Section 5.4 PEO LS S&T Focus Area

OPEN PLUG-AND-PLAY COMMUNICATIONS ARCHITECTURE

"Provide bold recommendations to expedite moving emerging capabilities from the S&T community to a program of record."
—Mr. Ray Mabus, Secretary of the Navy, October 2015

Figure 5.4-1. M-ATV

Open plug-and-play architecture provides vehicle platforms the capability to add a new communications, sensor, and data component to a system and have it integrate seamlessly without changing the architecture or technical configuration of the vehicle. Adapting such an architecture for the tactical vehicle fleet has great potential to improve tactical and operational flexibility for commanders. Consequently, the Marine Corps continues to develop a standardized approach to Command, Control, Communications, Computers, and Intelligence (C4I) and Electronic Warfare (EW) integration. PEO Land Systems continues to work with Marine Corps Systems Command, TARDEC,

MCCDC and the broader research community to integrate these systems through a coordinated development and acquisition process. Critical to this process is a shift to common resources accessed through open architecture systems. This change will reduce or eliminate a large number of duplicative and proprietary solutions that were procured during combat operations.

The Challenge

Many of the fielded vehicle-mounted C4I/EW systems in the inventory, which were primarily driven by urgent operational needs, are standalone solutions integrated onto tactical vehicles in a "bolt-on" applications that come with separate power, processing, clock, and location functions. Some current tactical vehicles were not designed to support radios at all, and certainly not the multiple new technologies that have been added to enhance combat effectiveness. The development of modular, scalable, open-system architectures, which enable a plug-and-play mission flexibility across all tactical vehicles, will enable rapid vehicle modernization and shared- resource allocation. It will also eliminate duplicate equipment for both legacy and future vehicle programs and ease shipboard operations.

Potential Solutions

MCWL Efforts

MAGTF Integrated Command and Control (MIC2)

MIC2 is a collaborative effort that takes advantage of existing programs (Aviation Hallway / Digital Interoperability Vision), ongoing predictable venues (WTI TACDEMO & IOC Graduation Events), and "other" technologies to identify and assess a collaborative solution. This effort will provide tailorable Over the Horizon (OTH), On the Move (OTM) communications, situational awareness, and fires for the forward deployed MAGTF. Naval Air Systems Command is currently working the flight clearance for Distributed Tactical Communications System installation and test on the MV-22 Osprey followed by installation on fleet aircraft for Special Purpose Marine Air-Ground Task Force (SPMAGTF)-CR EUE.
The goal is to develop a Command and Control (C2) capability that is scalable, platform agnostic, and expeditionary, which maintains the MAGTF commander's situational awareness (with or without airborne assets) from launch to recovery.

Distributed Tactical Communications System (DTSCS)

DTCS is an Iridium Satellite tactical radio MCWL and Naval Surface Warfare Center Dahlgren (NSWC-D) developed to provide Beyond Line of Sight (BLOS), Over the Horizon (OTH), and (OTM voice, data, and position location information.

Expeditionary Applications (ExApps)

The development of lightweight applications that leverage a common architecture for information sharing and allow eventual migration to a Joint Service Oriented Architecture is the purpose of this effort.

Coordinate with the Tactical Service Oriented Architecture (TSOA) and Network On The Move (NOTM) programs to identify gaps, inform requirements, and assist with the integration of TSOA, SOI Lite, and/or Navy Force Federation Data Service (FFDS) into NOTM ITV (FY16) and MAGTF DI ITV (FY17).

Sensor Fusion

The Sensor Fusion program facilitates the combining of sensor and telemetry data from multiple unmanned systems within a defined network, providing a more accurate, complete, and dependable tactical picture for the operator.

The program will develop an interface(s) that synergizes data, video and images, enabling an operator to comprehend and leverage the large amount of information available from multiple employed sensors.

