FCS Technology Insertion and Transition

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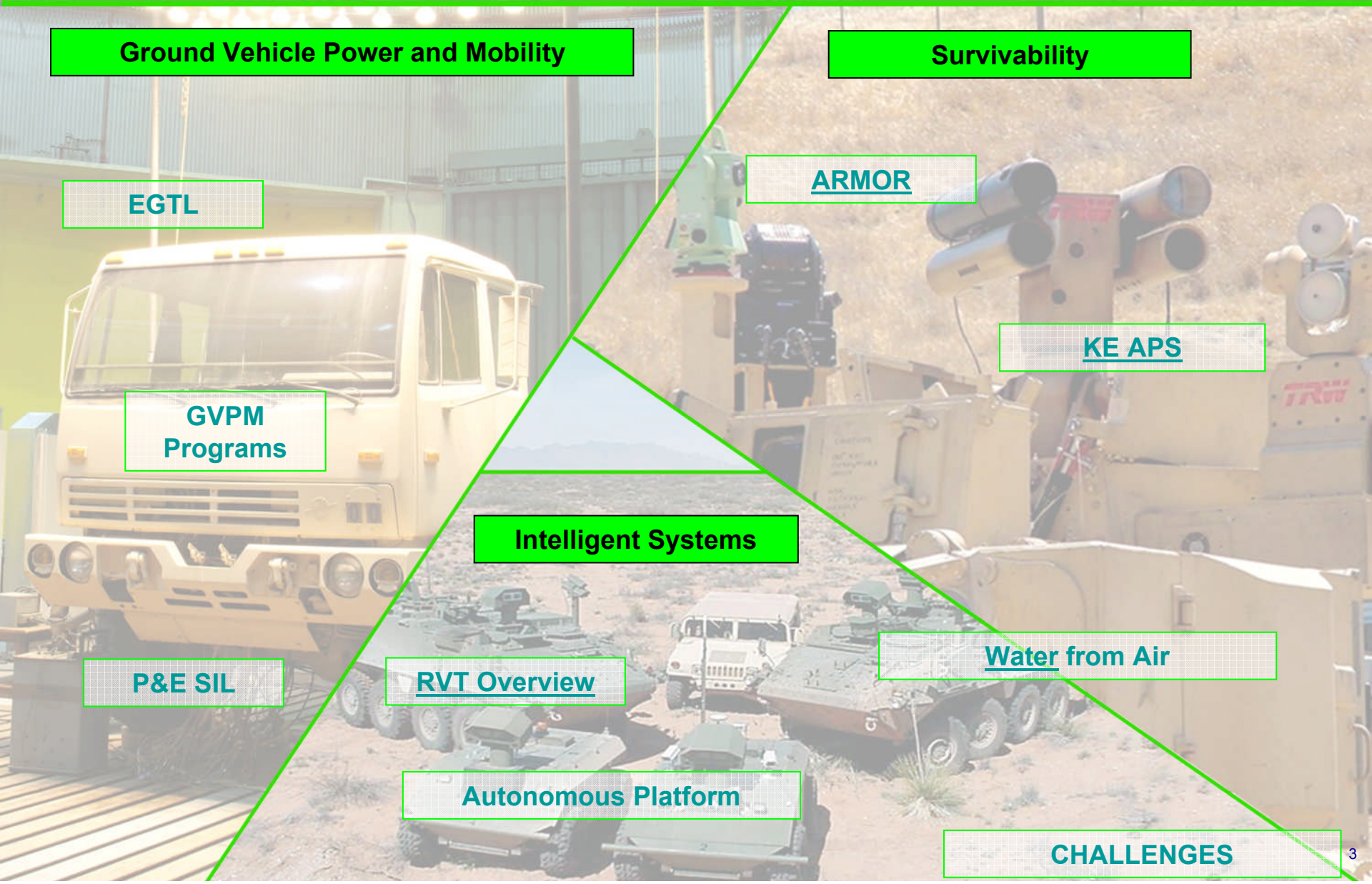
Ground Vehicle Systems and Support Equipment – For Today and Tomorrow

