PROJECT MANAGER FORCE PROJECTION

Army Robotics Portfolio Update to NDIA GRCC March 2016

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PM Force Projection

Agenda

- Army Robotics Portfolio Update
- Emerging Requirements
- Robotics Challenges & Opportunities

Framing the Army's Draft Robotic and Autonomous Systems (RAS) Plan

As the Army articulates RAS integration across multiple Warfighting Functions, this vision must also show ***realistic objectives*** in the **near-term**, ***feasible objectives*** in the **mid-term,** and ***visionary objectives*** for the **far-term.** Beginning with near-term objectives, each successive phase links its objectives to and builds from the achievements of the previous phase.

Near-Term Vision- *Adapt*

Near-Term Objectives:

- *Leader-Follower Convoy Technology Employment*
- *Lighten the Soldier load*
- *Enhance stand-off from threats and improve situational awareness*

Mid-Term Objectives:

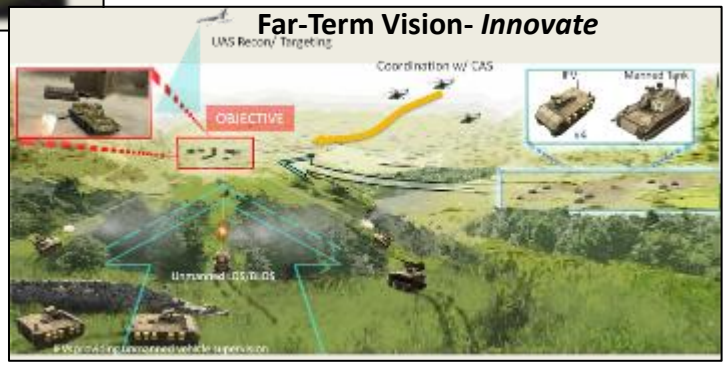
- *Technologies improve the **autonomy** of unmanned systems*
- *Technologies will enable unmanned cargo delivery*
- *Robots act as "teammates" rather than tools*
- *Micro autonomous air and ground systems will also enhance Platoon, Squad, and Soldier situational awareness*

Mid-Term Vision (F2025)- *Evolve*

Far-Term Objectives:

*Technologies will **enable manned and unmanned teaming in both air and ground maneuver** though investments in scalable sensors, scalable teaming, **Soldier-robot communication**, and shared understanding through advancements in machine learning.*

Far-Term Vision- *Innovate*



Source for All Listed Objectives: **TRADOC Pam 525-3-1, *Army Operating Concept*, Appendix C-2.**

PEO CS&CSS Robotics Overview

Man-Transportable Robotics System Mark I & II (EOD)

M160 Light Flail

Semi-Autonomous Control

Route Clearance & Interrogation System

Robotic Enhancement Program

Man-Transportable Robotics System Increment II

Common Robotic System Individual

Leader/Follower

Squad Multipurpose Equipment Transport

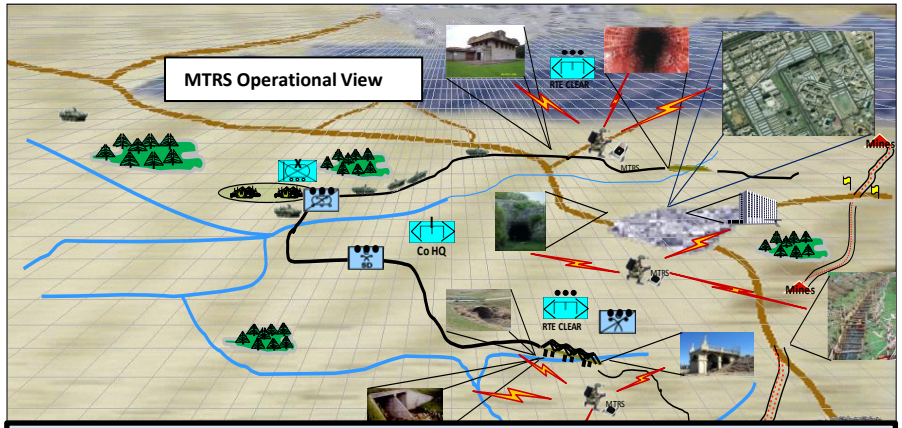
Talon IV	Packbot 510 FASTAC	SUGV 310 Mini-EOD	Dragon Runner	First Look
				

Non-Standard Equipment

Automated Convoy Operations

Husky Mounted Detections System

MTRS Inc II Program Overview



- (MTRS) Inc II is a remotely operated, man-transportable, robotic system.
- Provides a standoff capability to interrogate, detect, confirm and neutralize presence across War-fighting functions
- Identify disposition
- Counter hazards by providing a base capability of carrying various platform payloads in support of current and future missions.

