up as consortium November 2017

Army, Air Force, and Navy are collaborating under SOSA to develop a holistic open architecture that leverages existing standards, maximizes economies of scale, and provides the flexibility to rapidly insert the latest capabilities

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HOST Objectives

- **Create a hardware technical reference framework**
  - Used for developing embedded computing systems
- **Improve affordability**
  - Enables reuse
  - Increasing economies of scale opportunities
- **Enable effective and timely technology refresh cycles**
  - Abstract hardware from software
    - Acquisition community can pre-plan tech refreshes even during initial system acquisition program
    - Vendors know module interfaces, mitigating risk in new product investment
- **Initial focus on airborne mission processing**

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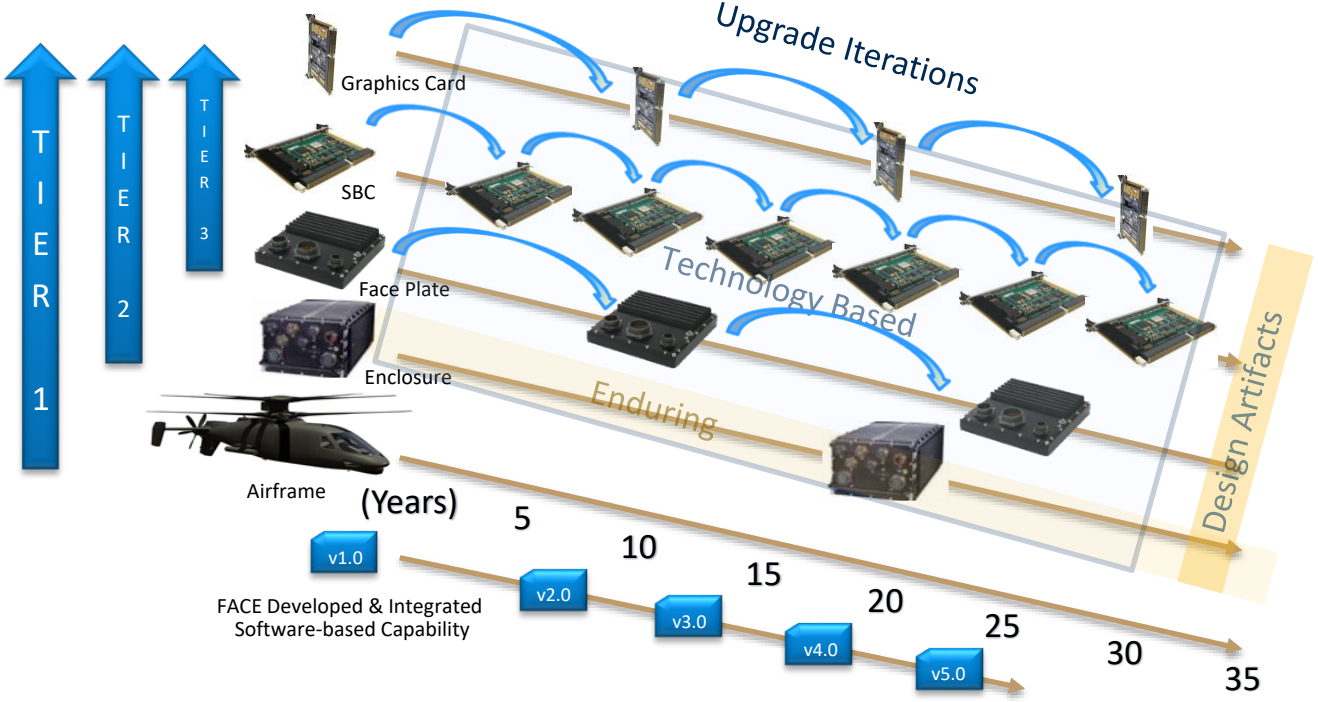
HOST Creates Module Level Specification

- **Establish interchangeability at the module level**
  - Specify hardware interfaces (e.g. pin and protocol) allowing creation of standardize modules
  - Create generic module requirements (e.g. single board computers (SBCs) or switch cards)
  - Is silent on functional requirements for particular payload capabilities
- **Establish interoperability through a layered approach which adds requirements for programmable logic**
  - Allow reconfigurability so that one component (e.g. SBC) can operate in two different systems
- **Enable components to be interchanged across systems utilizing common reconfigurable logic (e.g. Field Programmable Gate Array)**