Current		Future
70 ton main battle tank	Enhancing the Current Force	25-30 ton manned ground vehicle (FCS (BCT))
Unarmored Tactical		Armored Tactical
100% Manned Systems		Combined Manned/ Unmanned Capabilities
Conventional Power Trains		Hybrid Electric Systems w/ exportable power
Passive Suspension	Enabling the Future Force	Active Suspension
Steel Track		Segmented Band Track
Periscopes		Indirect Vision Driving
Conventional Armaments		High Power (EM) and Laser Weapons
Point to point Voice Communication		Shared Common Operating Picture
		Onboard Water Generation
		Fire-Resistant Fuels
		Laser Protection
		Diagnostics/prognostics
		Integrated C4ISR

RDECOM S&T Supporting FCS



Ground Vehicle Power and Mobility

EGTL

GVPM Programs

P&E SIL

Survivability

ARMOR

KE APS

Intelligent Systems

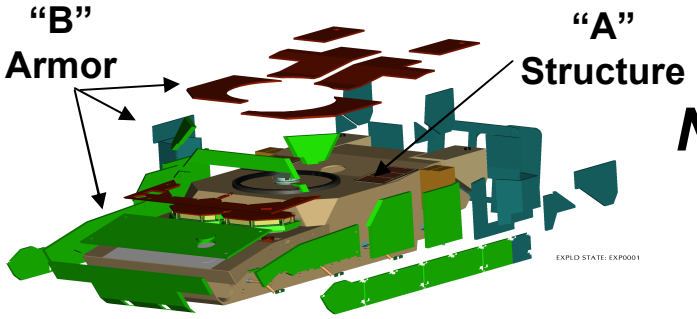
RVT Overview

Water from Air

Autonomous Platform

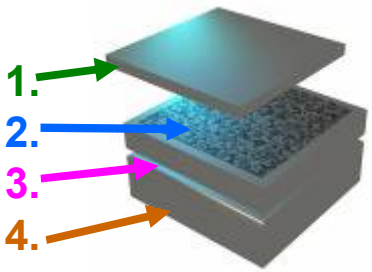
CHALLENGES

S&T Investment for FCS Armor



New Materials & Mechanisms For Bx Armors

Functionally Layered Armor Design



Functions:

1. Cover Plate
- Prevent nuisance damage

2. Ceramic
- Break & Erode Penetrator

3. Tile Enhancement & Isolation
- Mitigate Damage

4. Backing
- Support and containment

B1/U1

1. 2D- Composites
   - Aluminum
   - Titanium

2. SiC-N

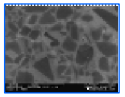
3. Rubber

4.
- 2-D Composites
- Al/ Ti

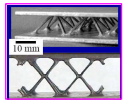
B2/U2

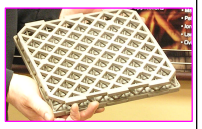
1. Particulate Metal Matrix Composites (MMCs):

2.
- SiC-XY
- Encapsulation:



3. Periodic Core:



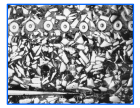


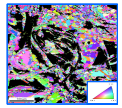
4.
- 3-D Composites
- Through-Thickness Textiles

B3/U3

1. Intermetallic Hybrid Laminates:

2.
- Ceramic Matrix Composites (CMCs)
- Functionally Graded CMCs

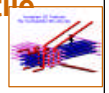




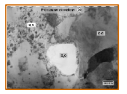
3.
- Intermetallic Hybrid Laminates

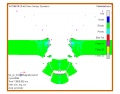
- Fibrous MMCs
- Gen II Periodic Core
- Self-Confining Mat'ls

4.
- Hybrid 3-D Textile Composites



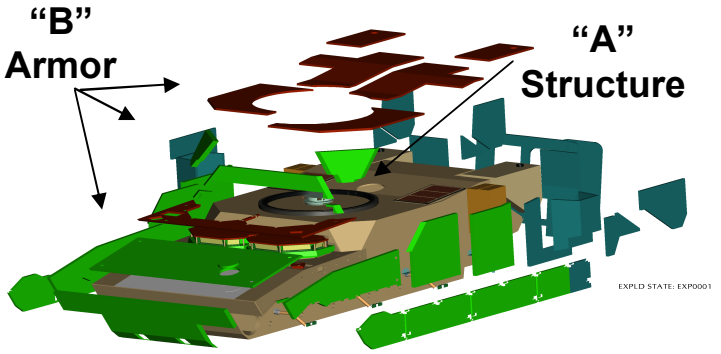
- Nano MMCs





S&T Investment for FCS Armor

Problem: FCS “B” armor solutions that are lighter weight **and** provide increased protection against bullets, projectiles, and blast threats (FY07-FY12)