TARDEC Efforts

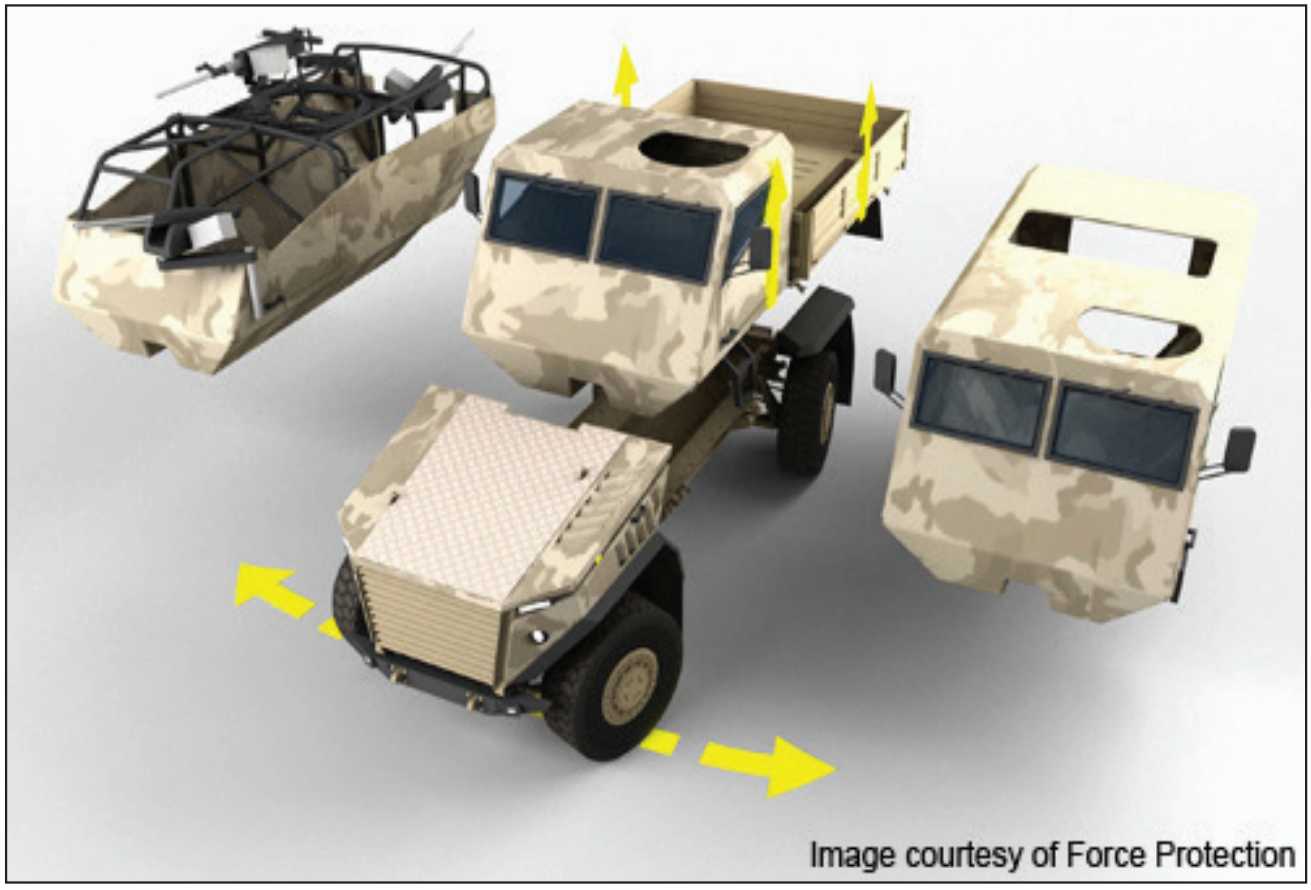
Vehicular Integration for C4ISR / EW Interoperability (VICTORY)

In FY-15, Marine Corps Systems Command and PEO LS have approved the VICTORY standard in future Marine Corps Vehicles. The current version (as of the publish date of the ATIP) of the standard is 1.6.1, which will be critical for future development of modular C4/Intelligence, Surveillance, and Reconnaissance (ISR) systems, is a required characteristic for new vehicle systems.

The VICTORY open plug-and-play architecture is being developed as a solution to the "bolt-on" approach to integrating C4/ISR systems into ground vehicles, which inhibits functionality, negatively impacts the vehicle's size, weight and power, and limits crew space. VICTORY will reduce these issues by embedding the systems directly into the platform. It provides a framework for architecture, standard specifications, and design guideline input.

VICTORY is developing a framework for integration of C4ISR/EW and other electronic equipment on Army ground vehicles. The framework is composed of:

- An architecture that defines common terminology, systems, components and interfaces



5.4-2. Potential VAM Construct

- A set of standard technical specifications for the items identified in the architecture
- A set of reference designs that provide guidance for how the architecture and standards can be instantiated to create designs against various types of requirements and environments

The architecture is documented in VICTORY Architecture - Version A2, which identifies the systems, components, and interfaces, but does not provide technical details. The technical details are specified in the VICTORY standard specifications, and are intended for the system acquisition and S&T communities to use as a citable reference in new procurements, modernization activities, and engineering change proposals.

