



U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND GROUND VEHICLE SYSTEMS CENTER

Ground Vehicle Modernization Technologies (GVMT)

Kevin Vanyo, Deputy Executive Director (DXD)

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GROUND VEHICLE MODERNIZATION TECHNOLOGIES (GVMT) ORGANIZATION & CAPABILITIES



Ground Vehicle Power & Mobility (GVPM): Associate Director- Dr. Bruce Brendle, bruce.e.brendle.civ@army.mil

- Powertrain
- Realtime System Controls
- Tires, Track & Suspension
- Powertrain Electrification
- Energy Storage
- Fuel Cell Technology
- Propulsion System Laboratory
- Ground Systems Power & Energy Lab

Ground Vehicle Survivability & Protection (GVSP): Associate Director- Jason Middleton, jason.r.middleton.civ@army.mil

- Architecture & Controls
- Advanced Armor
- Hard Kill Active Protection Systems
- Soft Kill Active Protection Systems
- Camouflage, Concealment, Deception, Obscuration (CCDO)
- Occupant Protection
- Sensor Protection
- Special Systems & Components

Vehicle Electronics & Architecture (VEA): Associate Director- Andrew Kerbrat, andrew.t.kerbrat.civ@army.mil

- Vehicle Data Network Architectures
- Electrical Power Architectures
- Embedded Electronics
- C5ISR Integration
- System Design and Analysis
- EMI expertise
- Spec Standards Development & Review
- Tech Evaluations & Analysis

GROUND VEHICLE POWER & MOBILITY (GVPM) ORGANIZATION & CAPABILITIES



Powertrain

- Thermal management (heat exchangers, fans)
- High efficiency, compact transmissions for wheeled & tracked vehicles
- Power Dense, Low Heat-rejection Engines

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Real Time Control Systems

- Real-time control system development for the Army's ground vehicles
- Automated testing and software documentation tools
- Army common electronic powertrain controller, neXtECU

POC: Kevin.T.Sharples.civ@army.mil

Track & Suspension

- Segmentation of composite track systems at weights above 45T
- Combat vehicle external suspension units
- Electric height management capability
- Fire resistant track elastomers

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Powertrain Electrification

- High temperature, power dense motors and generators
- High temperature, power dense inverters
- Embedded motor controls software

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Energy Storage

- Scalable high voltage battery architecture
- High energy density cell/batteries (>400Wh/kg)
- Battery safety
- Thermal Management technologies

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Fuel Cell Technology

- Metal supported solid oxide fuel cells
- Multi-fuel reformation technology
- High temperature proton exchange membrane fuel cells

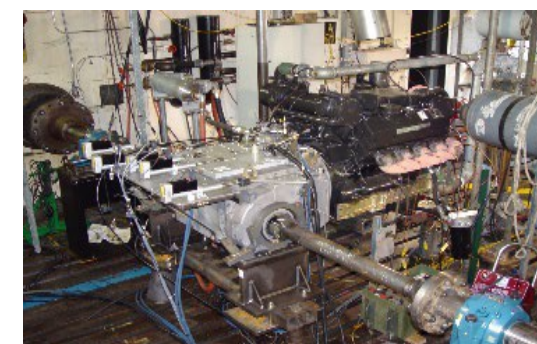
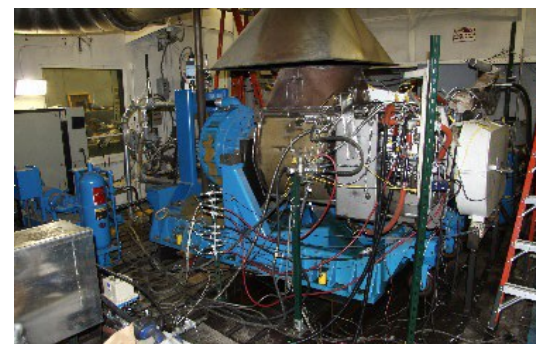
POC: Kevin.S.Centeck.civ@army.mil

GROUND VEHICLE POWER & MOBILITY (GVPM) PROPULSION SYSTEMS LABORATORY (PSL)



Capabilities:

