Tri-service Convergence:

C4ISR/EW Modular Open Suite of Standards (CMOSS)

Embedded Tech Trends

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Problem Statement – Why Converge?

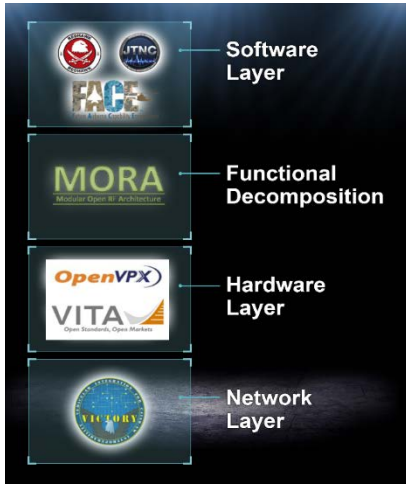
Years of quick reaction solutions have resulted in unsustainable SWaP-C and operator overload

- Current generation of C4ISR/EW systems exceed the size, weight, and/or power available on current and planned future platforms
- At the core, C4ISR/EW systems use many of the same building blocks, but they are not shared or distributed between systems
- Each additional capability or function comes as its own “system” resulting in:
  - Integration challenges
    - Competition for limited platform resources
    - Redundant sub-system components
    - Complex, costly and weighty cabling
    - Excessive heat generation
    - Less space on the platform for soldiers
  - RF compatibility concerns
  - High cost of maintaining and upgrading

Platforms – not just soldiers – are overburdened

Layered Standards

- Open interfaces enable rapid insertion of planned and unplanned capabilities, along with hardware sharing and interoperability across C4ISR/EW systems
- Layered approach includes specifications that are individually useful and can be combined to form a holistic converged architecture
- The aggregate architecture and associated standards is referred to as the **C4ISR/EW Modular Open Suite of Standards (CMOSS)**



Software Layer:

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

Functional Decomposition:

- Allows for sharing of RF resources such as antennas and amplifiers
- Defines interfaces between RF functions and components
- Enables best of breed along with rapid component upgrades

Hardware Layer:

- Enables capabilities to be fielded as cards in a common chassis
- Common form factor including physical, electrical, and environmental specifications

Network Layer:

- Provides connectivity within the platform and defines interfaces between capabilities
- Enables legacy systems to share services within the converged architecture

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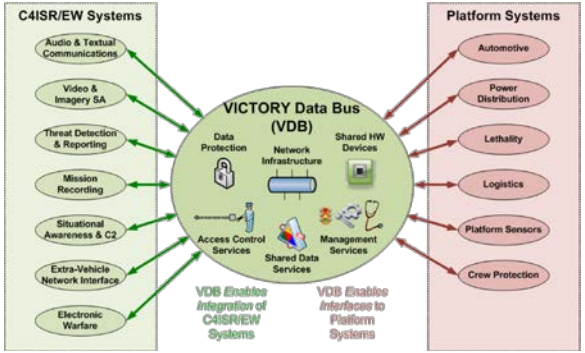
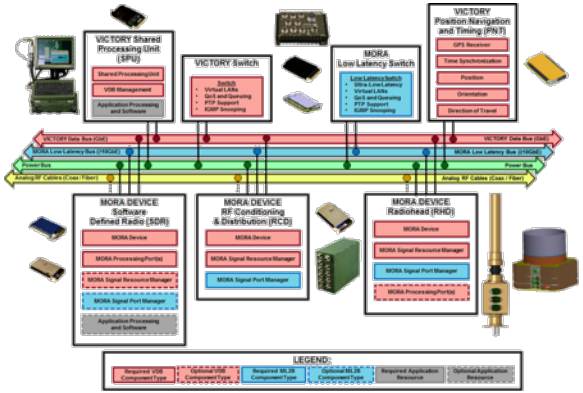
Standards Overview

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
- Applicable to ground, air, and sea platforms

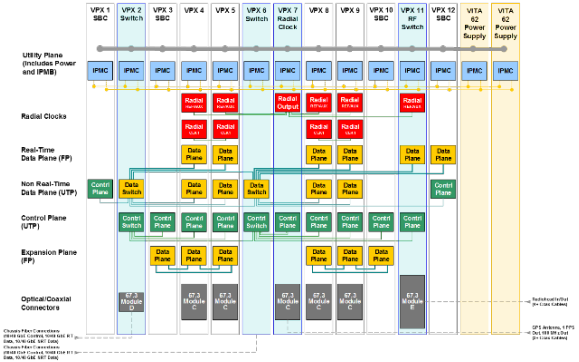
Modular Open RF Architecture (MORA)