The VICTORY standard specifications do not specify system design or the specific hardware and software components that will be used to implement the VICTORY standard specifications. In addition, these specifications do not specify the hardware configuration or the mapping of software to hardware.

The designs must be developed to meet the operational, functional, and performance requirements of the platform or product. VICTORY provides example designs to aid the community in understanding the options for deploying the specifications. These examples are documented in VICTORY reference design documents:

- **VICTORY Standards Maturation (VSM).** Maintain, develop, and adopt future capabilities to continue to enhance the Vehicular Integration for C4ISR/EW Interoperability (VICTORY) Specifications. Enhance existing Systems Integration Lab (SIL) capabilities to perform Validation and Verification for the updated standards.

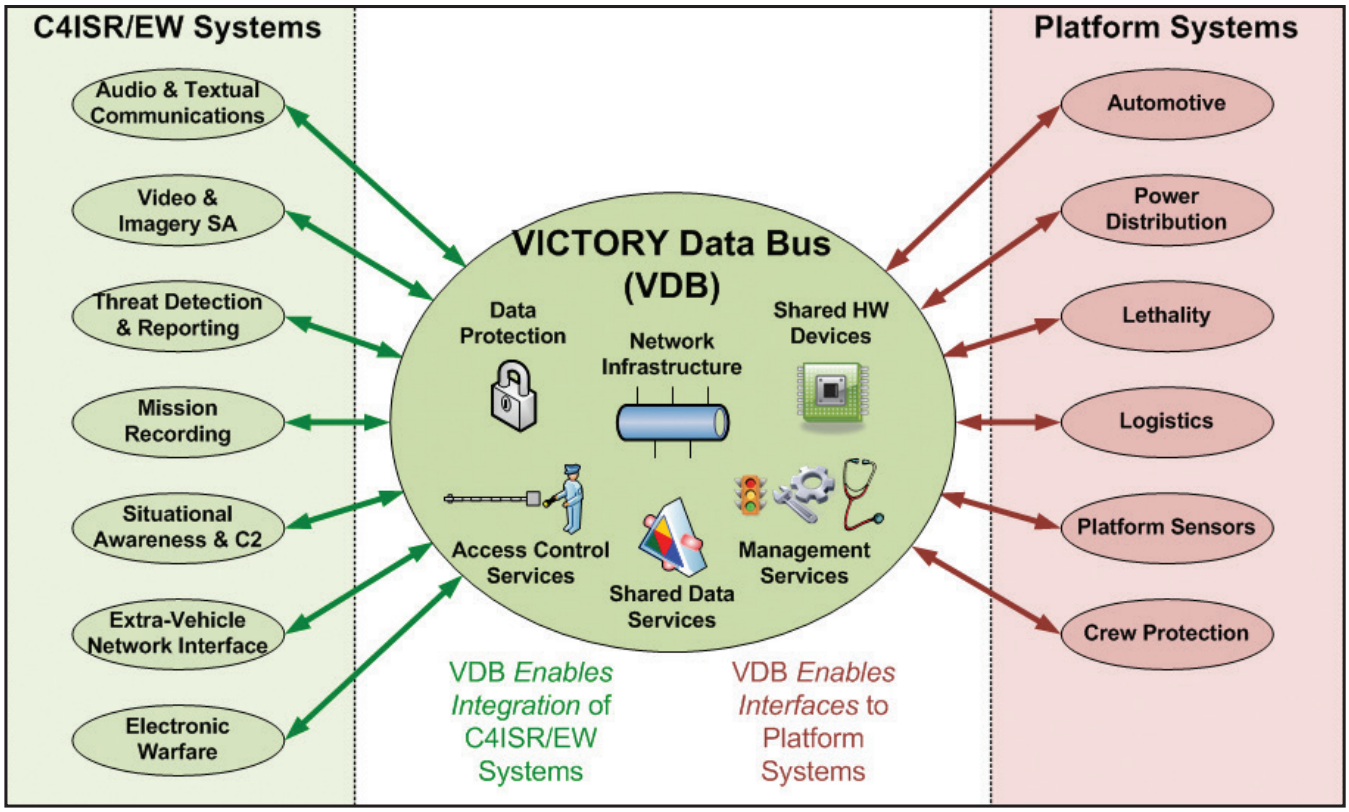


Figure 5.4-3. Core Concept: VICTORY Data Bus (VDB)

Continue to provide new capabilities that can be added to Military Ground Vehicle platforms as a part of ARFORGEN block upgrades or modernizations.

