



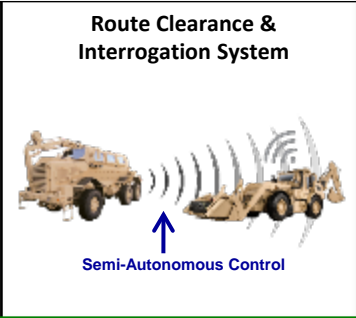
PROJECT MANAGER FORCE PROJECTION

Army Ground Robotics Overview: NDIA Ground Robotics Capability Conference 10 April 2018

Bryan McVeigh
PM Force Projection



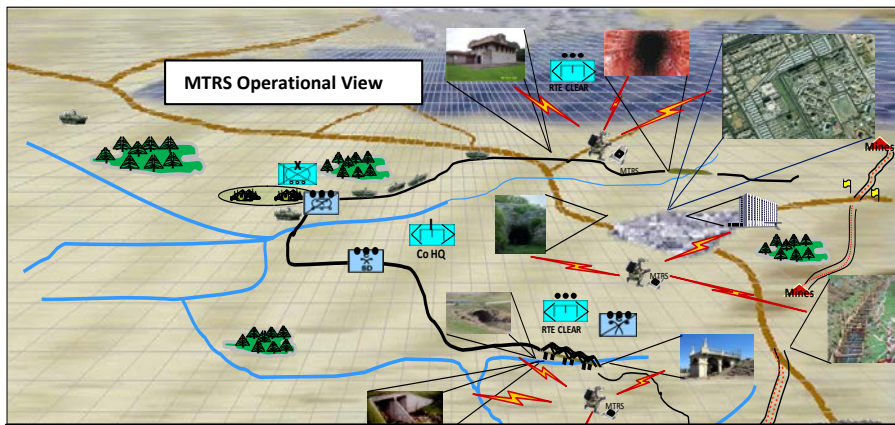
PEO CS&CSS Robotics Portfolio



* Images are conceptual representations, not endorsements



MTRS Inc II Program Overview / Update



- The Man Transportable Robotic System (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
- Capability to identify and disposition explosive hazards
- Army's medium sized common platform allowing use of various platform payloads in support of current and future missions

* AAO includes EOD requirement of 587

MTRS Baseline

Common Payloads

- Fiber Optic
- Manipulator
- Optics
- Radios

Autonomous Mine Detection System (Payload)

Engineers

PdM Counter Explosive Hazard, (PEO Ammo)

Base Platform
IOP V2.0 Compliant

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

CBRN Sensors

FirstDefender BMS

Robotic Deployment System
PM Assured Mobility Systems

- ✓ **CPD: Approved, 15 MAY 2013**
- ✓ **RFP Released: 09 NOV 2016**
- ✓ **Contract Award: September 2017**
- **First Unit Equipped: 4QFY19**
- **AAO: 1,210**
- **Users: Engineer, CBRN and EOD**