HOST Vision



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HOST's Three Tiered Structure

- **Tier 1**
  - Establishes universal requirements that apply to all HOST components regardless of core technology
  - Extensible to multiple core technologies (e.g. other formats)
  - Only one Tier 1 ever anticipated
- **Tier 2**
  - Defines platform agnostic technical requirements for each core technologies
  - Currently only the OpenVPX Tier 2 standard exists
    - Considering other application space for the next Tier 2
    - Thoughts include
      - Unmanned vehicles or smaller format than 3U
      - Weapon systems with unusual formats (e.g. round format)

HOST's Three Tiered Structure

- **Tier 3**
  - Specifies module level requirements (e.g. one for every unique module)
  - Define hardware requirements that must be combined with system unique requirements
    - Must add requirements to be a complete specification
      - Programmable logic
      - Payload capabilities
      - Integration logic (e.g. system startup, hardware management, etc.)
    - Component level documents that will guide H/W development to facilitate modular components, Tier 3 reuse, and upgradeability
  - Allows end user to create a component registry of Tier 3 specifications
    - Useable for management of a family of products (e.g. modularized systems)
    - Useable for sharing modules across programs and services

CMOSS Overview

Software Layer – REDHAWK, Software Communications Architecture (SCA), Future Airborne Capability Environment (FACE):

- Enables portability of software applications across hardware platforms
- Software framework selected based on mission area

Functional Decomposition – Modular Open RF Architecture (MORA):

- Extends VICTORY to RF systems
- Defines interfaces between RF functions and components
- Establishes pooled RF resources (antennas, amplifiers, etc.) that can be shared across missions

Hardware Layer – CMOSS OpenVPX Profiles:

- Enables capabilities to be fielded as cards in common chassis
- DoD profiles eliminate user-defined pins and enable 2 Level Maintenance
- Single profile selected for each type of slot

Network Layer – Vehicular Integration for C4ISR/EW Interoperability (VICTORY):

- Provides interoperability across C4ISR, EW, and platform systems
- Adds a network data bus to vehicles and specifies "on-the-wire" interfaces
- Enables sharing of services such as Time, Position, and Orientation

Consists of a suite of layered standards that are individually useful and can be combined to form a holistic converged architecture

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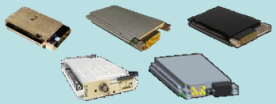
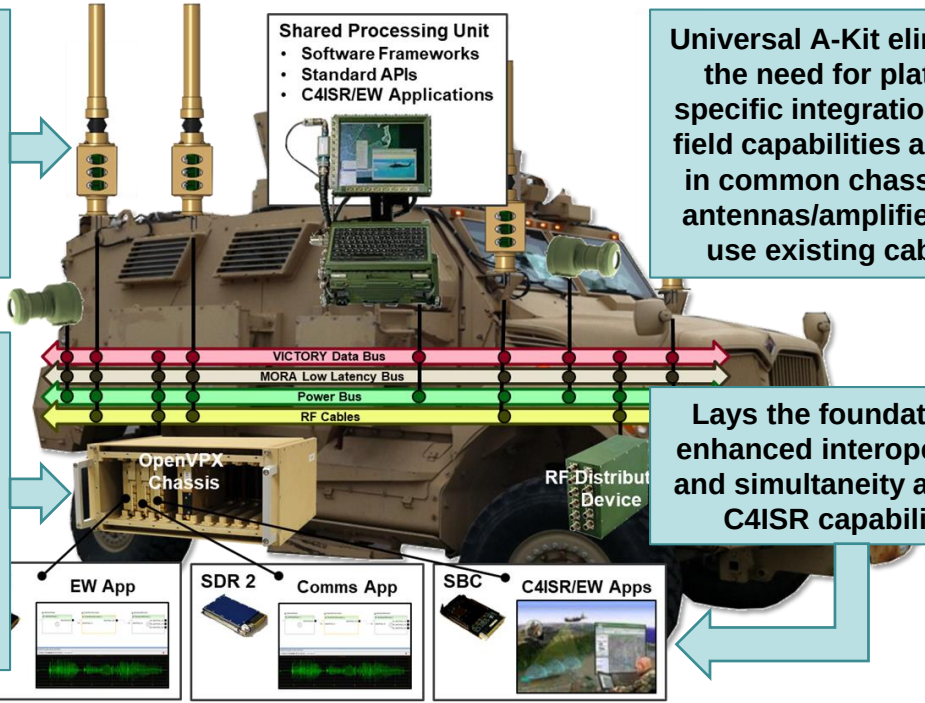
CMOSS Vision

Reduce the size, weight and power footprint of C4ISR systems by sharing hardware such as antennas and amplifiers.