- 6 Engine/Transmission Test Cells
- 3 Full Vehicle Test Cells
- Ground Systems Propulsion Systems Lab
 - Engine performance, endurance, qualification and acceptance
 - Transmission performance and efficiency
 - Vehicle full load cooling, tractive effort to speed, fuel economy and air conditioning
 - Drive axle endurance
 - Testing from 50 up to 3000 HP using Eddy current, water brake and AC dynamometers
 - Total dynamometer sprocket output load absorbing capacity enables testing of any known military ground vehicle in any transmission gear range
- Standardized or customized ISO 17025 accredited test procedures



Temperature
Ambient to 160 °F

Wind Speed
0 to 60 mph

Solar Loading
1,200 W/m²

POC: John Hubble, John.E.Hubble.civ@army.mil

GROUND VEHICLE POWER & MOBILITY (GVPM) GROUND SYSTEMS POWER & ENERGY LABORATORY (GSPEL)



Capabilities:

- 32,000 ft² of laboratory space
- 8 Labs Focused on Technology Development and Maturation:
 - Energy Storage
 - Fuel Cells
 - Heat Exchangers
 - Air Filters
 - Electrical Components
 - Robotic – Power and Energy Vehicle Environmental Laboratory (R-PEVEL)
 - Real Time Controls
 - HVAC
- Power & Energy Vehicle Environmental Lab (PEVEL)
 - Wheeled Vehicles (up to 10X10 Drive)
 - Tracked Vehicles (up to Bradley)
 - Controlled Environmental Conditions



POC: Igor Baseski, Igor.Baseski.civ@army.mil

GROUND VEHICLE POWER & MOBILITY (GVPM) PLATFORM ELECTRIFICATION AND MOBILITY

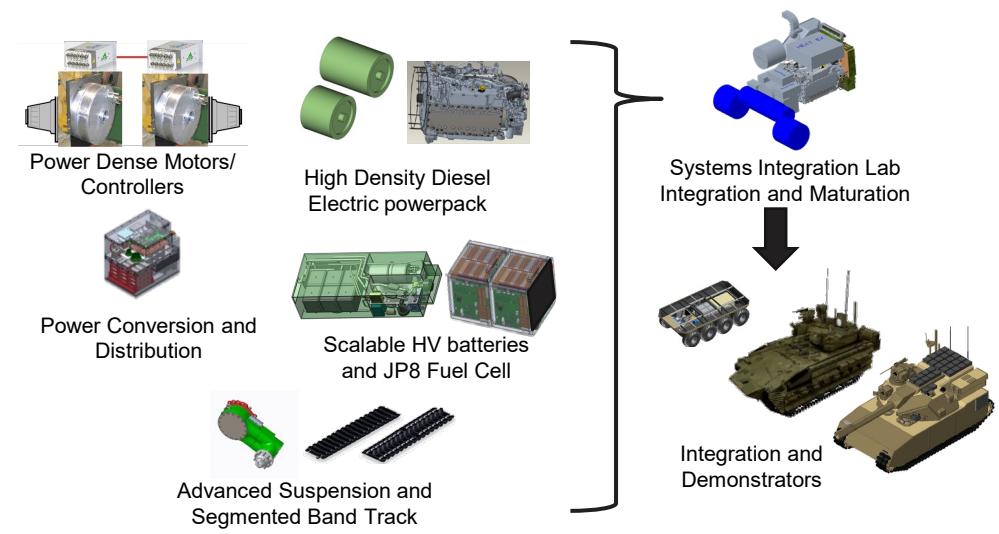


Platform Electrification and Mobility (PEM):

This project develops, integrates and tests essential electrification/hybrid electric technologies for various weight classes of Next Generation Combat Vehicle platforms.

Primary Investment Areas:

- Optimized scale-able high voltage architecture to permit future all electric power pack options.
- Power dense onboard ISG power generation and energy storage to enable DEW, electrified armors, etc.
- Segmented Composite Rubber track coupled to an advanced external suspension for weight reduction and improved off road & silent mobility performance.
- Li-ion based Modular HV Battery System.
- JP8 Fuel Cell for light vehicle propulsion and continuous silent watch/extended silent mobility on larger platforms.
- Electrified sprocket drive.
- Future battery chemistry development.
- Future tactical battlefield recharge.