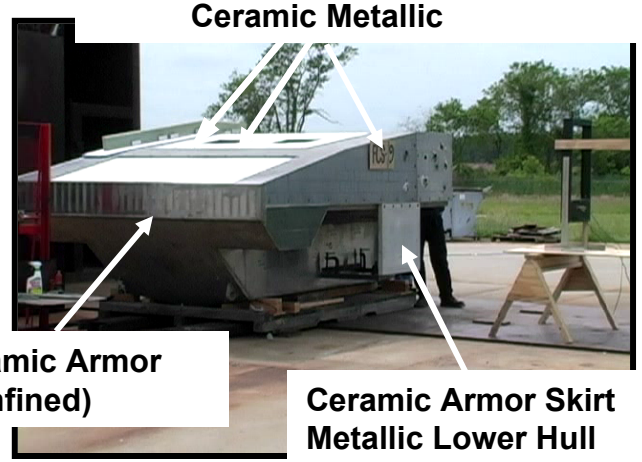


Approach: Improve and exercise M&S tools coupled with T&E to insert improved materials into armor recipes

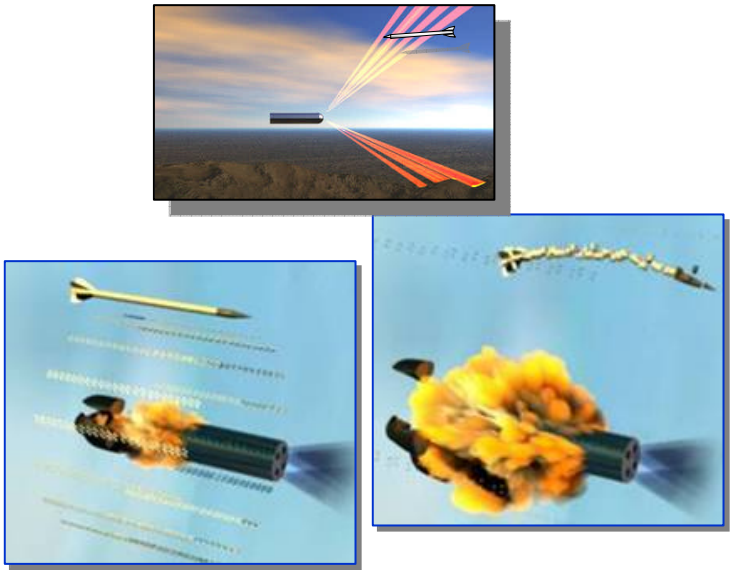
Product:

- Improved Armor Designs
- Advanced M&S tools
- Start of next generation armor materials

Structural Armor
Ceramic Composite
Ceramic Metallic



KE Active Protection System



Purpose:

- *Provide capability to identify, classify, and defeat FCS Tank-fired Threats as defined by ORD and PIDs.*
- *Threats include*
  - *Objective Tank-Fired (i.e. Kinetic Energy)*

Results:

- *Does:*
  - *Develops two color IR cueing sensor, 3 warhead designs & 2 interceptor chassis designs*
  - *Conducts robust component testing*
  - *Provides TRL 6 cueing sensor & countermeasure interceptor ready for systems level testing*
- *Does Not:*
  - *Develop tracking sensors or launcher*
  - *Conduct systems integration*
  - *Conduct vehicle integration*
  - *Conduct system level end-to-end testing*

Payoff:

- *Enhances protection of FCS against tank-fired threats*
- *Transitions to PM FCS in FY09 for SDD*

Ground Vehicle Power and Mobility - FCS Technologies

High Performance Engine Research (HIPER)

Objective: *Develop engine technology to provide 30% increase in system, power density and 30% weight decrease. Develop turbocharger for torque rise, improved response and increased engine power.*

Power & Energy System Integration Labs (SIL)

Objective: *Evaluation and integration of power and energy technologies in a "form, fit and function" environment.*

Li-Ion Battery Technology

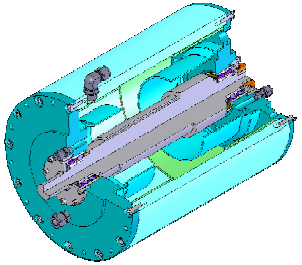
Objective: *Develop Li-ion battery with energy density of 120 Wh/kg.*