MTRS Baseline

Common Payloads

Optics

Manipulator

Fiber Optic

Radios

Autonomous Mine Detection System (Payload)

Engineers

PdM Counter Explosive Hazard, (PEO Ammo)

CBRN Payloads (Chemical Units)
JPM Nuclear Biological Chemical (PEO Joint Bio Chem Defense)

CBRN Sensors

FirstDefender RMX

Base Platform
IOP V2.0 Compliant

Notional Design

Robotic Deployment Syste
PM Assured Mobility Syste

- **CPD: Approved, 15 MAY 2013**
- **RFP Release: 4QFY16**
- **Milestone B/C: 2QFY17**
- **Contract Award: 2QFY17**
- **AAO: 566**

MTRS Inc II: Post Industry Day Updates

Acquisition Approach Update:

- Government has removed the option of using hulls from the Army fleet of medium sized robots as Government Furnished Equipment (GFE)
  - Government intent to provide Government developed standardized medium sized robot technical data package (TDP) remains unchanged from Industry Day release

Controller Update:

- Requiring use of Government Operator Control Unit software (i.e. Multi-Operator Control Unit – MOCU)

MTRS Inc II Controller Software - MOCU

OCU

Platform

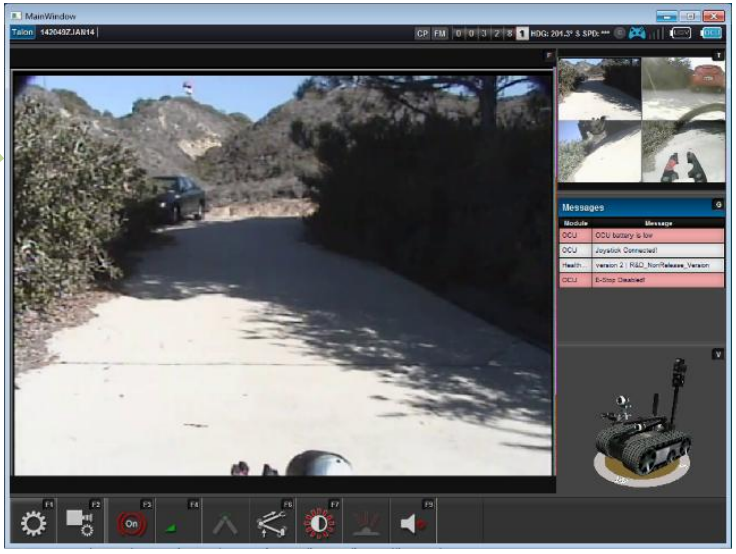
OCU Hardware
Operating System + Drivers
MOCU

Radio

Radio
Manipulator
Cameras

Platform

CBRN Sensors
AMDS
EOD Tools
Other Payloads



- **Multi-Operator Operator Control Unit (MOCU) software developed by Space and Naval Warfare Systems Command (SPAWAR)**
- **Promotes commonality with Navy & other programs**
- **Provides government with increased control over software configuration in sustainment**
- **SPAWAR will manage software configuration; vendor can submit change requests**

Common Robotic System – Individual (CRS(I))

System Description: A man-packable (< 25lbs), miniature, highly mobile, unmanned robotic system with advanced sensors and mission modules for dismounted forces. Designed so that operators can quickly reconfigure for various missions by adding/removing modules and/or payloads.

Common Robotic Platform Enabling Payloads to Address the Operational Capabilities Gaps:

- Standoff short range Intelligence, Surveillance, & Reconnaissance (ISR)
- Remote Chemical, Biological, Radiological, and Nuclear (CBRN) detection
- Explosive Obstacle Counter Measure (EOCM)
- Explosive Ordnance Disposal (EOD)
- Future Users: Engineer, CBRN, INF, EOD

- **CDD: Approved: Jan 16**
- **RFP Release: 1QFY17**
- **Milestone B: 3QFY17**
- **EMD Contract Award: 3QFY17**
- **AAO: 4,098**

***All diagrams are notional*
***CRS(I) weight requirement does not include payloads or manipulator (included in standard payload)*

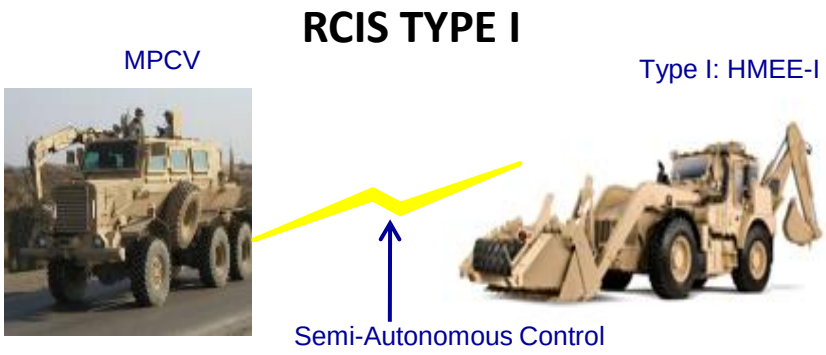
CRS(I): Dates of Interest to Industry

- MDD was approved 1QFY16
- RFI release February 2016
- Industry Day August 2016 (tentatively w/ GVSETS)
- RFP release planned for 1QFY17
- Milestone B and Contract Award 3QFY17
- PDR 1QFY18
- CDR 2QFY18