- Extends VICTORY to RF systems
- Establishes pooled RF resources (antennas, amplifiers, etc.) that can be shared across missions
- Leverages ANSI/VITA 49.2-2017 for low latency control and digital RF
- Being incorporated into the VICTORY Architecture and Standard Specifications

Standards Overview

OpenVPX

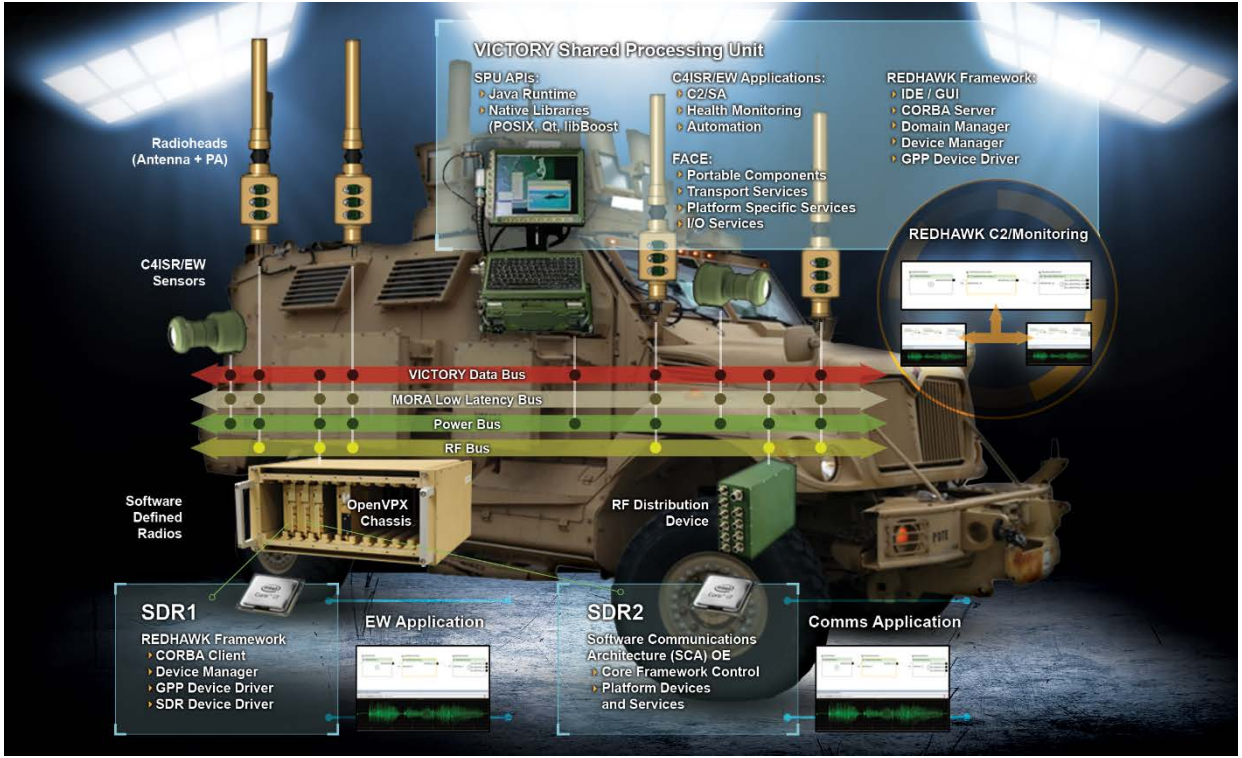


- Hardware form factor enables capabilities to be fielded as cards in common chassis
- DoD profiles (i.e., pinouts) eliminate user-defined pins and support 2 Level Maintenance
- Single profile selected for each type of slot
- CMOSS profiles included in ANSI/VITA 65.0-2017

