Section 6.4 PEO LS S&T Focus Area

OPEN PLUG AND PLAY COMMUNICATIONS ARCHITECTURE

"Innovation and fiscal responsibility will also continue to be hallmarks of the Marine Corps. We will continue to invest limited resources to restore combat capability and enhance our Marines' readiness at home and in overseas operating areas."

—U.S. Marine Corp Concepts and Programs 2014

M-ATV

By facilitating interoperability and using an open plug-and-play architecture within tactical vehicles, the Marine Corps will improve it's tactical, operational, and strategic advantages. Towards this end, 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 to integrate these systems through a coordinated development and acquisition process.

The Challenge

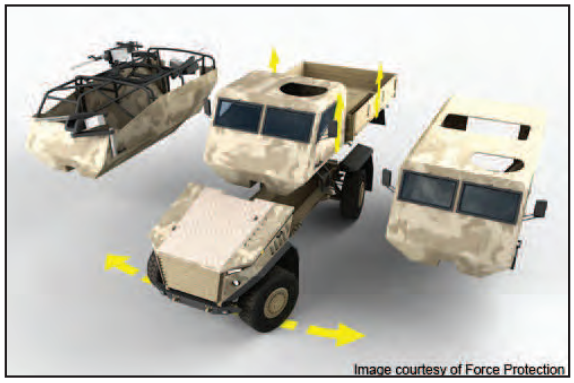
Most current C4I/EW systems, which are primarily driven by urgent operational needs, are standalone solutions that are integrated onto tactical vehicles in a "bolt-on" fashion. Current tactical vehicles were not designed to support the multiple new technologies that have been added to enhance combat operations. The development of modular, scalable, open system architectures that enable a plug-and-play mission capability across all tactical vehicles will enable rapid vehicle modernization, shared resource allocation, and eliminate duplicate equipment for both legacy and future vehicle programs.

Potential Solutions

ONR Code 30 Efforts

Vehicle Agnostic Modularity (VAM)

This ONR 30 effort is focused on developing a scalable, reusable, and subdivided vehicle system that will employ a series of self-contained functional modules (trauma, C2, remote weapons station, power, etc.). While the program is exploring potential solutions to a variety of technical challenges, it will require an open plug-and-play architecture to support the various modules and platform elements. This C4ISR backbone will permit system-wide power and thermal management and provide common interfaces for the different modules, thus enabling vehicle mission optimization. This S&T effort will result in reconfigurable multi-mission modules integrated into vehicle cargo areas that are applicable across a range of tactical vehicles.



Potential VAM Construct

The intent of the VAM program is that the structured application of Modularity principles to ground platforms will extend tactical range and operational reach, increase endurance in the field, reduce excess capacity and logistic footprint/burden, enhance small unit effectiveness, lighten the MAGTF load, enhance commonality, and reduce TOC.

TARDEC Efforts

Vehicular Integration for C4ISR/EW Interoperability (VICTORY)

The VICTORY open plug-and-play architecture is being developed as a solution to the "bolt-on" approach to integrating C4ISR 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 these 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 U.S. Army ground vehicles. The framework is comprised of:

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

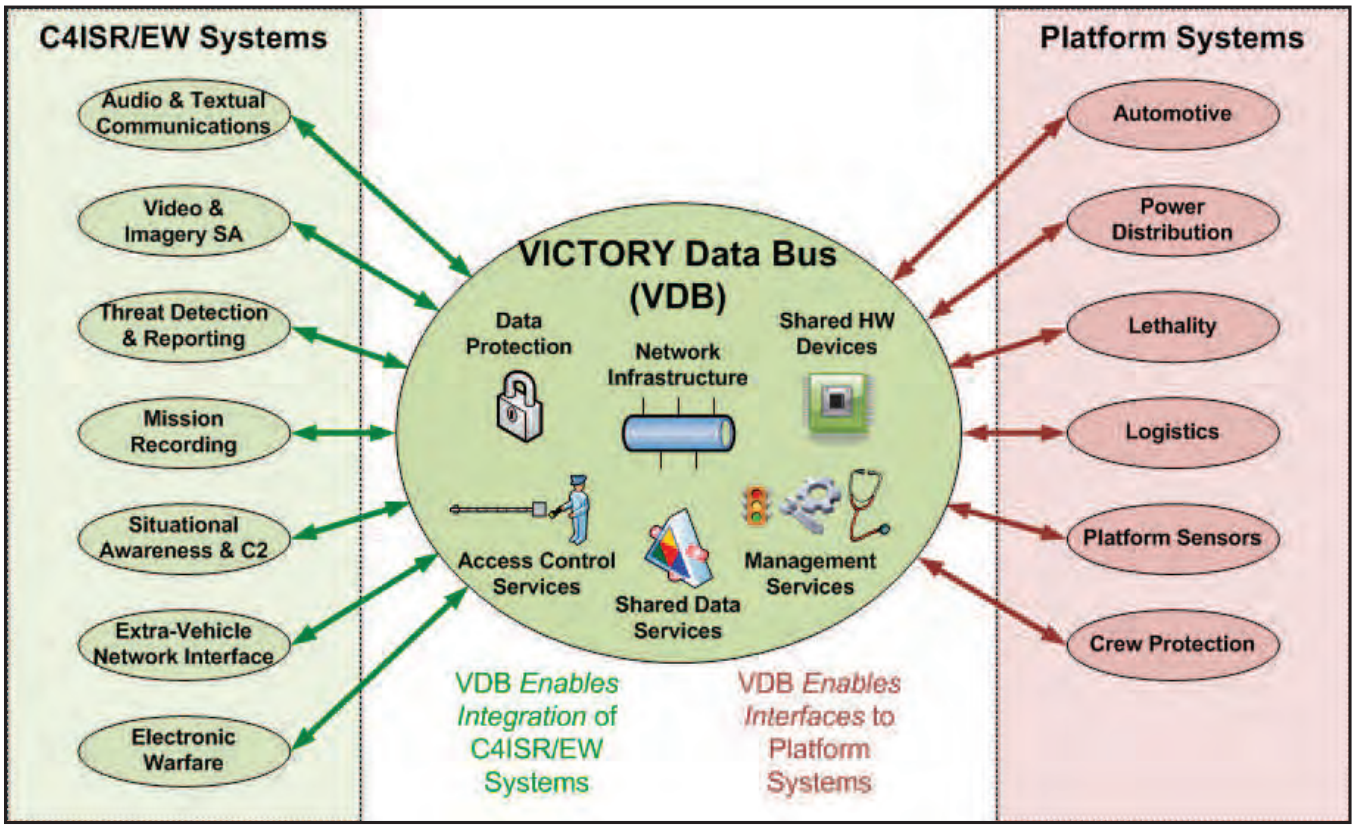


Figure 6.4-1. Core Concept: VICTORY Data Bus (VDB)

specified in the VICTORY standard specifications and are intended to be used by the system acquisition and S&T communities as a citable reference in new procurements, modernization activities, and engineering change proposals.

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.

Marine Corps Systems Command and PEO Land Systems have approved the VICTORY Standard for future Marine Corps Vehicles. The current version of the standard is 1.6.1. This standard will be critical for future development of modular C4ISR systems.

Common SIL

The development of a Common SIL will create a system-of-systems integration laboratory capability to support vehicle modernization efforts, demonstrate advanced technologies, and build the expertise of the workforce. Comprised of two separate SILs, a Vehicle Electronics and Architecture (VEA) Research SIL housed at TARDEC, and a C4ISR SIL located at the U.S. Army's Communications-Electronics Research, Development and Engineering Center, the Common SIL will link together through the Defense Research and Engineering Network to create an end-to-end simulation and evaluation capability.