- **VICTORY Enabled Company Transformation**. Transition and Demonstrate TARDEC's VICTORY investment from its current TRL 4 Lab Components to TRL 6 vehicle systems applicable to all platforms. This will reduce the risks for PMs of transitioning VICTORY components and systems onto their vehicle platforms by providing an accredited Information Assurance solution, aiding in the integration of legacy components, and providing a common vehicle integration package for VICTORY.

VICTORY System Integration Laboratory (VICTORY SIL)

The VICTORY SIL was developed to help facilitate verification and validation of the VICTORY standards in support of near-term PEO GCS Engineering Change Proposal efforts. It also provides a facility where vendor components are independently verified to VICTORY standards. The VICTORY SIL has a representative vehicle cabin to demonstrate the VICTORY standards in a system-level vehicle environment.

Capabilities

VICTORY SIL offers contractors the ability to bring hardware and software solutions to be tested and verified at VICTORY standards. The testing would be performed via a Test Service Agreement between the contactor and TARDEC.

Benefits

- Provides an independent implementation of VICTORY proposed standards
- Advances VICTORY standards from "proposed" to "draft"
- Identifies and clarifies issues with the VICTORY proposed standards

Radio Frequency (RF) Convergence

This effort will leverage CERDEC's RF Convergence project outcomes to define and build a flexible framework to readily adapt and allow insertion of existing and new C4ISR/EW technologies. It will define A-Kit & B-Kit specifications, common interfaces and reference implementations for electronics chassis, RF distribution network and power distribution network.

Vehicle Electronics & Architecture Research SIL (VRS)

The Army faces considerable challenges when integrating electronics on ground vehicles, compounded by the need to reduce cost and redundancy across multiple platforms. The VRS project will create a complete reference architecture to address the power, vetronics, and C4ISR integration challenges facing the modernization of the ground vehicle domain. This architecture and the associated SIL (as a TARDEC test asset) will support experimentation with future architectural concepts and implementations. This effort also includes the power management technologies for the VRS project.

Virtual Experiments Capability (VEC)

The VEC will develop a process for modeling innovative TARDEC technologies and inserting them into the Army Capabilities Integration Center (ARCIC)-led Early Synthetic Prototyping (ESP) environment. ESP is an ARCIC-led effort to develop a persistent video game environment Soldiers want to play and researchers can use to evaluate emerging military technologies.

Trust/Cyber

The purpose of this project is to always know the electronic weaknesses in our ground systems and operations before our adversaries do. To realize this vision, the project aims to discover and evaluate disruptive or emerging cyber research and use it to develop and demonstrate unconventional military uses against our ground vehicle electronic systems. In doing so, systems will be able to identify and grade risk across all cyber threat areas and develop tactics and strategies to enhance or defeat targeted electronic systems.

DARPA Efforts

High Assurance Cyber Military Systems (HACMS)

More and more of the nation's computer systems are embedded within networked devices, creating what has come to be known as the Internet of Things. One downside implication of this trend is that malicious hackers can now wreak not just informational havoc by breaking into email, for example, or stealing files but also physical havoc among autonomous or semiautonomous cyber-physical systems ranging from automobiles to sensors to flight controllers.

The goal of the HACMS program is to design and create technology to support the construction of high-assurance cyber-physical systems, where "high assurance" is defined to mean functionally correct and satisfying appropriate safety and security properties. Achieving this goal requires a fundamentally different approach than ones the software community has taken to date – one based on a mathematical discipline known as formal methods. Specifically, HACMS is taking a clean-slate, formal-methods-based approach to enable a semi-automated process for writing or synthesizing code that is provably unhackable for given specifications.

