OPEN PLUG-AND-PLAY COMMUNICATION ARCHITECTURE

Open plug-and-play architecture provides vehicle platforms the capability to add a new communication, sensor, and data component to a system and have it integrate seamlessly without changing the architecture or technical configuration of the vehicle. Adapting such architectures 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 LS continues to work with Marine Corps Systems Command, Tank Automotive Research, Development and Engineering Command, Marine Corps Combat Development Command 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 under pressure of 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 bolt-on applications that come with separate power, processing, clock,

Figure 5.4-1. M-ATV

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

SBIR

Artificial Intelligence (AI)-based C2 Digital Assistant

The Marine Corps seeks to employ advanced artificial intelligence (AI) technologies for its CAC2S program to reduce information overload, improve situational awareness (SA) and collaboration, and aid in Commander decision-making. Leverege will use its unrivaled subject matter expertise in CAC2S and its deep experience with cutting-edge machine learning techniques to research and test the optimal algorithms for the AI-based digital assistant. The research and development will identify the areas that need to be addressed, propose and study alternative solutions, and provide simulated but relevant input to test our hypotheses against known CAC2S use cases.

Leverege intends to address the following quantitative commercialization metrics and achieve increased maturity in the following areas: Multi-level neural network approaches to speech tokenization, deep machine learning, and contextual understanding, Conversational bot technology that remembers 0x9D context between individual queries, Autonomous big data 0x9D architectures and implementation strategies that can be embedded into disconnected systems and meet stringent performance and security requirements, and Improved data presentation and user experience methodologies for digital assistants.

TARDEC Efforts

Vehicular Integration for Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4/ISR)/ 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 date this document was published) of the standard is 1.6.1, which will be critical for future development of modular C4/ISR systems, is a required characteristic for new vehicle systems.

The VICTORY open plug-and-play architecture is being developed as a solution to operating forces applying solutions to identified C4ISR capability short falls through short term solutions quickly bolted on to 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.
- 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 used to create designs against various types of requirements and environments.

The architecture is documented in VICTORY Architecture - Version A2, which identifies the

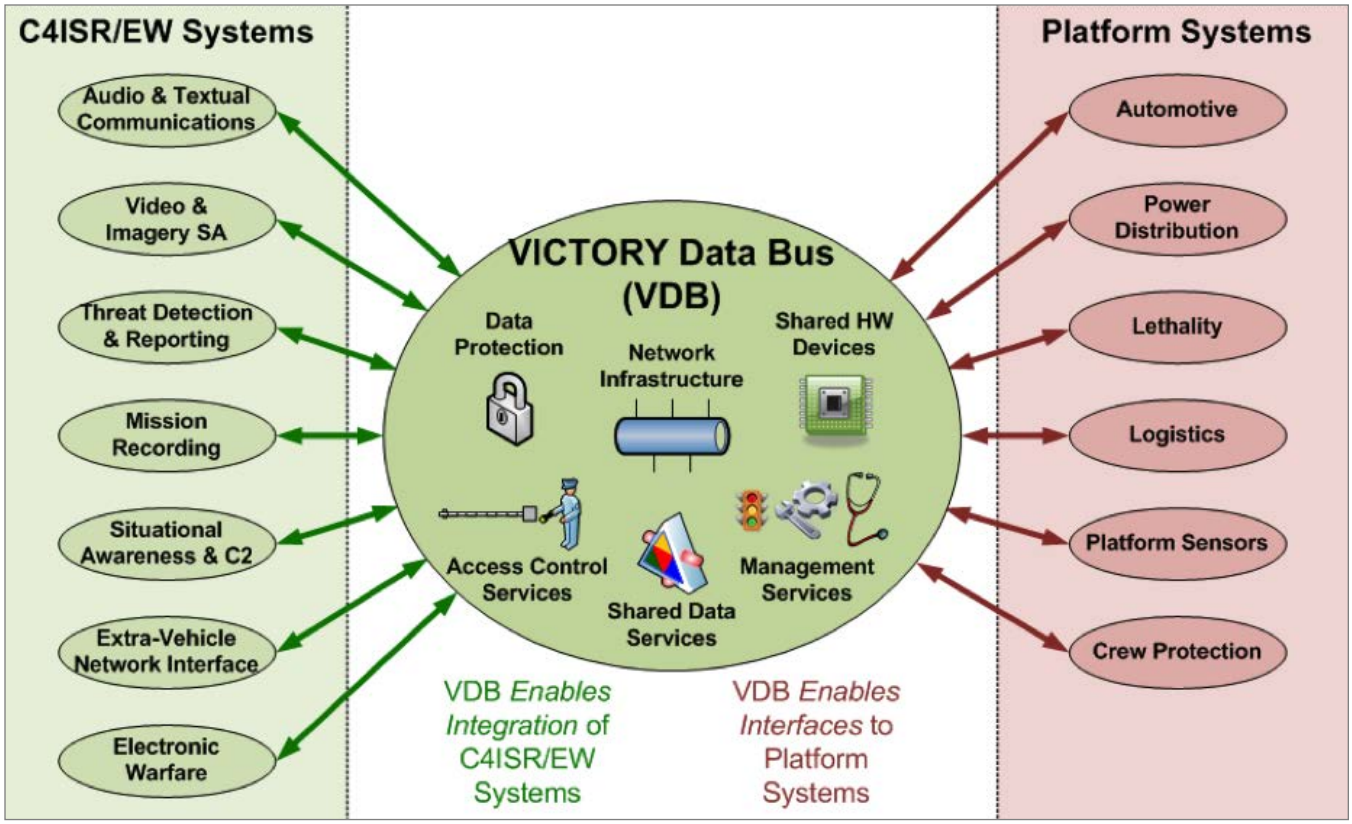


Figure 5.4-3. Core Concept: VICTORY Data Bus (VDB)