Technology	Industry Partner
Generators	Wittenstein
Inverter	DCS/Calnetix and Internal
Electric Sprocket Drive	Qinetiq
Engine	Cummins
Universal High Voltage Converter	Create
JP-8 Fuel Cell	Precision Combustion Inc. (PCI)
Modular High Voltage Battery	UEC Electronics
Composite Track	Soucy Defense
External Suspension Unit	Horstman Systems

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GROUND VEHICLE SURVIVABILITY & PROTECTION (GVSP) INTEGRATED OFFICE



- DEVCOM Centers
- Industry Cooperation
- Int'l Relationships
- Academic Partnerships
- Collaboration

- PM Guidance
- Contractor Plan
- 6.2 S&T Plans

- Arch & Controls
- Soft Kill
- Advanced Armor
- CCDO
- Hard Kill

Materials,
Sensor Protection,
Occupant Protection,
Special Systems and
Components

- Performance Specs
- Requirements
- Test Data
- Drawings
- Hardware
- Cyber Security
- Software
- Configuration Management

PdM
VPS

- Continued Maturation
- Platform Integration
- Vehicle Testing
- Logistic Product Development
- Training
- Fielding

- OMFV
- AMPV
- RCV
- MPF
- PMs

Performance Specs, Requirements, Test Data, Drawings, Hardware, Cyber Security, Software Configuration Management, etc.