Electrical Power Standards

The development of electrical power architecture will allow seamless electrical integration of any load that converts or consumes electrical power. Similar to the VICTORY architecture, but intended for electrical power, electrical power architecture will create commonality of loads and power conversion devices for any ground vehicle that adopts the standards. Creating and adopting common voltage standards and electrical power architectures for

new start and modernization programs will lead to common components and plug-and-play ability between platforms; common implementations and control schemes that reduce training; and a common approach to achieving safety for high voltage systems.

VEA Mobile Demonstrator

The VEA technical area was formed in January 2009 to improve TARDEC's responsiveness to its enterprise partners' emerging needs and to better address requirements. VEA, part of TARDEC's Research Technology and Integration (RTI) Group, aims to develop technologies, processes, and capabilities while maintaining the overarching architecture of hardware and software systems that support Army ground vehicles. TARDEC's VEA consists of three main groups: Electrical Power, Vehicle Architectures, and Systems Integration Laboratories & Customer Support, with teams supporting multiple subgroups. VEA is currently involved in a four year effort developing a mobile demonstrator.

Vehicle Architectures Group

The Vehicle Architectures group is comprised of several subgroups: electromagnetic environmental effects; intra-vehicle data networks; computers; component thermal; and the VICTORY architecture team. The Vehicle Architectures Group works to develop hardware and software that enables communication and data sharing among various electronic devices and computing elements within a vehicle.

SILs and Customer Support Group

The SILs and Customer Support group is primarily composed of the engineers and facilities that support the program management offices. Current support activities include matrixed engineers for the PM-Heavy Brigade Combat Team; the PM Stryker Brigade Combat Team (SBCT); the PM MRAP; PEO Combat Support &Combat Systems Support; and the Integrated Logistics Support Center. This group also maintains SIL facilities to support PM SBCT and PM MRAP, and is working to develop the VEA Research SIL component for the Research Development Engineering Command Common SIL initiative.

Vehicle Electronics & Architecture Research (VRS)

The Warfighter 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 that addresses the power, vehicle electronics, 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.

Additional TARDEC projects that are of interest to PEO LS include:

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. Define A-Kit & B-Kit Specifications, Common Interfaces and Reference implementations for Electronics Chassis, RF Distribution network and Power Distribution network.

High Efficiency Truck Users Forum (HTUF)

This will include commercial/military medium and heavy duty trucking communication protocols/needs with National Highway Traffic Safety Administration's car and light duty trucks communication protocols for safety. It will also facilitate VEA's military truck cyber security protections to aid commercial adoption to protect commercial trucks communication systems and capability with entire trucking industry. This

project will also continue working Ground Vehicle Robotics (GVR) autonomous safety standards and connectivity.

Other Government Agencies (OGA) Engagements

This effort will include commercial/military medium and heavy duty trucking communication protocols/needs with the Federal Highway Administration's (FHWA) car and light duty trucks communication protocols for Vehicle to Infrastructure (V2I) isues/safety. This will facilitate VEA's and Software Engineering Center's (SEC) military truck cyber security protections to aid commercial adoption to protect commercial trucks communication systems and capability with entire trucking industry. Also, it will continue working GVR/SEC/VEA autonomous safety standards, protocols, cyber and connectivity with FHWA and V2I.

VICTORY Standards Maturation (VSM)

This effort will maintain, develop, and adopt future capabilities to continue to enhance the VICTORY Specifications. It will enhance existing SIL capabilities to perform Validation and Verification for the updated Standards and will continue to provide new capabilities that can be added to Military Ground Vehicle platforms as a part of Army Force Generation block upgrades or Modernizations.