Advanced Lightweight Track

Objective: *Develop lightweight, robust and logistically supportable track for FCS MGV.*

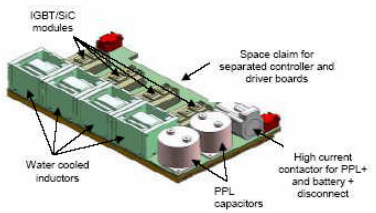
IPM Traction Motor Technology

Objective: *New motor concept with high torque & high power density. The demonstration and test data will be transitioned in Dec 07.*

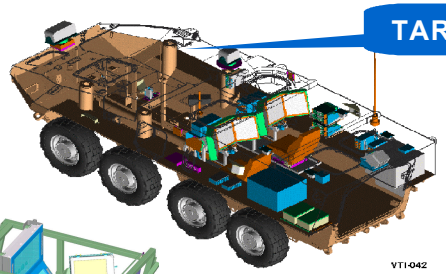


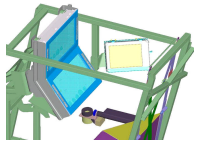
SiC Power Electronics

Objective: *Develop compact, high temperature, lightweight power electronics.*



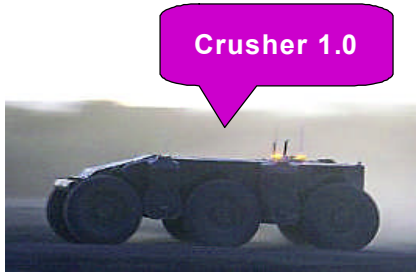
Robotic Vehicle Technology Overview





Robotics Mission Workstation

FCS Defined Radio Network



SOSCOE

SOSCOE

SU Surrogate

FCS WMI Surrogate

BCME Surrogate

PPS Surrogate

BCME Surrogate

SDM Surrogate

RSTA Surrogate

VMS Surrogate

ANS

Acronyms:
WMI = Warfighter Machine Interface
SU = Situational Understanding
BCME = Battle Command Mission Execution
PPS = Planning and Prep service
NMS = Network Management Service
RSTA = Reconnaissance Surveillance, & Target Acquisition
SDM = Sensor Data Management
VMS = Vehicle Management Software
ANS = Autonomous Navigation System

RC ATO

FCS

RVT*

Crusher

ANS

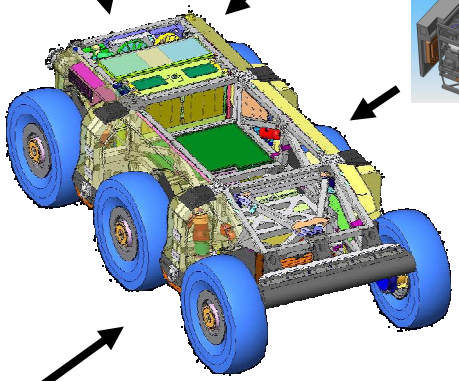
RVT ATO Overview

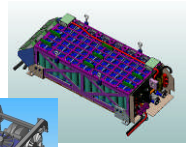
FCS Representative Interfaces to be Monitored for Performance In UGV Functional Testing

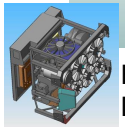
Autonomous Platform Demonstrator

Existing DARPA/CMU-NREC
Crusher 1.0

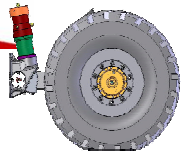
PM FCS
ARV SFR Requirements







Hybrid
Drive
Technology



Suspension
Technology

Purpose:

- **This platform demonstrator will develop, integrate, and test next generation UGV mobility technologies such as hybrid electric drive systems, advanced suspension systems, lightweight chassis technologies, and efficient, low density auxiliary systems integrated on a single platform while preserving deployability of 2 in a C-130.**
- **To design, integrate, and test (platform mobility/system performance) guided by and based on FCS ARV SFR requirements/specifications (including weight, mobility performance, and size).**
- **To develop an Autonomous Platform Demonstrator (APD) for the demonstration of ARV platform technologies developed under the ATO D.TAR.2008.04, Robotic Vehicle Technologies (RVT) for FCS ATO on an improved UGV platform.**