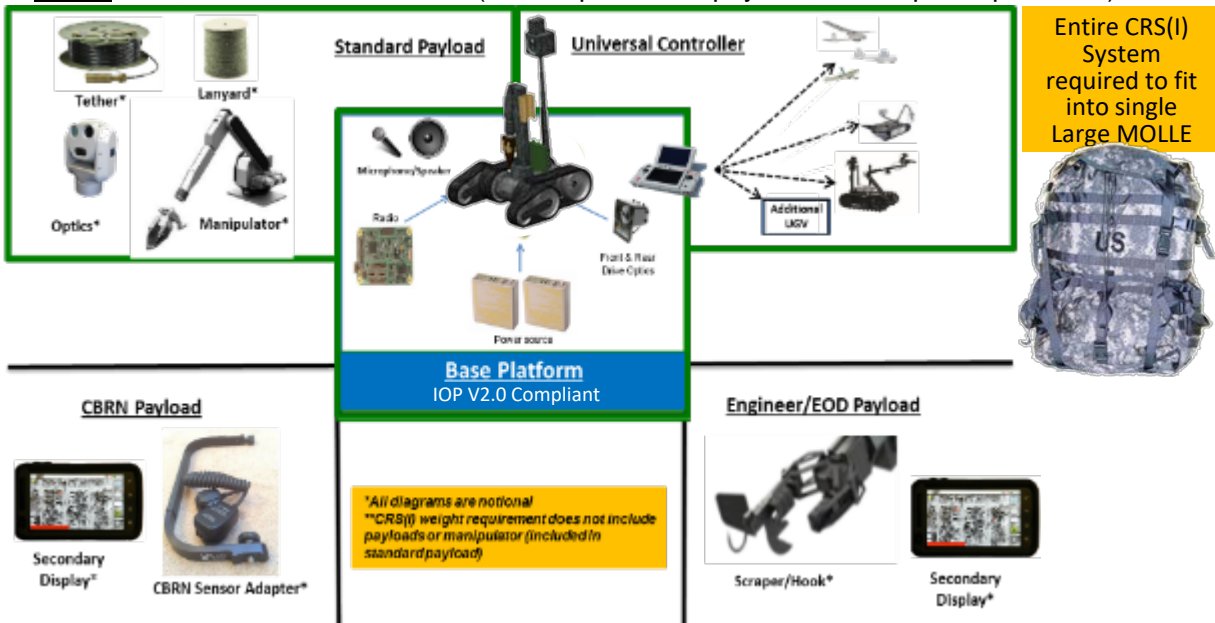
Common Robotic System (Individual) {CRS(I)}

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.

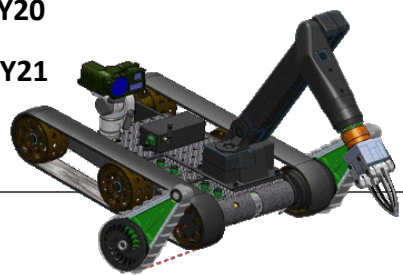
Common Robotic Platform Enabling Payloads to Address the Operational Capabilities Gaps:

- Standoff short range Intelligence, Surveillance, & Reconnaissance (ISR)
- Remote Chemical, Biological, Radiological, and Nuclear (CBRN) detection
- Remote Explosive Obstacle Counter Measure (EOCM)
- Remote Explosive Ordnance Disposal (EOD) operations
- Remote clearance of danger areas

Users: INF, CBRN, ENG and EOD (EOD equals ENG payload; no unique requirement)



- ✓ AAO: 3,258 (Does not include Marines)
- ✓ RFP Released: 16 May 2017
- ✓ Milestone B: 26 March 2018
- ✓ EMD Contract Award: 30 March 2018
- Milestone C: 2QFY19
- FUE: 2QFY20
- IOC: 3QFY21



EMD contract awarded to Endeavor & QinetiQ on 30 March 2018



Squad Multipurpose Equipment Transport (SMET)

System Description: The SMET provides the small unit with the ability to support squad and platoon operations for 72 hour missions. Provides unmanned or optionally manned internal resupply capability to the small unit.

SMET Capabilities:

- Carry up to 1000 lb. of Soldier gear
- Operate for 60 miles within 72 hours without external resupply
- Provides mobile power generation capability to the small unit
- Operable with remote control with options for Follow-me, Teleoperation and Operator Control Unit



- **Acquisition Category (ACAT):II (Pre-MS C)**
- **Acquisition Objective (AAO): 5723**
- **Program of Record (POR) Acquisition Cost: \$100K each**
- **Directed Requirement: 3QFY17**
- **Urgent Material Release (UMR) of Directed Requirement: 4QFY18**
- **Capability Production Document (CPD): 1QFY20**
- **Milestone C: 1QFY20**



SMET Directed Requirement Status

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Phase I – Vendor Solution Assessment