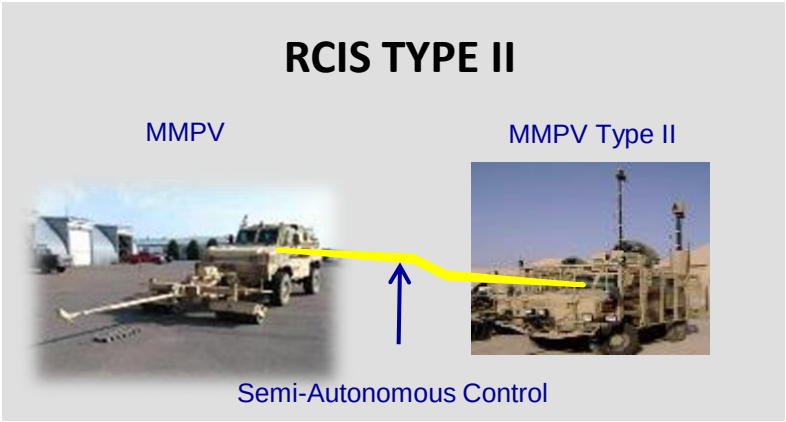
Route Clearance & Interrogation System

Route Clearance & Interrogation System (RCIS) CPD consists of two capabilities that are unmanned, semi-autonomously controlled, highly mobile platforms to support Route Clearance Platoons and the BCTs.

- RCIS Type I:
  - Optionally manned or unmanned
  - High Mobility Engineering Excavator (HMEE) capable of enabling Soldiers to semi- autonomously interrogate, excavate, and classify deep buried explosive hazards, IEDs, and caches.



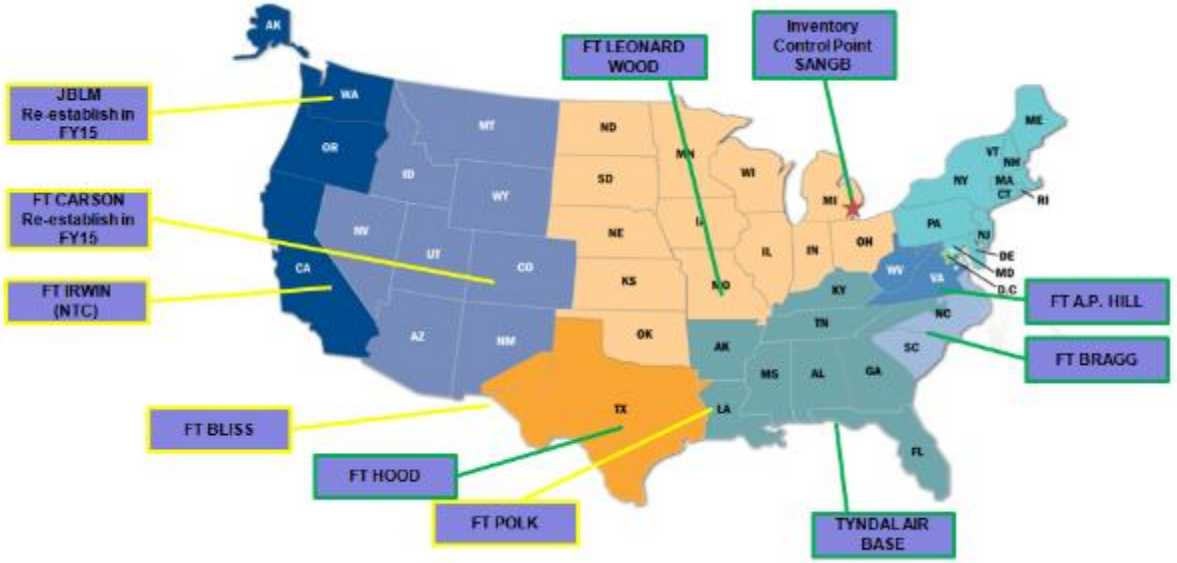
- RCIS Type II to follow, leveraging technology and architecture from the RCIS Type 1 program



- **CPD: Approved, Dec 2012**
- **Industry Day: 23-24 Mar, 2016**
- **RFP Release: Jul, 2016**
- **Milestone B: 2QFY17**
- **Contract Award: 2QFY17**
- **AAO: 266**

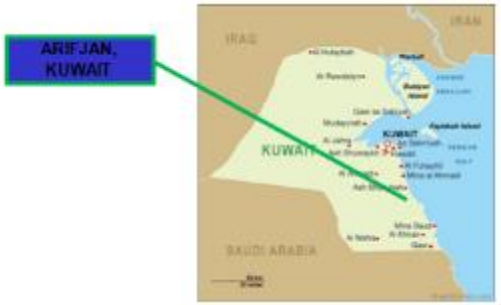
RLSC Directed Requirement Portfolio

Director Robotic Logistics Support Center	
Non Standard Robots	O&S
Man Transportable Robotic System (MTRS) MKII	O&S
Man Transportable Robotic System (MTRS) MKII Recap	O&S