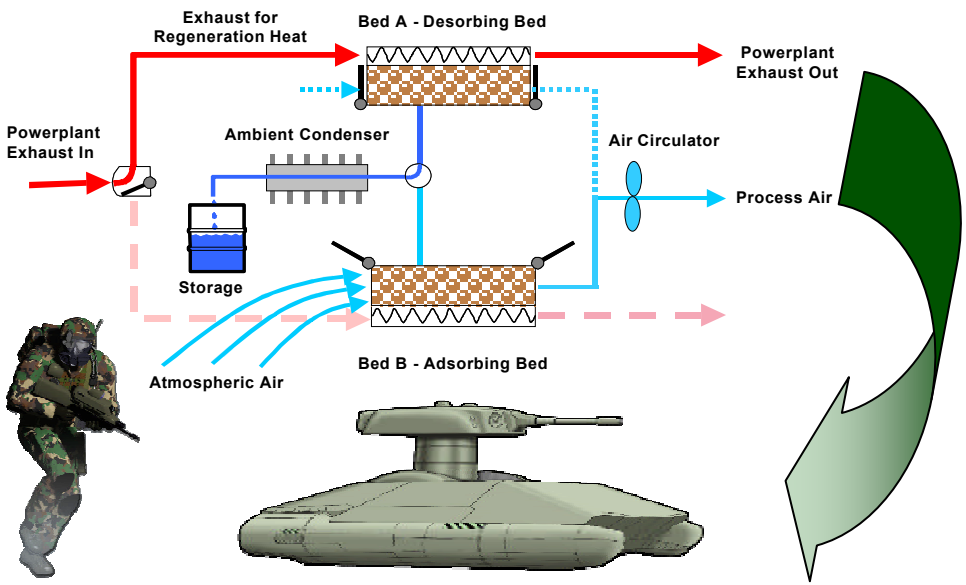
Results:

- **Platform capable of demonstrating reliable mobility drivetrain and chassis subsystems (engine, transmission, suspension, and hybrid electric drive).**
- **Engineering data through platform mobility and performance testing to refine ARV SDD-level designs.**

Payoff:

- **Continuing to develop and mature UGV core mobility technologies into the APD will benefit all unmanned platform mobility, subsystem and control development.**
- **Higher performing UGV platform for continued ATO control experimentation.**
- **Integrated APD platform and experimentation data that provides design risk reduction for ARV platform rqmts.**

Water From Air



Purpose:

- Develop the capability to produce drinking water from systems embedded in combat platforms by harvesting water from humidity sources, including the atmosphere & crew compartments – reduce the large water logistical footprint.

Product:

- Lightweight, energy efficient device to generate water from air for units or platform integration.

(Warfighter) Payoff:

- Reduces the logistical footprint associated with water storage and distribution by 50 to 66%.
- Enables soldiers/systems/units to operate without resupply for 72 hours.
- Transitions to FCS, PAWS, HTV, FTTS and/or FFW demonstrators.

Technical Challenges

Armor:

- Appropriate weight/volume goals
- Improved materials that utilize current “understood” defeat mechanisms
- M&S tools that capture micro and macro responses
- Alternative defeat mechanisms – disruptive technologies (less dependence on passive armor)

KE APS:

- Increase frame rate from 100 Hz to 400 Hz to improve clutter rejection and threat classification
- Implement “Rapid Declaration Of Threats” to meet stressing threat timeline
- Increase Red Band sensitivity to improve clutter rejection and threat classification

Water from Air:

- Operation over a militarily relevant range of environmental conditions.
- System energy efficiency.
- System deployability.

Technical Challenges

Robotic Vehicle Technologies:

- Sensors for perception and terrain understanding to enable higher speed (greater than 65 KPH) autonomous navigation in increasingly complex environments (cluttered urban)
- Advancements in obstacle detection & terrain classification
- System Self Security
- Technologies to enable tighter teaming between Soldiers and robots
- Human Factors

Technical Challenges

Mobility:

- High Performance Engine Research (HIPER) -

  Challenges: *Engine work would have to transition to an ATO-D. Diesel combustion rate/engine speed is limited due to burn time. Peak cylinder pressure/ rate of rise is difficult to control.*

- Li-Ion Battery Technology -

  Challenges: *Maximizing the battery energy content in space and weight limitations, manufacturing process development and cost control, current technology will not meet FCS goals for silent watch requirement of 833 wh/kg with batteries alone.*

- Advanced Lightweight Track -

  Challenges: *Segmented band track will achieve TRL 6 maturity by Dec 08. Back-up Hybrid steel track will only achieve TRL 5 by Dec 08.*

