VICTORY: An Open System Architecture for Military Ground Vehicle Electronics

A Case Study for Modularity & Interoperability

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Military Ground Vehicle Problem Space

- **Targeting:** Computer Display, 2x GPS RX/Ant
  - Legacy Wiring, Antennas, Amplifiers, UI Devices

- **Weapon Station:** Computer Display, Wiring, UI Device
  - Intercom
  - (Legacy) Voice Comm

- **Battle Command:** GPS RX/Ant, Computer Display, KB/UI Devices, Wiring

- **CREW System:** GPS RX/Ant Computer(s), Wiring

- **DVE System:** Display/KB/UI Device/Wiring

- **Future Systems?**
  - SA Video, Intel, Protection, A-PNT
  - No Path Forward

- **New Radios** Each with GPS RX/Ant

- **Root Cause:** Systems are procured separately, without knowledge of a common vehicle architecture that could provide services and support interoperability.
Vehicular Integration for C4ISR/EW Interoperability (VICTORY) Approach

- Include an Ethernet In-Vehicle Network (IVN) as part of vehicle (infrastructure)
  - Integrate C4ISR/EW systems, interface with other electronic systems
  - Provide the plumbing for systems and components to interoperate

- Provide shared hardware, services, and security protections as part of IVN
  - Shared transport, processing resources, user interface devices
  - Position, orientation, direction of travel
  - Management mechanisms: config, control, data logging, health reporting
  - Access control, data protection, etc.

- Define modules: “Component Types” interoperate via network-based messaging interfaces
  - C4ISR, EW, Vehicle Platform, Weapons Systems CTs interoperate on IVN with open standards

*VICTORY is not about new technology. It is about adding in-vehicle networks to platforms, and agreeing upon open specifications for interfaces.*
What Drove the VICTORY Approach

- Vehicle programs cannot levy requirements for specific software middleware on devices
- Define messaging interfaces allowed VICTORY to not affect internal design details
- Loosely-coupled, federated architecture, requiring only “on the wire” protocols
- **Common semantic**: format, encoding, encapsulation, transport, and security controls
  - Messages, data elements, operations, parameters, protocols
What Drove the VICTORY Approach

- VDB (In-Vehicle Network) infrastructure provides capabilities as part of the vehicle
  - Shared transport with QoS, Shared processing to host software applications
  - Information Assurance controls built-in (access control, data protection, etc.)
  - Shared services: Position, Navigation, Timing (PNT)
  - Support for system management; configuration, control, health
VICTORY Framework Products

- **Architecture**: defines common terminology, structures, component (types), and interfaces
- **Standard Specifications**: provide technical specifications for the items identified in the architecture
- **Compliance Test Suite (CTS)**: provides [for each component type] the “golden standard” test plan, report template and test tool for compliance testing

- **Reference Designs**: provide samples on how to use the standard specification
- **Validation Artifacts**: results of the initial implementation of the standard specifications
- **Reference Software Library**: reusable software to jumpstart implementation, that has been verified with the use of Compliance Test Tool (CTT)

The architecture documents the scope of interest, system structure, boundaries, “component types”, their functions, and their interfaces. It does not identify a specific design or set of HW/SW components. The CTT includes the specifications with browsing capability.
VICTORY Implementation & Status

- VICTORY Standards Support Office (VSSO)
  - In Program Executive Office for Ground Combat Systems (PEO-GCS)
  - Manages architecture and standards, led by an Executive Steering Group (ESG)
  - Vehicle and product program managers staff ESG, and fund the VSSO

- Stable architecture and standards, with supporting tools and reference SW
  - VICTORY Architecture, Version: A3, 23 May 2014
  - Engineering Change Proposals (ECPs) being executed as needed

- Being implemented in programs of record
  - Vehicle and product programs (across the gamut)
  - Government laboratories developing common products
  - Multiple vendor products (HW / SW)

- Future extension of VICTORY scope –will not change current baseline
  - Modular Open Radio Frequency Arch (MORA) – from Army S&T Community
  - Extend modularity into RF systems such a radios, intelligence, & EW
  - Make large SWaP components sharable
    - Antennas, amplifiers, signal conditioning, Signal processing, common applications
Take-Aways

- **VICTORY:** an example Modular Open Systems Approach (MOSA)
  - Developed to create modularity / interoperability
  - Developed for the military ground vehicle business model
  - Has a long-term support strategy, and is being implemented

- Technical approach determined by business model
  - Defines “on the wire” message formats first, as opposed to an API
  - Entities procured are largely “Boxes”, not software modules
  - Cannot assume all end points can run a middleware or even software

- OSA best practices and common shared artifacts are badly needed
  - E.g. Robotics Interoperability: efforts do not share data model
  - Concepts are re-created from scratch - be it a middleware (APIs), message definitions, or software framework effort
  - Technology / notation distract from real job: common semantic
  - **Current opportunity:** develop common shared artifacts for robotics!
Questions? Discussion?

• For more information
  • VICTORY: www.victory-standards.org

Contact me at msmooreinsa@gmail.com with questions.