Non-Standard Robots

Talon IIIB	Talon IV	PacBot 510 FASTAC	SUGV 310 Mini-EOD	Dragon Runner	First Look
					



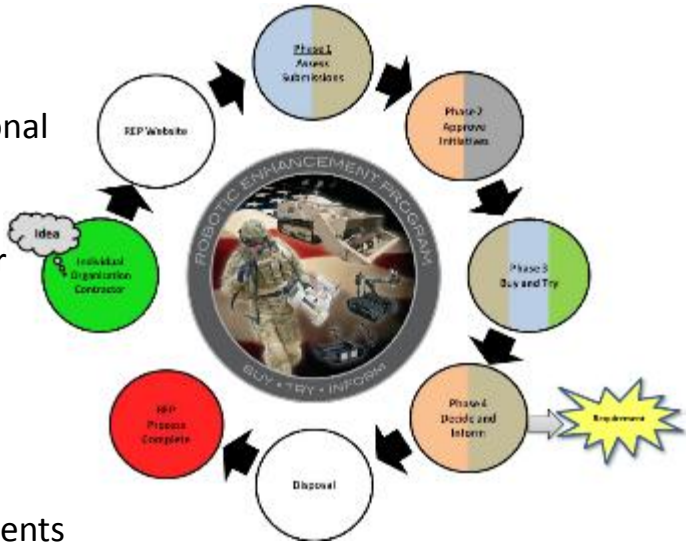
MTRS EOD Robots

MKII MOD0	MKII MOD1	MKII MOD2	MKI MOD0	MKI MOD1	MK5
					

Robotic Enhancement Program (REP)

Problem: Robotic technology is rapidly evolving. The standard requirements/acquisition timeline of 3 to 7 years increases the risk that robotic systems will be obsolete before fielding or even before reaching Initial Operational Capability (IOC).

Mitigation: Evaluate small quantities of state-of-the-art robotic systems and/or payloads to inform the requirement and acquisition process.



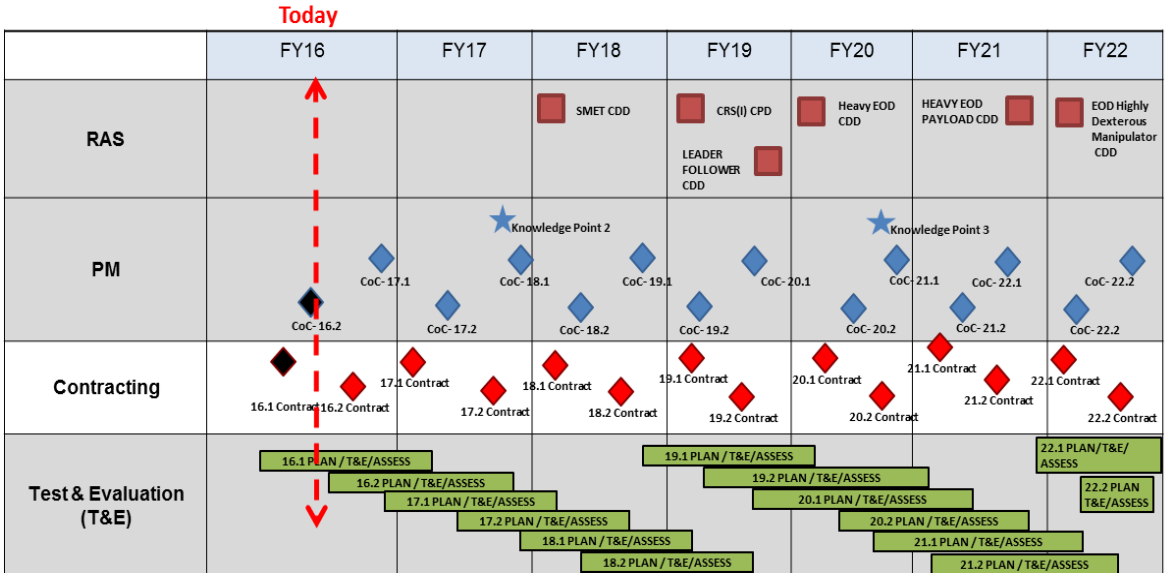
Concept:

- Concept based off of Solider Enhancement Program
- REP is a special project (not a full life cycle acquisition program)
- Uses a "buy-try-inform" methodology to better inform future Army requirements

Experiment Focus:

- Protect the Force
- Reduce Warfighters' Workload
- Enable Situational Awareness
- Sustain the Force
- Enable Lethal/Non-lethal Engagements
- Reduce Cost

http://www.peocscss.army.mil/rep.html



Note: REP Council of Colonels (CoC) 17.1 Submission Deadline: 1 July 2016

Robotics Enhancement Program (REP)

- 16.1 Initiatives
  - Obstacle Avoidance and Mapping: Autonomous Behavior Module, 3D Mapping Payload, Mesh Network/Repeater