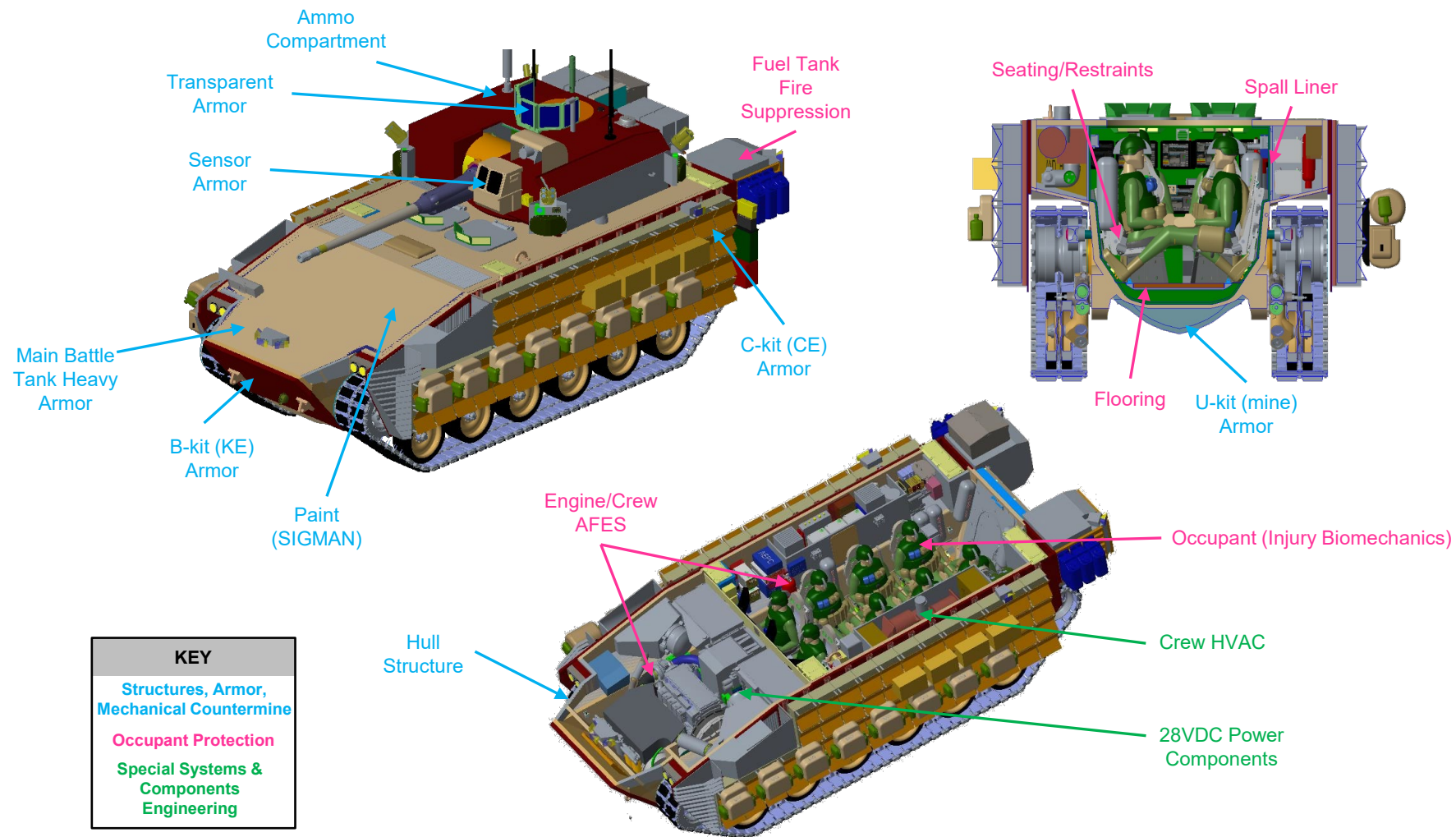
PMs

GROUND VEHICLE SURVIVABILITY & PROTECTION (GVSP) ACTIVE-RDE FUNCTIONAL COMPETENCIES



Active-RDE Leads DEVCOM in Coordinated, Layer-able Defense Systems

GROUND VEHICLE SURVIVABILITY & PROTECTION (GVSP) P/R-RDE VEHICLE-BASED FUNCTIONAL COMPETENCIES



P/R-RDE Leads DEVCOM in these Competencies

GROUND VEHICLE SURVIVABILITY & PROTECTION (GVSP) LAB OVERVIEW

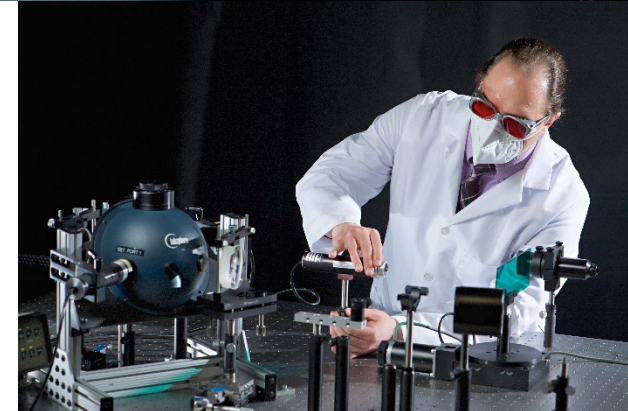
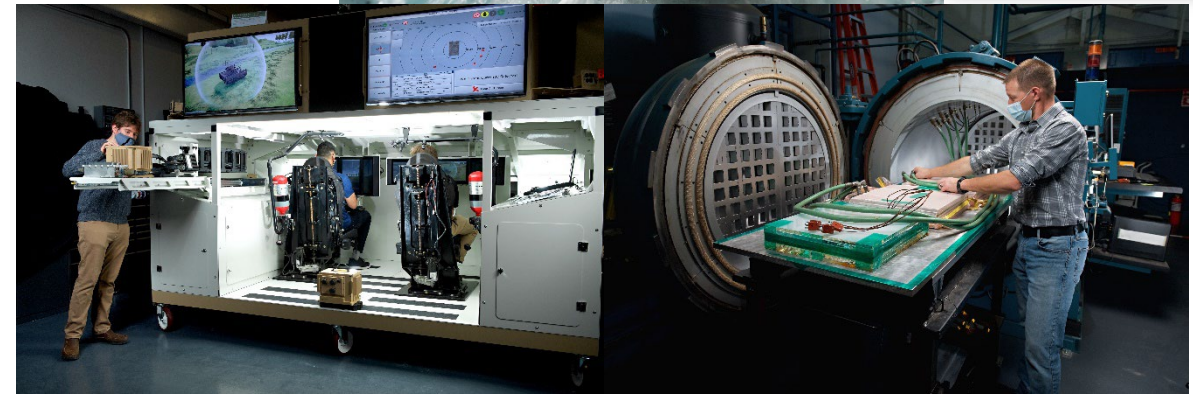


GVSP owns and operates research equipment valued at **\$14M** in more than **68,000 square feet** of lab space at GVSC and Selfridge Air National Guard base



Ground Vehicle Systems Center facilities:

- **Survivability Armor Ballistics Lab**
 - First article tests/manufacture of transparent armor
 - Production control tests
 - Weld coupon tests
 - Projectiles range in size from 5.56mm to 105mm
- **Vehicle Protection Integration Lab**
 - MAF compliance testing (Army authority)
 - Software development for modular APS/Control systems
 - Virtual Battlespace Environment for M&S
- **Vehicle Armor Lab**
 - Design/Build /fabricate/evaluate/test composite systems at a coupon, subsystem and system level to identify material issues early in development stage
- **Laser Application Systems Research Lab**
 - Peak fluence measurement (sensor)
 - Laser-induced damage threshold testing (eye)
 - Laser sensor jamming (cameras and LIDARS)



GROUND VEHICLE SURVIVABILITY & PROTECTION (GVSP)

LAB OVERVIEW CONTINUED



Camp Grayling facilities:

• **Rapid Evaluation Capability (Mobile experiment lab)**

- Real-time experiments/evaluations of emerging technologies against high-explosive threats (EFPs, RPGs, ATGMs, Recoilless Rifles, Mines, Direct-Fire Suppression)
- Verifies medium-caliber armor manufacturing processes
- UAS testing capabilities



SANG facilities:

• **Fire Lab**

- Integration/Testing/Evaluation of existing/emerging extinguishing components/agents
- Integration and engineering test/evaluation of AFES for watercraft, tactical/armored manned/unmanned ground vehicles

• **SABL Bunker**

- Ballistic weld testing
- Up to 75mm projectiles

• **Soft Kill Integration Cell / Active Defeat Lab**

- Evaluation of subsystem performance/integration for RADAR/LASER/Thermal/DE
- Testing of Sensors with Lidar/Laser or Radar capabilities

• **Ballistics Simulation Lab**

- Close-in and advanced survivability protection technology testing using multiple air-fired projectile threats

• **Occupant Protection Lab**

- Crew Compartment Underbody Blast Simulator (CCUBS)
- Sub-System Drop Tower (SSDT)

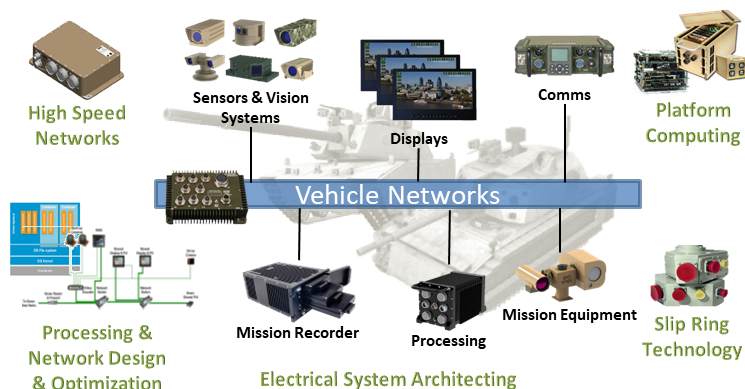


Tools available to support external programs for Industry and the PMs. Partners include Fort Johnson (NGIC & ERDC); MTU/KRC; ENMTC

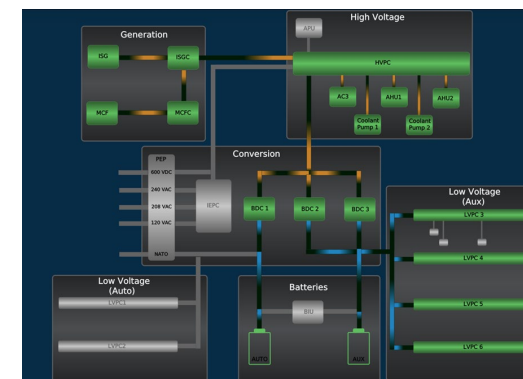
VEHAICLE ELECTRONICS & ARCHITECTURE (VEA) OVERVIEW



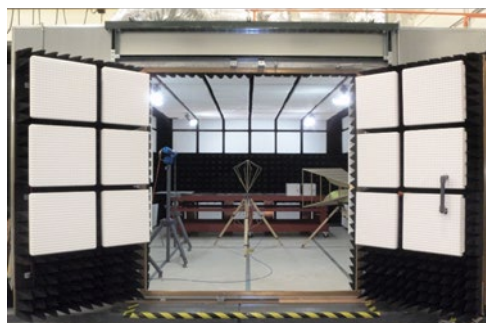
Vetronics



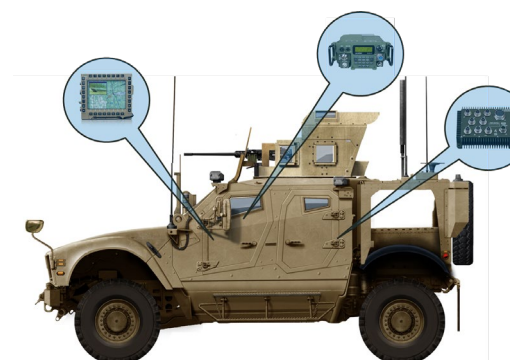
Electrical Power Distribution & Management