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. 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)** Transition and demonstrate TARDEC's VICTORY investment from its current Technology Readiness Level (TRL) 4 Lab Components to TRL 6 vehicle systems applicable to all platforms. This will reduce Program Managers' risks for 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 Ground Combat System 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**
The 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 through the process from proposed standards to draft. standards.
- Identifies and clarifies issues with the VICTORY proposed standards.

Radio Frequency (RF) Convergence

The intent is to 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.

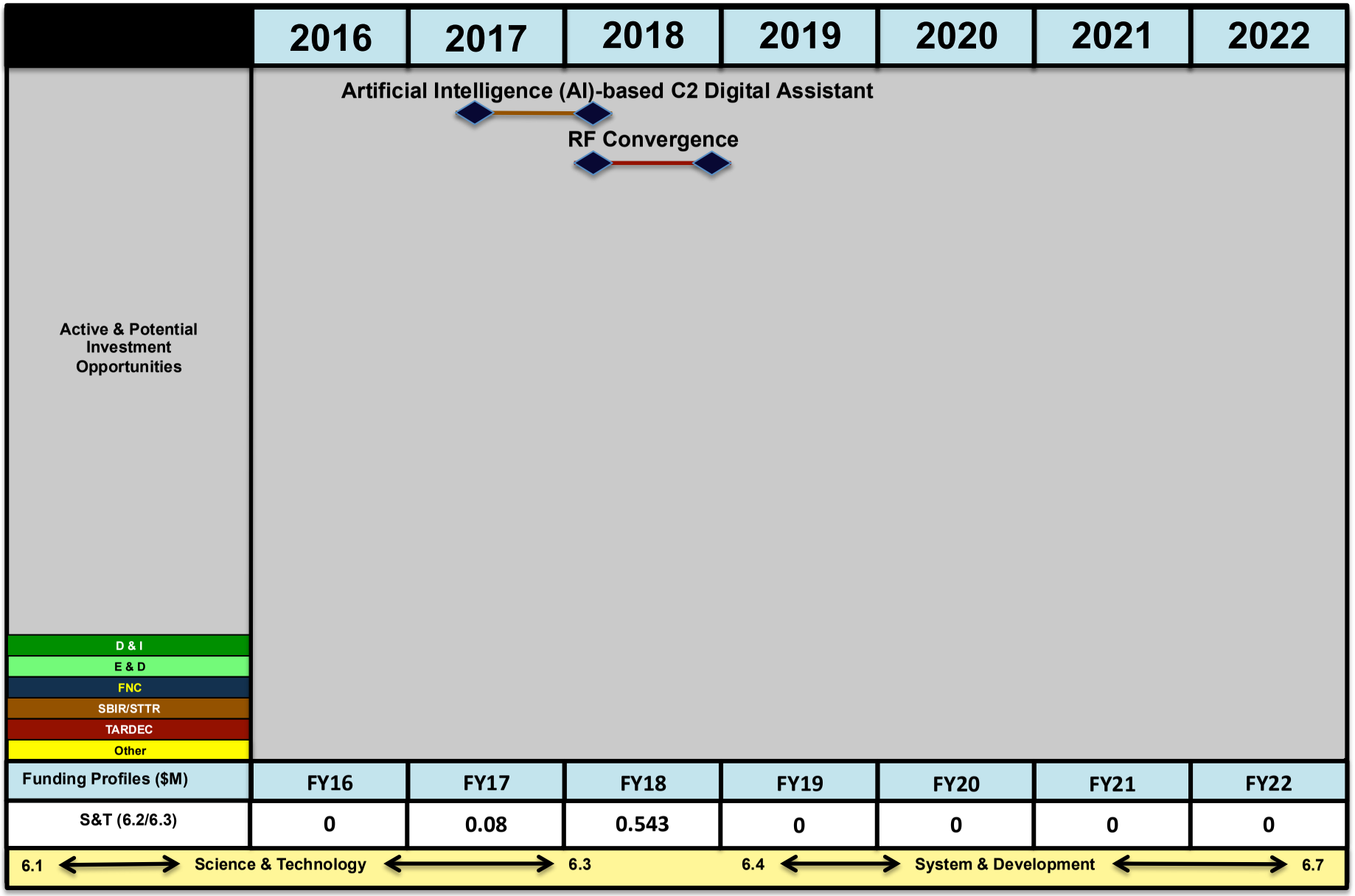
Vehicle Electronics & Architecture Research SIL (VRS)

The Army faces considerable challenges when integrating electronics into 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.

Open Plug and Play Comms Architecture



Funding Profiles ($M)	FY16	FY17	FY18	FY19	FY20	FY21	FY22
S&T (6.2/6.3)	0	0.08	0.543	0	0	0	0

6.1 ⟷ Science & Technology ⟷ 6.3 6.4 ⟷ System & Development ⟷ 6.7