  - Extending the Range: Multiple Input/Multiple Output Mesh Radio, Bread-Crumbs, Tethered Mast
- Submissions Reviewed for 16.2 cycle by REP Stakeholder's
  - **(32) 16.2 Submission Proposals:**
    - 05 RECOMMENDED FOR CoC 16.2
    - 14 Deferred
    - 13 NOGO
  - **(20 of 56) Previous 16.1 Submissions Reviewed:**
    - 06 RECOMMENDED FOR CoC 16.2
    - 03 Remain Deferred
    - 11 NOGO – Recommend Delete as 2nd round of reviewed; no advocate

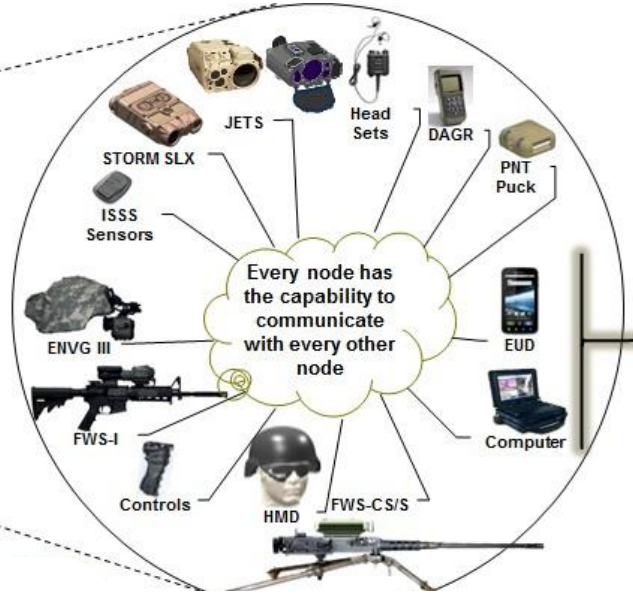
Note: Reference Herein to any specific commercial company, product, process or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply endorsement, recommendation, or favoring by the United States Government or the Department of Army. This document or the ideas expressed herein shall not be used for advertising or product endorsement purposes. Photos and product descriptions are from publically available websites and product overview sheets.

- CoC 16.2 Cycle: 4 Selected Initiatives
  - Inform Heavy EOD CDD (iRobot Kobra and NGC Andros)
  - Safe Warfighter Movement & Detection of Targets Capability (Offset Drop Zone)
  - Highly Dexterous Manipulation System (HDT Torso and dual arms)
  - SMET Expeditionary Bridging Payload (HDT Air Beam)

- CoC 17.1 Submission Cut-Off is 21 Jun 16

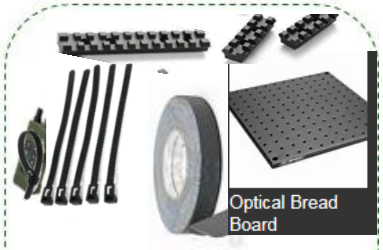
PdM UGV/TRADOC RFI: Intra ROBOT Wireless (IRW) Area Network

Robotic Payloads

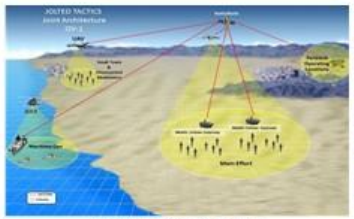


Intra ROBOT Wireless (IRW) Area Network

Ultra Wideband (UWB) at 3.1 -10.6 GHz
2-meter Diameter



ON ORDER BOT TRANSPORT



Tactical Cellular / WiFi (Future)

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- **Mimics Intra Soldier Wireless Scheme and extends application of Soldier Borne Sensors to "Robotic Battle Buddy"**
- **Intra ROBOT Wireless (IRW) to provide a secure, Wireless Area Network (WPAN) for ROBOT/Soldier-Borne sensors and ancillary devices**
  - **Provides a system level commodity that can be used across the PEO portfolio of products**
  - **Capable of selectively accommodating Low/High Bandwidth and Very Low Power Profiles using Ultra Wide Band (UWB) technology**
  - **NSA approval and IA certification to be addressed from a modular and extensible ROBOT System perspective**
  - **Suitable for operations in Electronic Warfare (EW) conditions with Low Probability of Intercept/Detection (LPI/LPD), and low latency**
  - **IRW IOP Reference Standard(s) to be non-proprietary and open standard(s) – Same as Intra-Soldier Wireless**

Emerging Requirements

PLS A1 Leader Follower

System Description: Appliqué System linking unmanned Follower PLSs to a soldier-operated Leader PLS vehicle for increased throughput and Soldier protection both on the road and off road. Calculates separation distances, provides status, and receives input from leader/followers.