Enable rapid technology insertion using best of breed capabilities to address emerging requirements.





Universal A-Kit eliminates the need for platform specific integration. PMs field capabilities as cards in common chassis and antennas/amplifiers that use existing cabling.

Lays the foundation for enhanced interoperability and simultaneity amongst C4ISR capabilities.

Reduce logistics tails by enabling common sparing. Eliminate the need for "End of Life" buys for a 30+ years sustainment by enabling hardware modernization every 5-10 years

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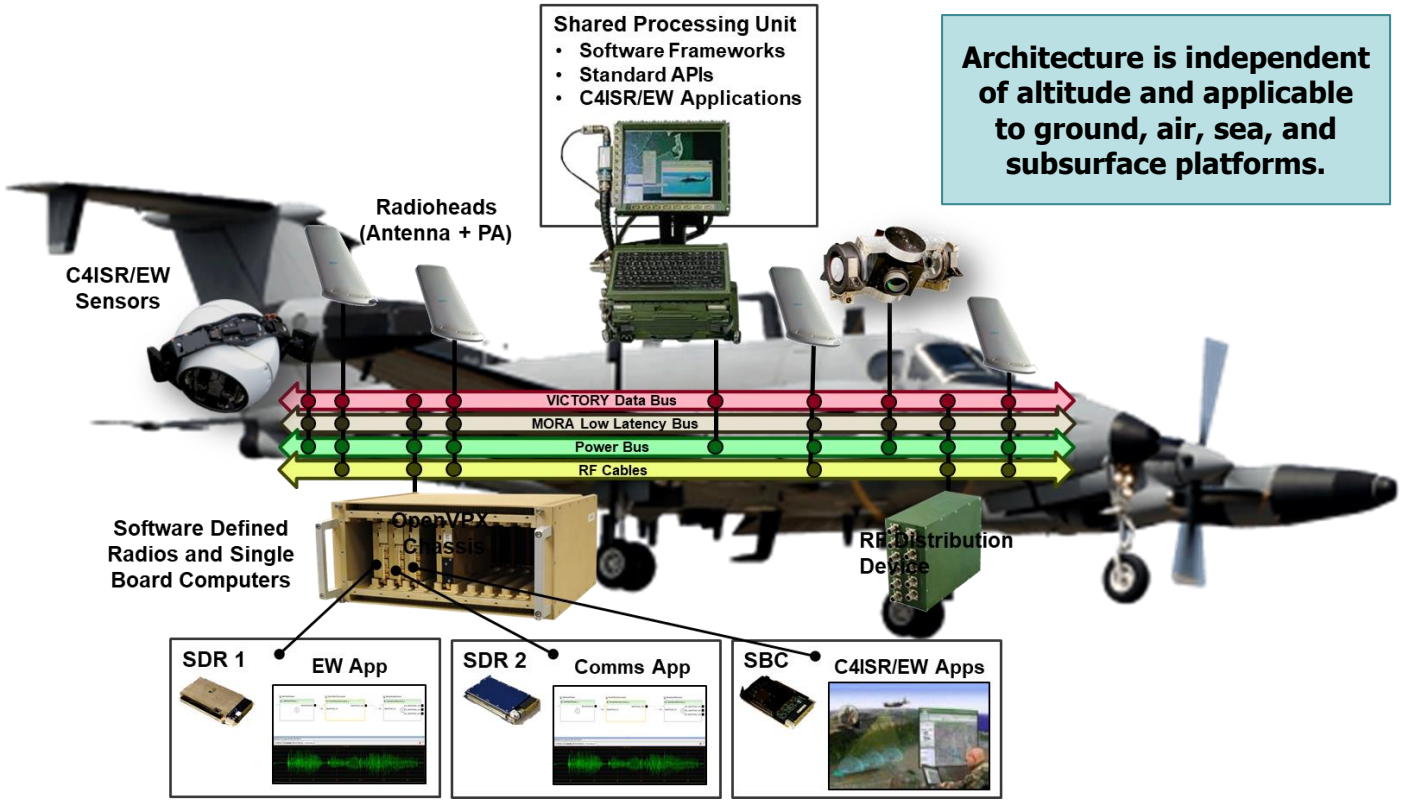
CMOSS Vision