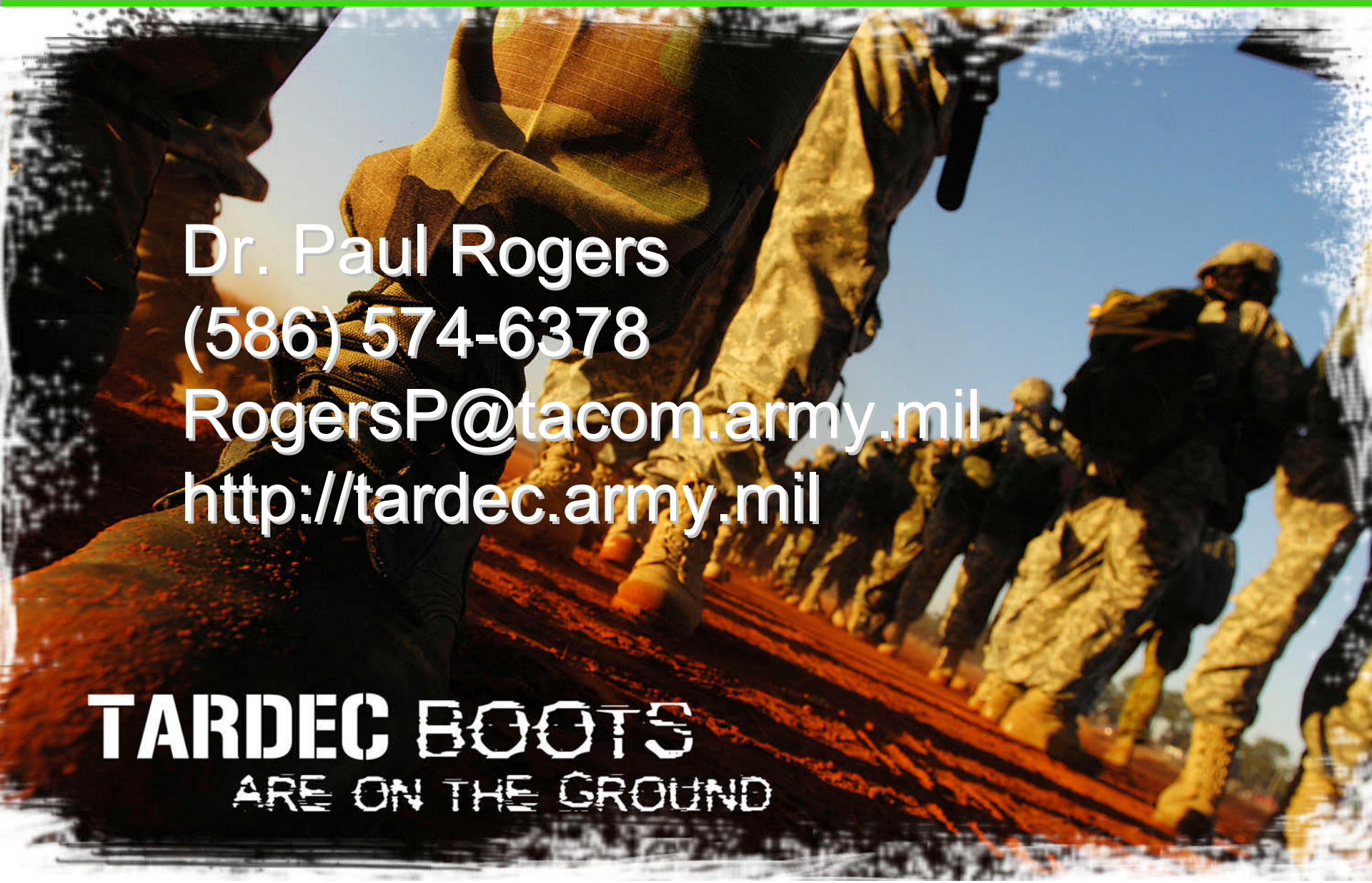
- IPM Traction Motor Technology -

  Challenges: *The IPM a new motor technology. The Demonstration and test data will be transitioned in Dec 07. Further development is required for vehicle Integration Current motor technologies require. Improvements in thermal management.*

- SiC Power Electronics -

  Challenges: SiC *material quality and device yield require further improvement before transitioning for production. Currently only SiC diodes can be transitioned.*

Contact Information



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