Drive by Wire and Active Safety

- Steering
- Braking
- Dashboard
- Data Buses (I/O)
- In-cab Camera
- Temperature Sensor
- Rain Sensor
- GPS and base maps
- Rear and Side Radars
- Wheel Encoders
- Forward Radar
- Display

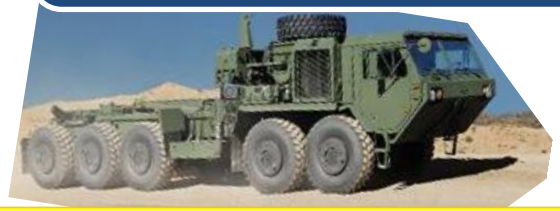
CDD (FY 16-17)

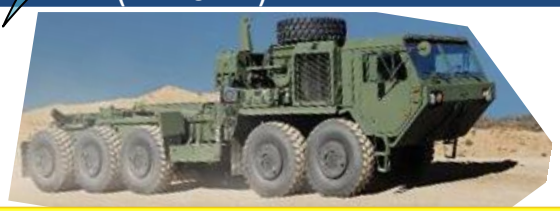
Competing in POM (FY 18-22)

EMD (FY18-20)

Leader Follower

- LIDAR
- Tactical Radio
- Navigation Solution
- Cameras
- UWB Radios
- Fiducial Markers
- Computers





Provides Leader Follower Unmanned Capability to the PLS A1 Vehicle

Leader Follower Risk Mitigation

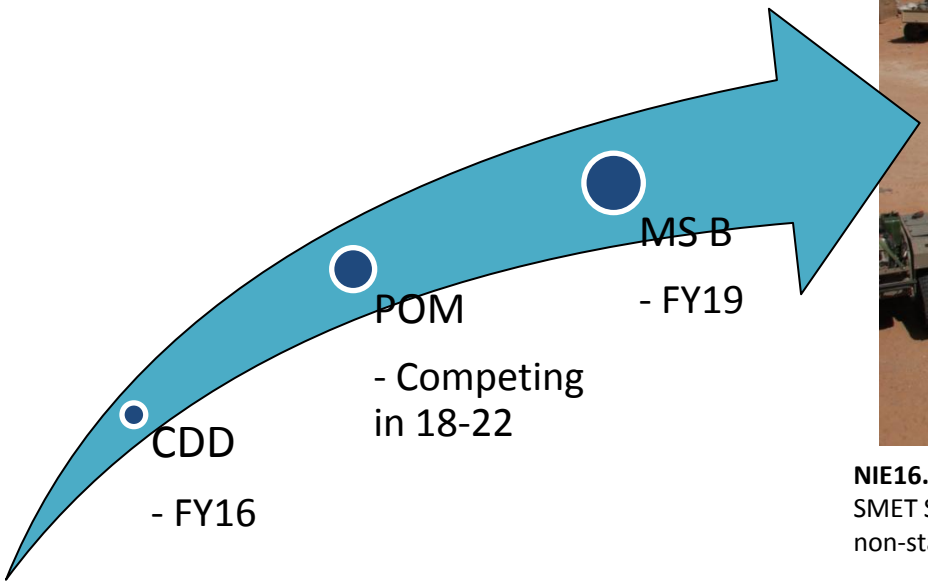
- In managing the affordably risks associated with adding autonomous capabilities to large tactical wheeled vehicles, PM FP is actively pursuing several efforts:
  - Interoperability Profiles (IOP) V3 development for interface between automation kit & by-wire kit
  - Modeling & simulation through System Integration Labs (SILs) for use-case analyses
  - Automation engagement with test community
  - Software re-use strategic planning with TARDEC for Robotic Operating System for Military (ROS-M)

Squad-Maneuver Equipment Transport (S-MET)

System Description: The S-MET will lighten the Warfighter's load and sustain the force during operations. The S-MET will maneuver with the dismounted force and enable Warfighters to conduct operations carrying equipment required to conduct dismounted operations.

Potential Capabilities:

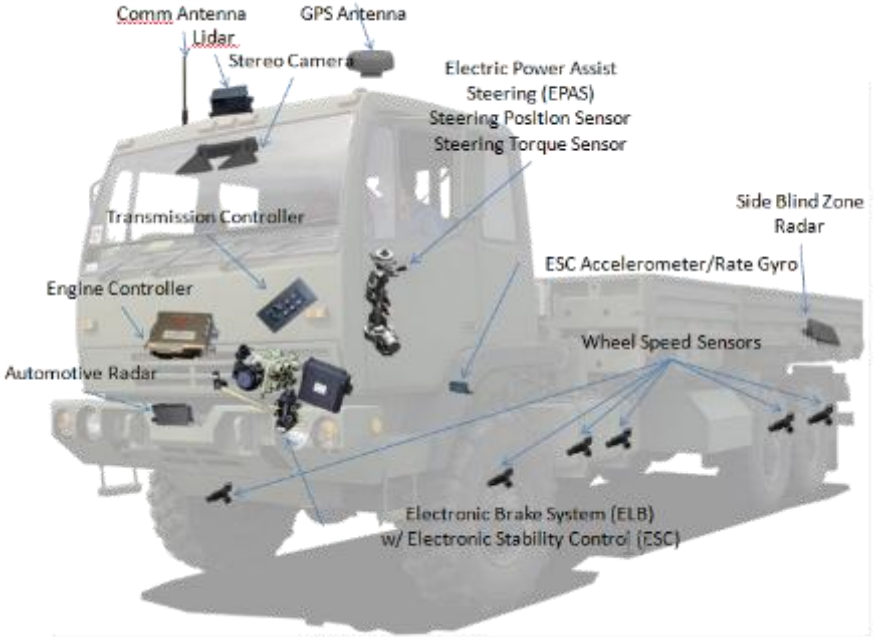
- Load Lightening
- 2-3 Sizes
- Resupply
- Tele-operate and Automation
- Adaptable to Squad Missions
- Extend Communications
- Reconnaissance
- Battlefield Sensors
- Squad Power Source