EMI Analysis & Test



C5ISR Integration



Trusted Authority & provider of ground vehicle power and data architectures

VEHICLE ELECTRONICS & ARCHITECTURE (VEA)

VEHICLE DATA NETWORK ARCHITECTURES



Objectives

- Demonstrate a MOSA based common military ground vehicle architecture to inform future instantiations of GCS Common Infrastructure Architecture (GCIA)

Key Development Areas:

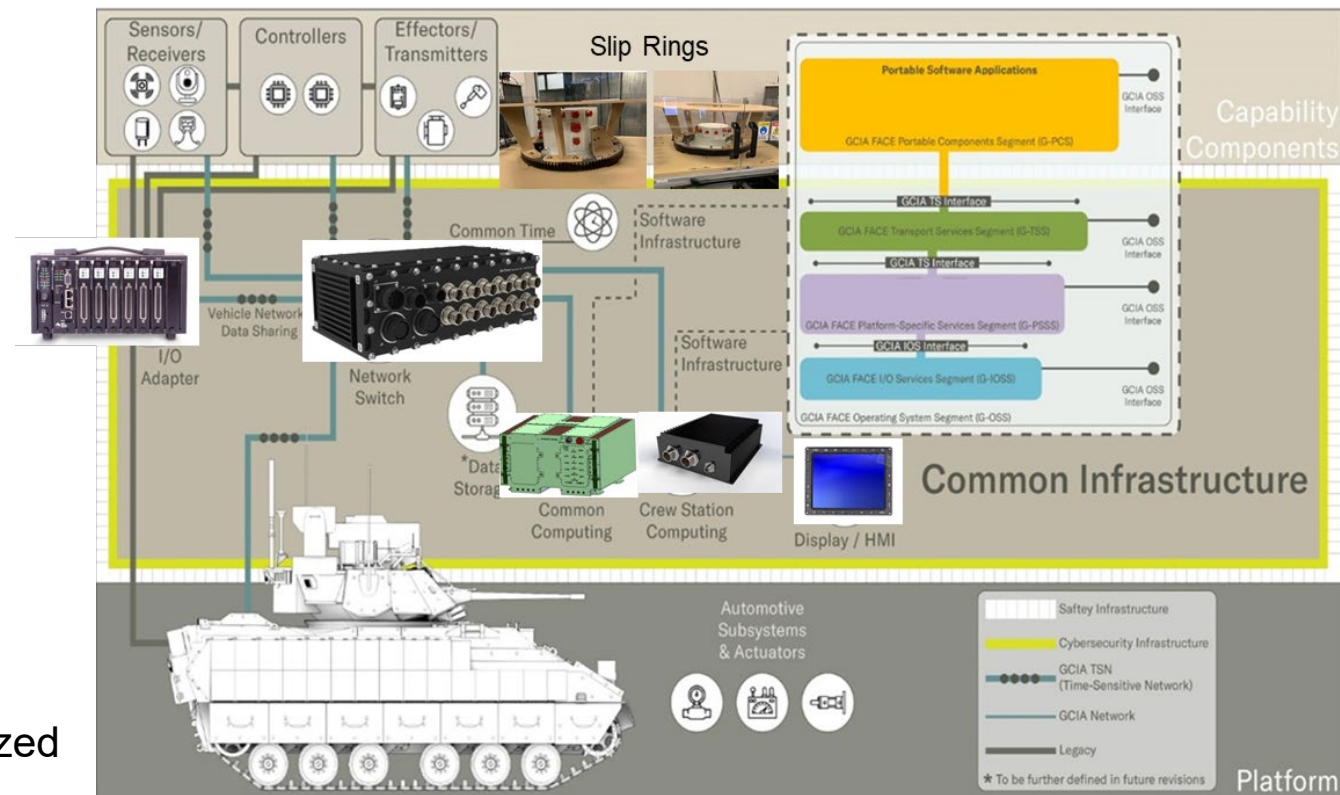
- Time Sensitive Network (TSN)
- Common Compute
- Crew Station Compute
- Common Displays
- I/O Adapters
- Software Services
- Adaptation with FACE
- Video and Sensor Distribution