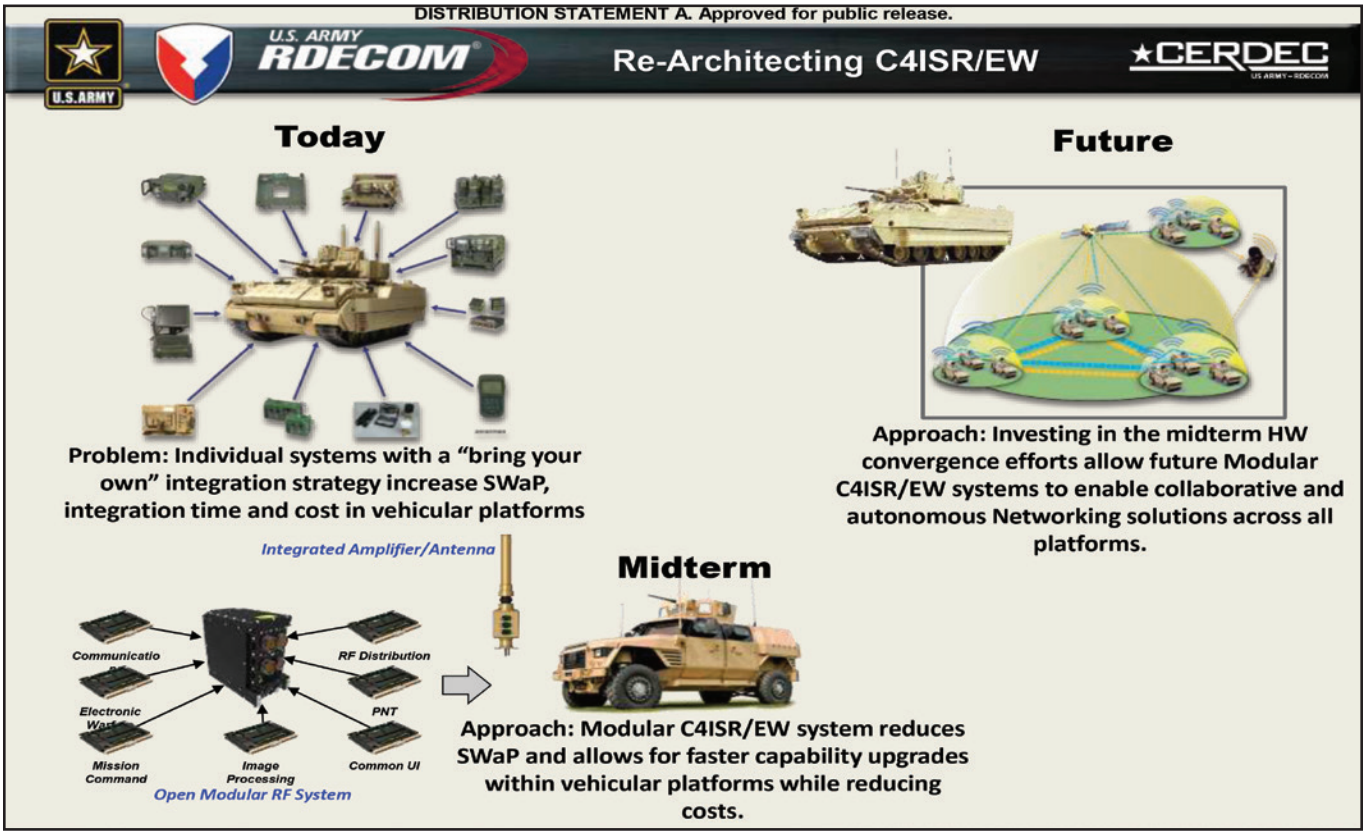


Figure 5.4-4. Re-Architecting C4ISR/EW

In unmanned drone and helicopter tests, HACMS has already proven its potential, rendering those previously hackable aircraft unhackable. Code kernels developed under HACMS are being made publicly available in DARPA's Open Catalog to encourage their wide distribution and application in both the commercial and defense software sectors. In addition to its focus on aircraft, HACMS performers are currently working to develop and generate open-source, high-assurance operating system and control system components for use in military vehicles, with the longer-range possibility of incorporating these technologies in unmanned aerial and underwater vehicles; weapons systems; satellites; and command and control devices.

Squad X Core Technologies (SXCT)

The SXCT program aims to allow dismounted U.S. Army and U.S. Marine Corps squads to dominate their environment and enjoy squad-level overmatch by giving them enhanced situational awareness and other advantages through the development and integration of component systems that are small, lightweight, easy to use and more autonomous.

The program aims to address a longstanding and increasingly critical conundrum: Technological advances in recent years have catalyzed game-changing military capabilities, from real-time situational awareness to instant digital information-sharing to precision armaments. Dismounted units, however, have not fully benefited from many of these breakthroughs because the underlying technologies have often been too heavy and cumbersome for individual Soldiers and Marines to carry or too difficult to use under demanding field conditions.

DARPA recently awarded Phase 1 contracts to nine companies and other research organizations to develop technologies that would specifically address this challenge, with focus areas in precision engagement, non-kinetic engagement, squad sensing and squad autonomy.

The Open Plug-and-Play Comms Architecture Focus Area chart on the following page highlights critical efforts monitored and supported by the PEO LS S&T Director.

Open Plug-and-Play Comms Architecture