NIE16.1 OCT15
SMET Surrogates demonstrated reduced Soldier load, commo network extension, non-standard casualty evacuation, and battery charging capability

Automated Convoy Operations

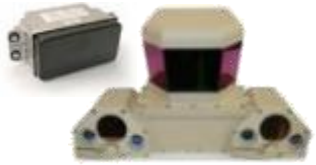
(Future Program of Record)



Appliqué Kit

A-Kit
Universal Brain

B-Kit
Vehicle Specific Connectors



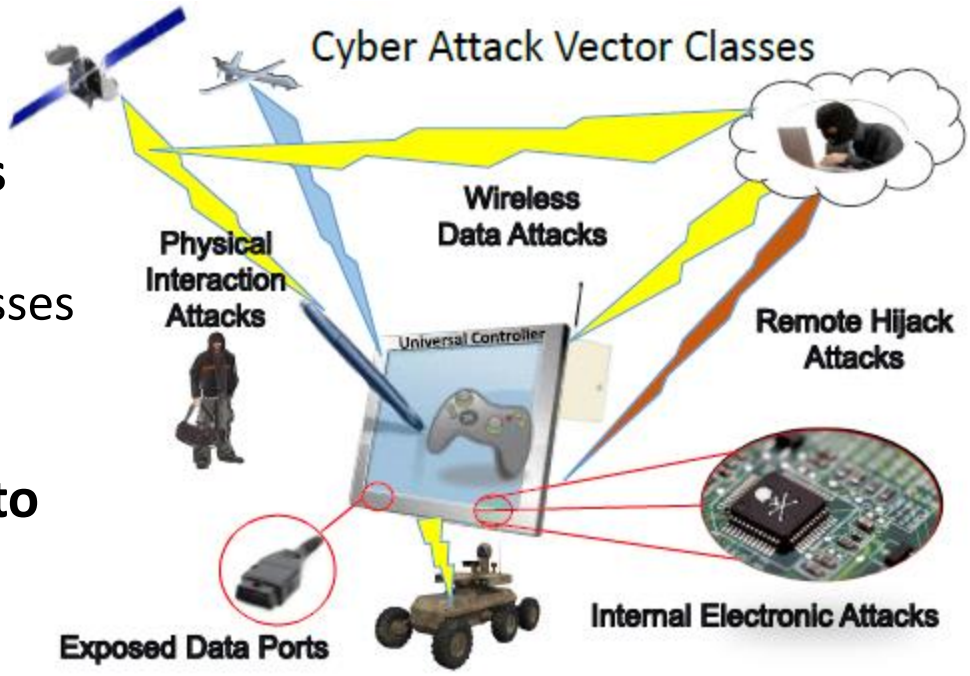
C-Kit
Modular Sensors

Provides *optional* unmanned capability to *any* manned vehicle;
from driver assist to automated driving and navigation

Robotics Challenges & Opportunities

Robotics Top Level Cybersecurity Strategy

- **Characterize Cyber Risk**
- **Evaluate Necessary Cyber Controls**
  - Wireless encryption
  - User authentication & login processes
  - Biometrics
  - Supply chain risk management
- **Develop Programmatic Approach to Cyber**
  - Cyber controls outlined in Systems Engineering Plan (SEP), Test & Evaluation Master Plan (TEMP), Program Protection Plan (PPP)
  - Envision cyber penetration testing during Developmental Testing (DT)
  - Envision periodic software updates/patches planned into sustainment



Relevant Cyber Policies

- DoDI 8510.01 – Risk Management Framework (RMF)
- Committee on National Security Systems Instruction (CNSSI) 1253
- Federal Information Processing Standards (FIPS) 199
- NIST SP 800-60, Volume I
- DoDI 8500.01 (Cybersecurity), AR 25-2
- Wireless Encryption: IAW FIPS 140-2 for FOUO, NSA certification for SECRET

Looking for Cybersecurity Insights from Industry in Current CRS-I RFI

Government/Industry Partnership

- PM FP is working with the National Advanced Mobility Consortium (NAMC) on the following initiatives:
  - Open architecture & reference implementations for Universal Controller software
  - Interoperability Profile (IOP) promulgation
    - Developing IOP Standardized Baseline Instantiations (SBIs)
    - Hosting IOP website
    - Supporting development of IOP V3

POCs

PM Force Projection (FP)

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PROJECT MANAGER
FORCE PROJECTION
PM SKOT
PD TMDE
EQUIPMENT
MEASUREMENT
DIAGNOSTIC
SUPPORT CENTER
GROUND VEHICLES