Items of Interest:

- Industry's adoption of MOSA for ground vehicles
- High Performance Onboard Compute
- Size, Weight, Power, Cooling and Cost-efficient ruggedized
- Safety critical applications in a digital age



Sensor and Video Distribution



Paradigm Shift for the Ground Community

VEHICLE ELECTRONICS & ARCHITECTURE (VEA) ELECTRICAL POWER ARCHITECTURES



Objective

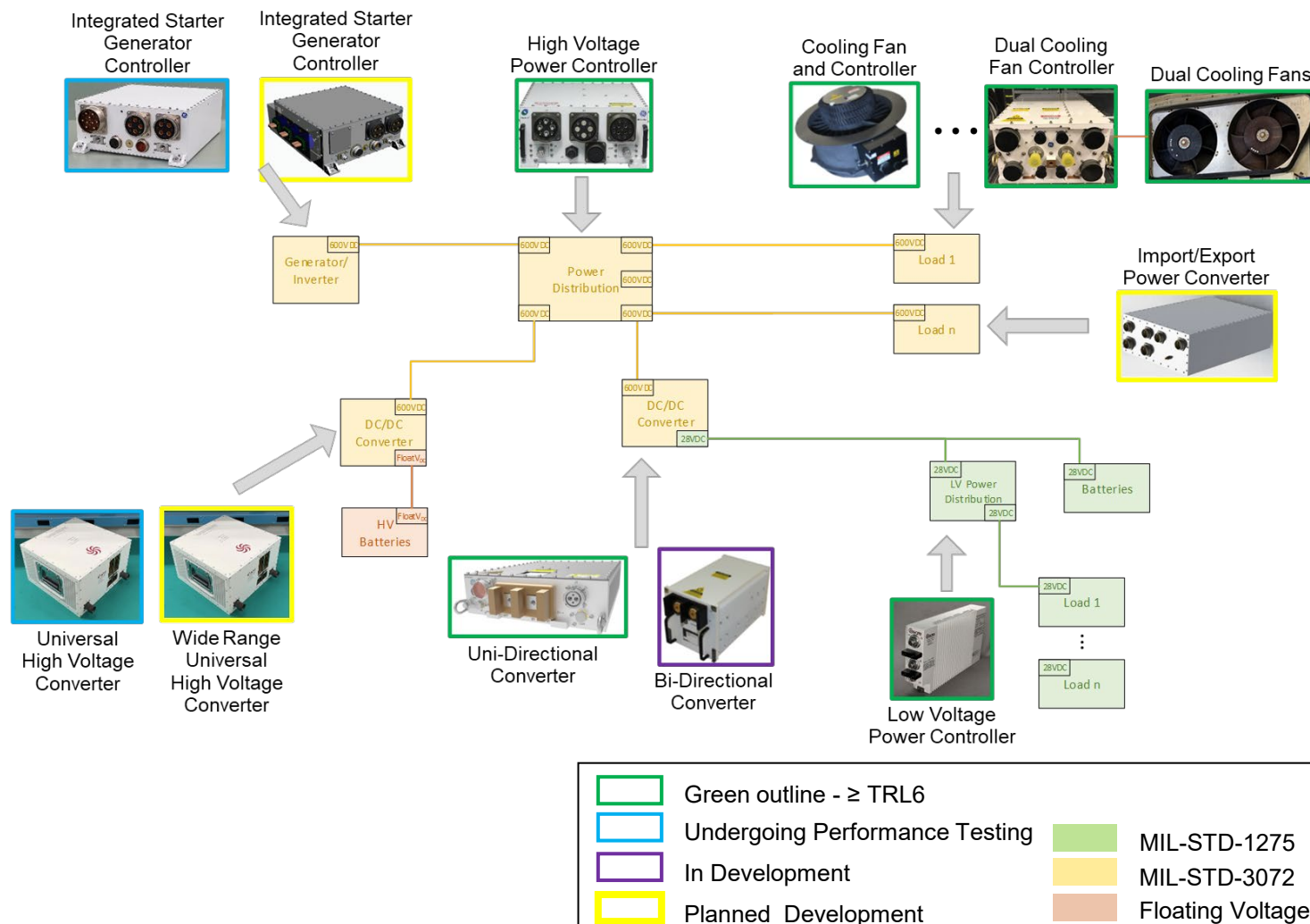
- Develop high voltage power distribution architectures and components for Military ground vehicles