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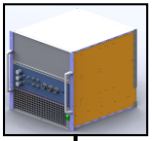
CMOSS Maturation

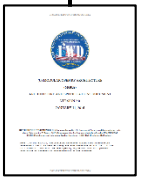
MORA V1.1
SEP 14

VICTORY Standard Specifications V1.6.2
MAR 15

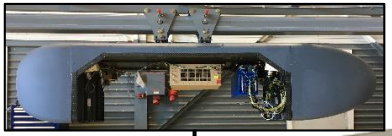
CMOSS Lab Demo
APR 15



MORA V2.0
JAN 16



SOSA Proof of Concept Demo
JUN 17



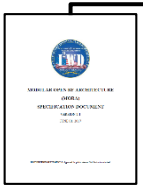
CMOSS Lab Demo
APR 17

CMOSS Vehicle Demo
OCT 17

CMOSS in SOSA Snapshot
FEB 18

MORA in VICTORY Architecture A4
NOV 17

MORA V2.1
JUN 17



CMOSS Profiles in OpenVPX
JUL 17

MORA Requirements in ANSI/VITA 49.2
JUL 17

Industry is actively developing capabilities:

- 7+ radio cards
- 2 PNT cards
- COTS processing cards
- 5 systems

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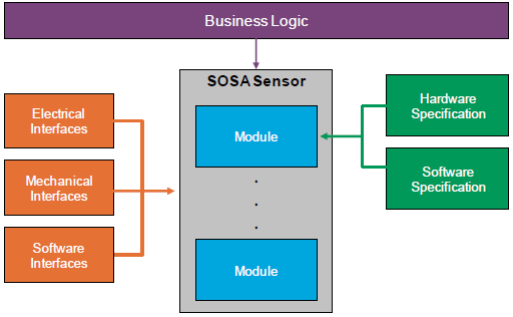
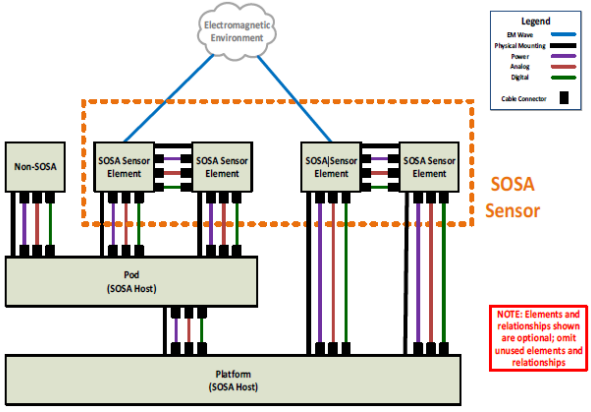
SOSA Overview

- **Collaborative effort across C4ISR development community**
- **Includes users and suppliers**
  - Air Force, Army, Navy, and Other Government Agencies (OGAs)
  - Industry partners
    - Prime contractors, integrators, systems developers, module and payload developers, etc.
  - See SOSA Open Group Forum for complete list of participants
- **Jointly developing common standards for sensor subsystems at the electrical, mechanical and software interfaces**



SOSA Facets
(from SOSA Technical Standard Snapshot 1)



SOSA SV-1
(from SOSA Technical Standards Snapshot 1)

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SOSA Consortium Objectives

Develop

- An effective Sensor Open Systems Architecture (SOSA) for use across the C4ISR community to include Air Force, DoD, and other governmental agencies

Maximize

- Platform and system affordability, reconfigurability, performance, and re-use

Define

- Open interface standards for various sensor modalities including Radar, EO/IR, SIGINT, EW and Communications

Prepare

- Tech package support for future RFPs

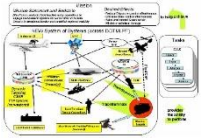
SOSA addresses key operational needs across all sensors

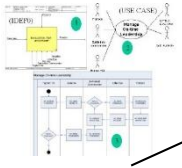
SOSA Vision

VISION - Business/acquisition practices and a technical environment for sensors and C4ISR payloads that foster innovation, industry engagement, competition, and allow for rapid fielding of cost-effective capabilities and platform mission reconfiguration while minimizing logistical requirements