Discussion

M160 Robotic Mine Flail

ACAT III – Fielding

PEO CS&CSS/PM FP/PdM ALUGS

Program Description

- Tele-operated Robotic system designed to protect Soldiers as they clear a minefield through the use of stand off.
- Fulfills the light flail requirement in the area clearance family of systems
- Original Equipment Manufacturer: DOK-ING, Croatia

Recent Milestones

- ✓ June 2015: CREW Radio Retrofit Kits Contract let
- ✓ January 2016: Physical Configuration Audit

Near Term Milestones or Events

- ❑ March 2016: Install first CREW compatible radio kit
- ❑ April 2016: CSB
- ❑ March 2017: First Unit Equipped

Program Schedule, Budget and Status

Cost	→	**Congressional**	
Schedule	→	**T&E**	
Performance	→	**Interdependencies**	

Color indicates current condition, Direction indicates future assessment

Issues/Concerns

- None

REP Cycle 16.1 Initiatives

➢ Obstacle Avoidance & Mapping (OA&M) Capability

(Currently available Light Detecting And Ranging OA&M Capability to the future MTRS Inc II platform.)

✓ 16.1-8: UxAutonomy Behaviors (AB) *

(Provides an IOP-compliant autonomous navigation capability in a small SWaP configuration.)

✓ 16.1-40: Top Layer-Underground 3D Mapping Capability Payload

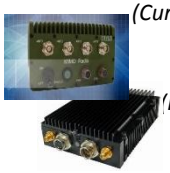
(Compact operational imaging device capable of extracting depth and distance information and pairing it with a standard video of scenes for intuitive situational awareness in tunnel warfare.)

✓ 16.1-47: Underground Tactical Robotics Ground Team (UTRGT®)

(Provides tactical, squad level set of solutions to deal with the main challenges in the SubT environment: consists of 4 high mobility unmanned platforms, an underground repeater network, real time 3D mapping to enhance situational awareness and operational effectiveness in the subterranean environment.)

➢ Extending the Range of the Platform and Payload Capability

(Currently available radio range extenders such as repeaters and/or re-transmitters that will increase overall standoff and range of the platform with its payloads.)



✓ 16.1-3: Multiple Input Multiple Output (MIMO) Mesh Radio

(Provides enhanced range, throughput, and range in a variety of environments including tunnels and extreme non-line-of-sight.)

✓ 16.1-39: UGVs "Breadcrumbs" – Communications Restrictive/Underground Signal Relay Kit (CRUSR)

(Improves the capabilities of unmanned ground vehicles during subterranean operations.)

✓ 16.1-53: Tethered Mast Demonstration UAS

(Designed for the austere environment where high fidelity, persistent SA is required, but lack of infrastructure prevents use of existing, larger systems.)

REP Cycle 16.2 Initiatives (cont)

- Inform Remote Ordnance Neutralizer System (RONS) Replacement CDD
  - ✓ 16.2-5 iRobot 710 Kobra Multi-Mission Platform

(Surpassing current large/RONS vehicles in mobility, lift capacity, transportability, runtime, and supportability, iRobot's powerful (550lbs) 710 Kobra platform is ready now to serve Army's EOD Technicians and the infantry as the next-generation robotic asset.)

- ✓ 16.2-10: Andros FX

(Andros FX is a heavy duty (850lbs), multi mission 850 pound unmanned ground vehicle designed primarily for Vehicle Borne IED defeat and military base support operations. It has a 9 DOF manipulator with high dexterity, including fly the gripper for reducing mission time and increasing user capabilities and heavy lift capabilities.)

- ✓ 16.2-7: iRobot uPoint Multi-Robot Control (MRC)

(iRobot developed the uPoint Multi-Robot Control (MRC) System to standardize the control of every robot within the iRobot family of systems to include the 110 FirstLook, 310 SUGV, 510 PackBot, and 710 Kobra.)

- Safe Warfighter Movement & Detection of Targets Capability
  - ✓ 16.1-34: Offset Drop Zone Polaris MRZR

(The use of a MRZR Dismounted Soldier Autonomy Tools (DSAT) robotic kit will allow the Soldiers to drive the vehicle from the off-set drop zone to the objective and drop off all Soldiers – with the vehicle returning to the off-set drop zone robotically (unmanned).)

- Highly Dexterous Manipulation System
  - ✓ 16.1-29: The Highly Dexterous Manipulation System (HDMS)

(The Highly Dexterous Manipulation System (HDMS) offers unprecedented, human-like manipulation capability, featuring two dexterous arms and a torso. Each arm has five axes of control. The two arms are connected by a torso which is able to pitch forward and back. The default end-effectors for HDMS are two two-finger hands that offer another axis of control each.)

- SMET Expeditionary Bridging Payload

(# and description of gap.)

- ✓ 16.1-35: SMET Expeditionary Bridging Payload

Capability Enhancement: This demonstration will investigate the feasibility of an expedient, transportable bridge using lightweight hybrid inflatable structures designed to carry both vehicles and personnel. Inflatable structures have successfully been used for applications to include: temporary shelters, airplane wings, and pedestrian bridges.