- Successfully completed 5 weeks of testing with 7 Contractors (8 platforms)
- 2 Contractors ran tests in parallel
 - Separate, secure staging areas
 - Offset testing schedules
- 5 days of testing for each contractor
 - 24 hour range access and Government support/supervision
- Contractors operated their own systems through the tests using remote control only
- Pass/fail and weighted scores assessed for each test; used as phase II down select criteria



Phase II – Operational Technology Demonstration Selected Platforms



- Phase II IBCT Locations
 - 1/101st at Fort Campbell, Kentucky
 - 1/10th at Fort Drum, New York
- Contractor Requirements
 - Dedicated Field Service Representatives (FSR) at ATC and both IBCT locations
 - Provide Contractor Logistics Support (labor, spare parts, supplies, and tools)
 - Operator Training Support Package
 - Commercial Off-The-Shelf Operator Manual
 - Operator Task Videos
 - Conduct Operator New Equipment Training (24 curriculum hours for 12 students)
 - Participation in a Government-led T&E WIPT



CRS(H) Program Overview

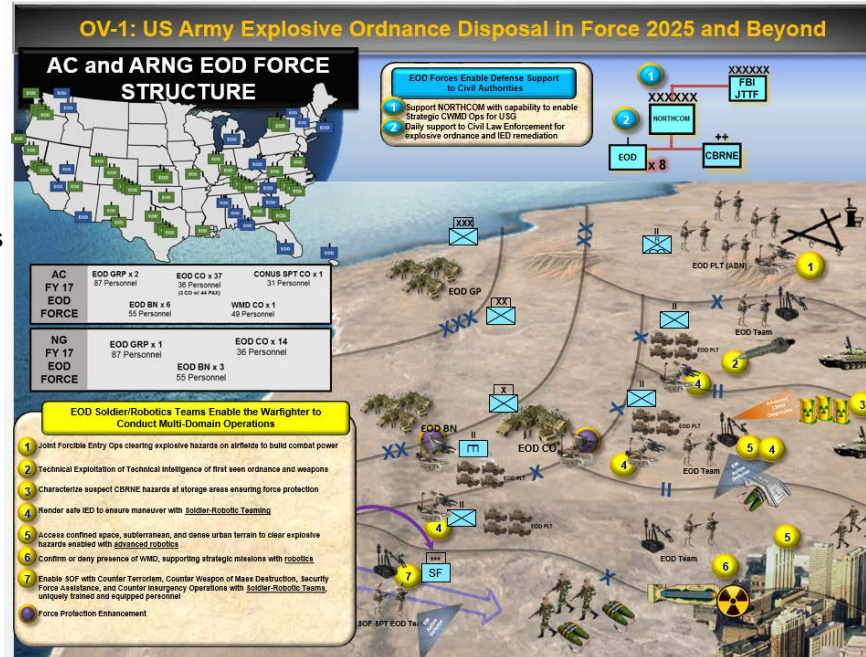
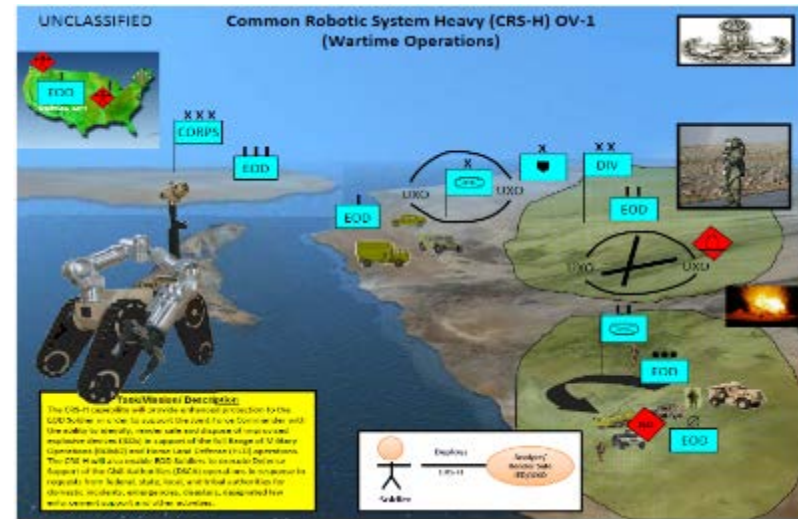
System Description:

The CRS(H) is the Army's large sized, vehicle transportable, common robotic platform capable of accepting various mission payloads enhancing protection to the EOD Soldier by providing increased standoff capability to identify, render safe and dispose of explosive ordnance and improvised explosive devices in support of the Range of Military Operations and Homeland Defense operations.

Emerging Threshold Performance :

- Manipulator Arm Lift Capacity
 - Close to Platform > 275 lbs;
 - Full Extension (72 in) > 100 lbs
- Platform Speed > 6 mph
- Obstacle Clearance > 32 in (Jersey Barrier)
- Platform Endurance > 7 hrs
- Weight < 700 lbs curb weight, 1000 lbs gross system weight
(includes 300 lbs of non-native payloads)
- Interoperability – IOP compliant
- Cyber Hardened

- CPD: Projected April 2018
- RPP Released: Projected 3QFY18
- Contract Award: Projected 4QFY18
- Fly-Off: SEP - OCT 2018 (T)
- AAO: Projected 248
- Target AUMC: TBD
- Users: EOD and CBRN



* Images are conceptual representations, not endorsements



CRS-H Acquisition Strategy (Emerging Insights)

OTA Fly-Off: Phase I

- Evaluate vendor proposals and down-select (up to 5) to participate in a fly-off
- Candidate systems put through operational demonstrations
 - 5 days per vendor with same evaluation team
 - Vendors bring (1) system; only FSR's will operate the system in accordance with current EOD TTPs
 - Gov't team (incl. user) will observe and evaluate
- Vendors will be provided Gov't assessment two weeks after completion of event
- SEP-OCT 2018 at Fort Leonard Wood
- Execute under REP 18.2



** Images are conceptual representations, not endorsements*

OTA Fly-Off: Phase II – ATEC/User Evaluation



- Down-select (up to 2) to participate in ATEC/User evaluation
 - Proposals based on Fly-off #1 results; include cost for (3) production representative systems, data to support safety confirmation and logistics development
 - Systems (x2) will be put through both safety testing and user operation
 - Additional system (x1) will be utilized for concurrent logistics development
 - May-JUN 2019 at Aberdeen test Center (APG)
- Evaluations will inform follow-on production phase



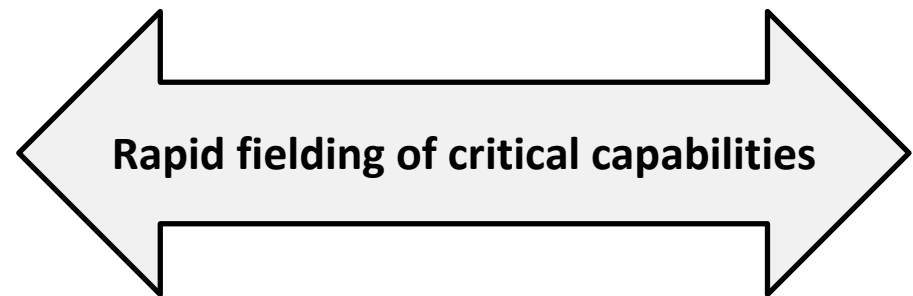
CRS-H Acquisition Strategy Emerging Insights (Cont)

OTA Production Phase

- Fly-Off #2 participants submit final production proposal
- Down-select from two OEM's to one pending:
 - Performance Data
 - Technical Proposal
 - Cost Proposal
 - Safety Assessment
 - User Evaluation
 - Product Support Assessment
- Production award to one OEM (Target award - JUL 2019)
- Immediate fielding under CMR
- FMR achieved within two years



** Images are conceptual representations, not endorsements*





Enhanced Robotic Payloads (ERP)

System Description:

The ERP is a suite of modular capabilities designed with open architecture to provide an increased level of standoff, situational awareness, disruption capability and dexterity to respond to current and emerging Engineer, CBRN and EOD requirements. These multiple, modular robotic mission payloads will use open architecture to integrate with the MTRS Inc II and CRS(H) platforms to form the Army's next generation platform adaptable robotics systems.