Open	Standardized	Harmonized	Aligned	Cost Effective	Adaptable
Vendor and platform agnostic open modular reference architecture and business model	Software, hardware, and mechanical module interface standards	Leverage existing and emerging open standards such as: FACE, OMS, SPIES, CMOSS, VICTORY, VITA	Consistent with DoD acquisition policy guidance	Affordable C4ISR systems including lifecycle costs	Rapidly responsive to changing user requirements

SOSA Scope and Working Groups

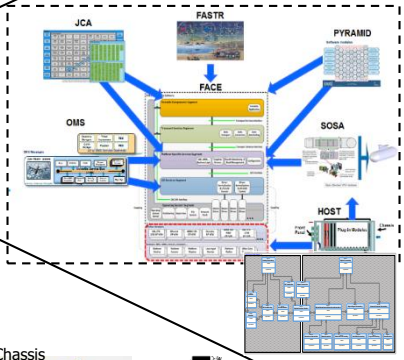


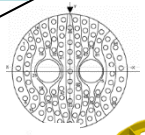


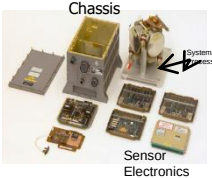
Data Rights
IP
Contracting Guide

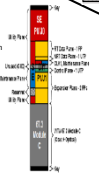
SOW
CDRL
DID
Section L, M Support

Marketing
Outreach
Business Development
Open Acquisition Guide









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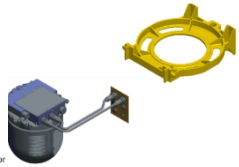
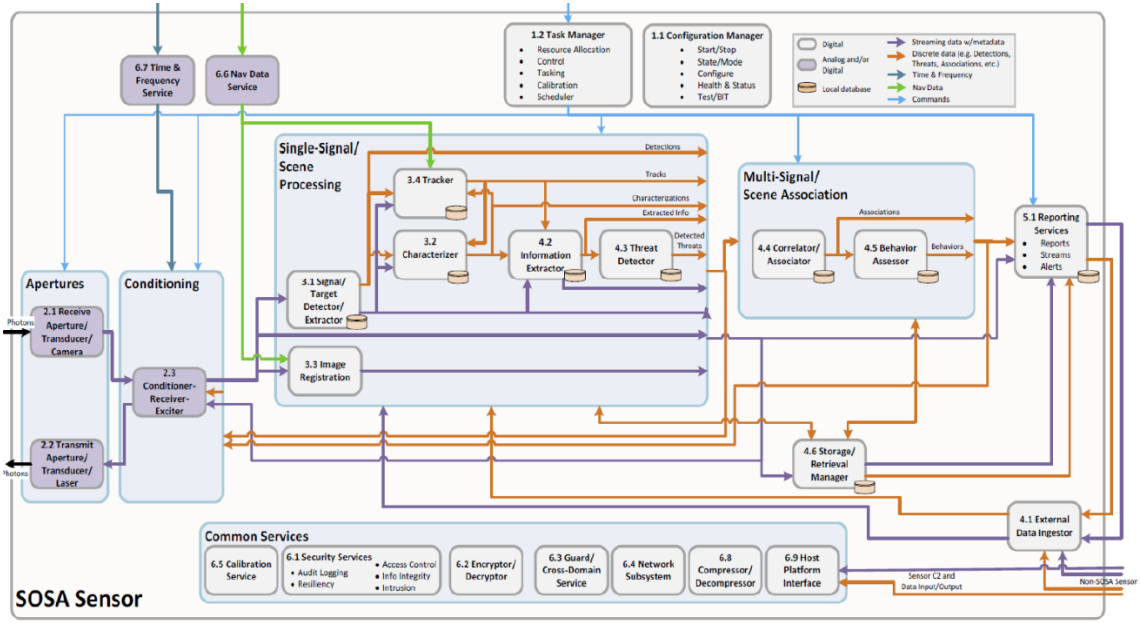
SOSA Architecture





Each module is designed to be competitively procurable and translatable to selected OSA's

Summary

- **Tri-service Coordination for a Common Architecture Approach**
  - Establishing a common approach to embedded system standardization across all three services
  - Using industry standards wherever possible (e.g. VITA, VICTORY, MORA, etc.)
    - Adding specificity where necessary for interchangeability or interoperability
  - Creating / extending standards where necessary
    - Examples include chassis / hardware management
- **Converging in one standards body – SOSA**
  - HOST being mapped into CMOSS and added to SOSA
  - CMOSS being absorbed under SOSA
  - SOSA being extended and broadened to fulfill open architectures goals