Key Development Areas:

- Next Generation Power Electronics
 - Wide Range Universal High Voltage Controller
 - Bi-Directional Motor Inverter
 - Uni-Directional Converter
 - Bi-Directional AC Inverter
- MIL-STD-1275 & MIL-STD-3072

Items of Interest:

- Industry's adoption of high voltage architectures
- COTS components applicable to Electrification, Mild Hybrid and Full Hybrid Architectures
- Thermal management & MIL-810 environmental
- Size, Weight, Power, Cooling and Cost-efficient ruggedized power distribution components



VEHICLE ELECTRONICS & ARCHITECTURE (VEA) LAB OVERVIEW

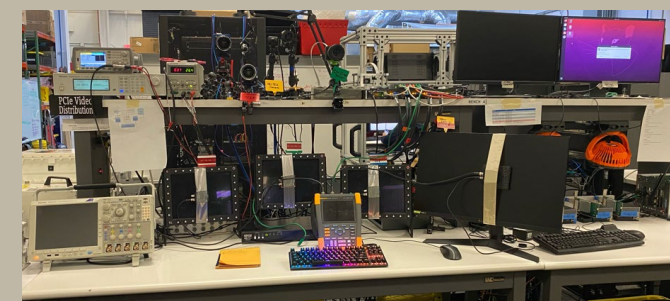
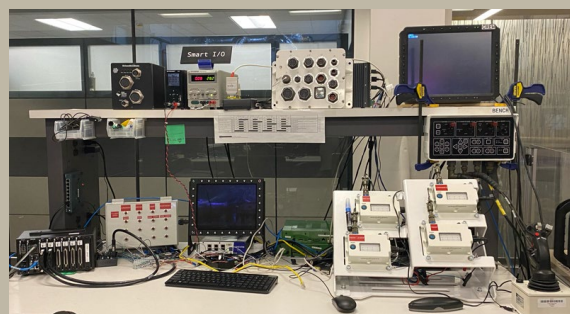


The VEA lab is used for architecture development and electronics integration for tech-based R&D projects, supporting electronics and power systems development, integration and testing. The VEA EMC Laboratory also performs several of the MIL-STD-461 electromagnetic interference (EMI) tests applicable to electrical and electronic subsystems integrated on Army Ground Platforms.

CAPABILITIES

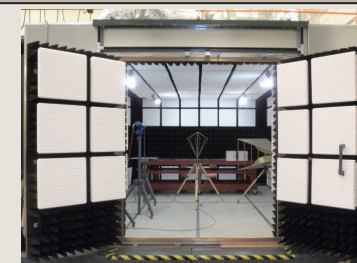
Digital network architecture, components, and systems

- Requirements verification
- Deterministic networking analysis
- Bench top testing
- Vehicle integration
- Verification on vehicle
- Network bandwidth/throughput analysis
- Network load studies
- Architecture standard verification of hardware and software
- Video glass-to-glass latency testing



E3 Testing & Services

- MIL-STD-461 Testing
 - Conducted Emissions, Conducted Susceptibility, Radiated Emissions, Radiated Susceptibility
- MIL-STD-464 Testing
 - Bonds and Grounds
- Testing of subsystems with 28VDC to 600VDC power.
- Waveguide-below-cutoff coolant loop with thermal conditioning to support EMI/EMC testing of liquid-cooled power electronics.



High and Low voltage power components and systems

- MIL-STD-1275 and MIL-STD-3072 Testing
- Performance requirements verification
- Bench top testing
- Vehicle integration
- Performance characterization on vehicle
- Electrical power studies
- Electrical power architecture analysis



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Questions?

Join the GVSP, GVPM, and VEA Teams for One-on-One Conversations:

- **GVSP Table #4 Classroom 143**
- **GVPM Tables: #9, #10 and #11 Classroom 145**
- **GVPM & VEA Table #13 Classroom 145**