Software Frameworks

- Enables portability of software applications
- REDHAWK is a free and open-source software (FOSS) software defined radio (SDR) framework
- Software Communications Architecture (SCA) is developed by JTNC for Comms applications
- Future Airborne Capability Environment (FACE) is developed by NAVAIR PMA-209 for avionics applications

Architecture Overview

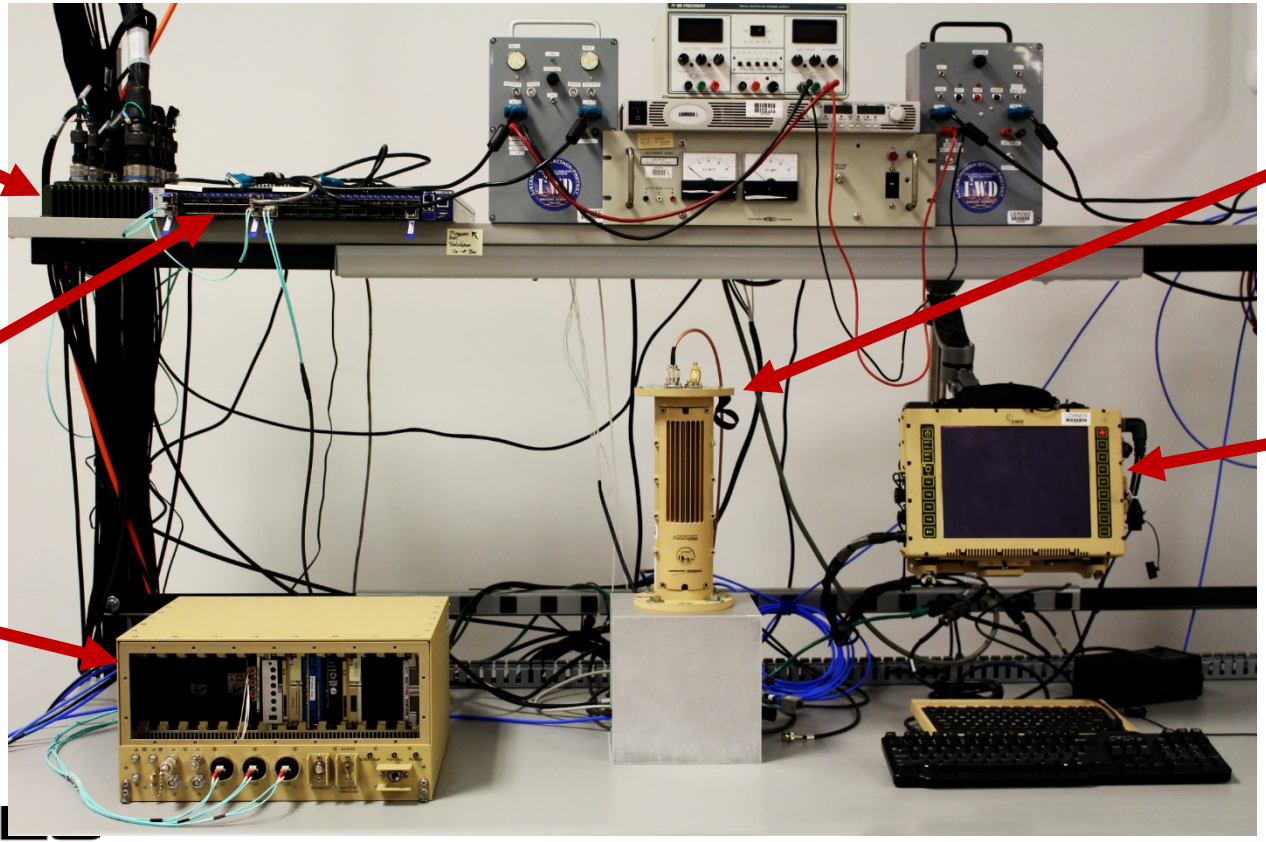


- "Universal A-Kit" allows PMs to field capabilities as cards in a common chassis and RF components that use existing cabling
- Logistic tails can be smaller due to common spares
- Unit costs can be reduced by greater competition and economies of scale
- Enables modernization through spares with hardware refresh every 5 years
- Architecture is applicable to ground, air, sea, and subsurface platforms