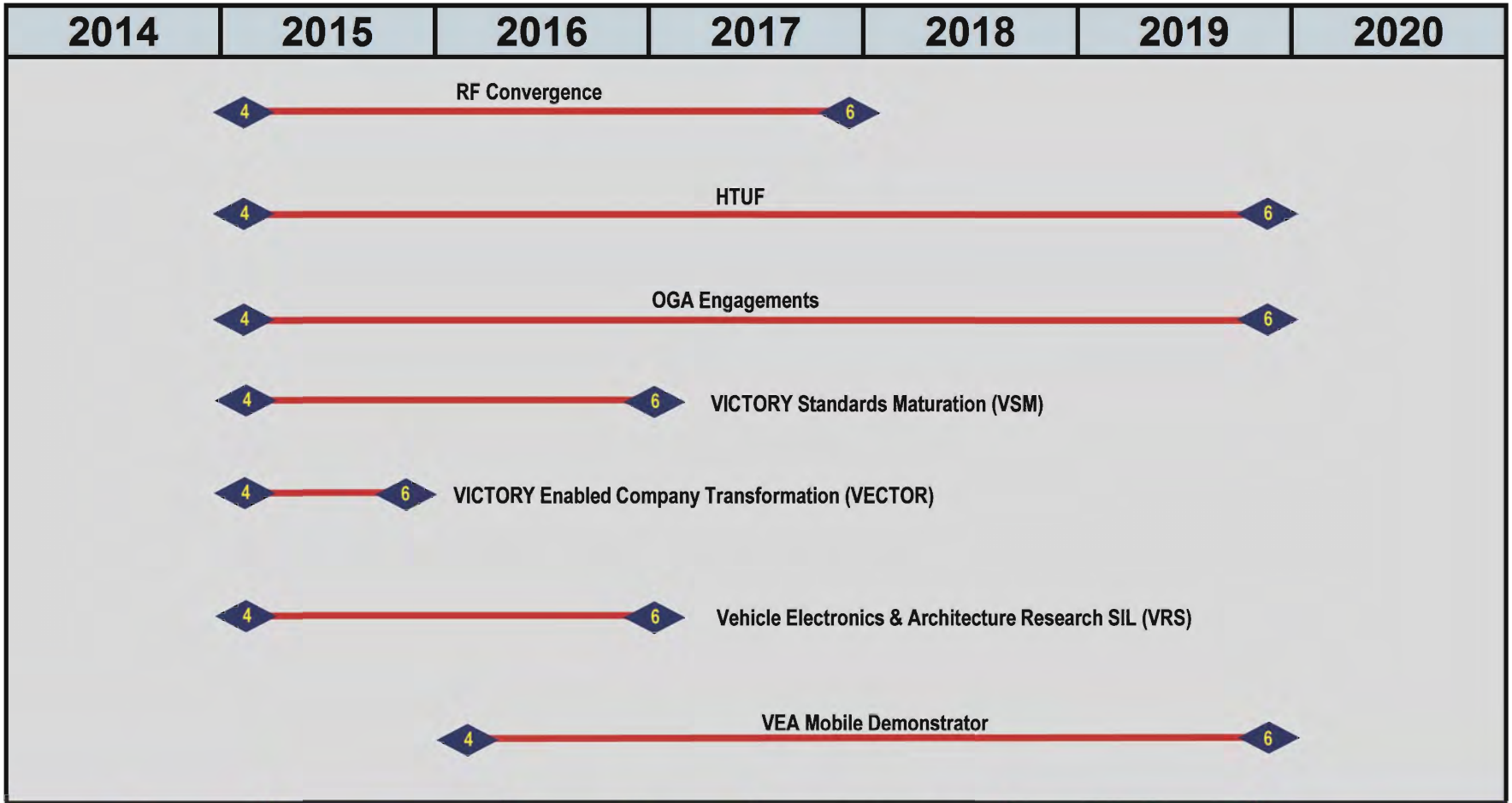
VICTORY Enabled Company Transformation (VECTOR)

This project will 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 (IA) solution, aiding in the integration of legacy components, and providing a common vehicle integration package for VICTORY.

The Open Plug and Play Communications Architecture Focus Area charts on the following pages highlight critical efforts monitored and supported by the PEO LS S&T Director.

MRAP Loaded with C4I/EW Equipment

Open Plug and Play Comms Architecture



D&I	E&D		FNC	SBIR/STTR	TARDEC		Other
Funding Profiles ($M)	FY14	FY15	FY16	FY17	FY18	FY19	FY20
S&T (6.2 / 6.3)	25.63	14.41	13.24	11.06	10.63	75.56	

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