Participants

- **AF Life Cycle Management Command (AF LCMC):**
  - Participating/influencing Air Force Sensor Open Systems Architecture (SOSA)
  - I2WD is the Vice Chair of the SOSA Hardware Working Group
  - CMOSS is being included in the SOSA specification
- **NAVAIR PMA-209:** Alignment with Hardware Open System Technologies (HOST)
- **VICTORY Standard Support Office (VSSO):** Leveraging the VICTORY specification. MORA is being incorporated into the VICTORY Architecture and Standard Specifications.
- **VITA Standards Organization (VSO):** CMOSS requirements included in ANSI/VITA 65.0-2017, ANSI/VITA 65.1-2017, and ANSI/VITA 49.2-2017.
- **Tank and Automotive Research, Development and Engineering Center (TARDEC):** Partner for vehicle integration. Stryker demo in FY17.
- **National Security Agency (NSA):** Participated in WIPT to ensure architecture is accreditable. Aligning MORA and TOA.
- **Academia:** Research and development partners
  - MIT-LL: VITA 65 profiles and editor
  - JHU-APL: VITA 65 and 49.2 development
  - PSU-ARL: PNT card and MORA reference implementation development

CMOSS Lab Validation



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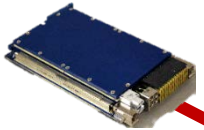
CMOSS Reference Chassis

Transceiver
- EW Application
- REDHAWK Device
- MORA interfaces

Transceiver
- EW Application
- MORA interfaces

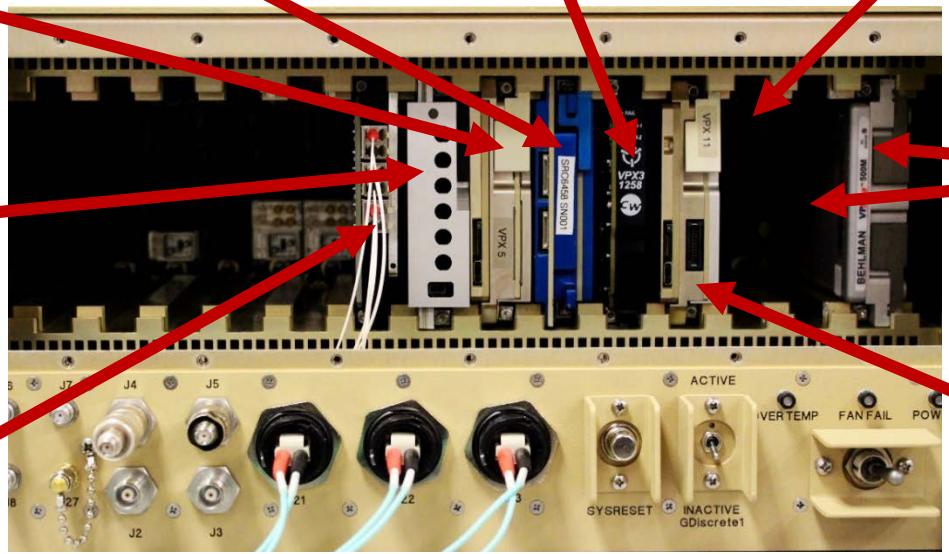


Single Board Computer
- EWPMT VM
- REDHAWK VM

Single Board Computer
- Video Processing
- EO/IR Sensors

Clock Test Card
- Drives radial clocks over the backplane

Ethernet Switch
- Control and Data Planes
- Front panel fiber ports



VITA 62 Power Supplies
- Paralleled for output power and redundancy

RF Switch
- Connects transceivers to Radioheads
- MORA interfaces

Styker Integration

MORA Radioheads

CMOSS Chassis (Curbside Sponson)

DF Sensor

Summary

- Built upon open standards, CMOSS enables the soldier for the next fight while providing significant cost savings during the procurement and sustainment phases of the life-cycle
- CMOSS is being included in and managed under the SOSA initiative with Army, Air Force, and Navy participation
- The CMOSS specifications can be obtained from:
  - VICTORY (https://portal.victory-standards.org)
  - MORA (https://portal.victory-standards.org/MORA)
  - OpenVPX (http://www.vita.com)
  - REDHAWK (https://redhawksdr.github.io/Documentation)
  - SCA (http://www.public.navy.mil/jtnc)
  - FACE (http://www.opengroup.org/face)
  - SOSA (http://www.opengroup.org/sosa)