Capabilities*:

- Dual Arm Dexterity
- Multi-Shot Disrupter
- Fine Precision Aiming Module
- Multispectral Overlay Camera
- Obstacle Avoidance & Digital Modeling
- Extended Range Radio & Mesh Networking
- Extended Range UAV & Surveillance



- CDD Approval: ~4QFY18/1QFY19
- RFP Release: TBD
- AAO: Projected 743
- Users: CBRN and EOD

* Only obstacle avoidance & mapping and extended range/mesh networking will be fielded to CBRN units

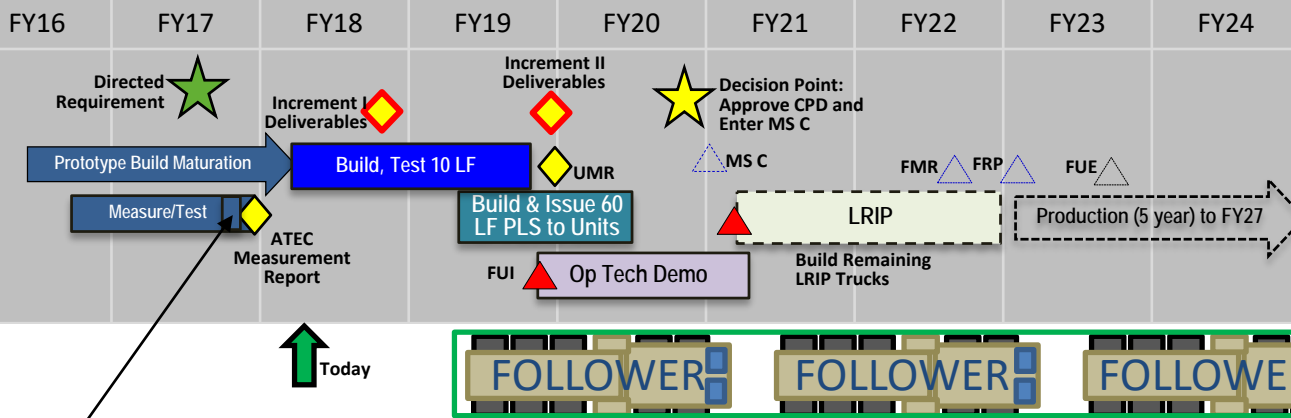
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Leader Follower Operational Technology Demonstration

Leader Follower is a robotic applique kit to provide an optionally manned capability to current Tactical Wheeled Vehicles (TWV)



- Operational Evaluation with Soldiers at Camp Grayling on 11-22 SEP 2017
- Supported by (7) Soldiers from Army's 1st Armored Division out of Ft. Bliss, TX
- Evaluation included:
 - Driver Warning/Assist
 - Teleoperation
 - Leader Follower



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Robotic and Autonomous System Components



Regardless of mission role, there are many **common components** that enable RAS platforms to **perceive** the environment, make **decisions** and **execute** the mission.

How Can Modeling & Simulation Help?

Assured Control

Autonomous System Control

Computing Resources, Software Behaviors (World Model, Path Planner, Vehicle Control)

Communication Systems

Cyber Secure, High Bandwidth, Low Latency, Localization, Human Machine Interface

Sense and Perceive

Maneuver Sensors

LIDAR, Stereo Vision, Automotive Radar

Act and React

By-Wire Lethality Control

Target Sensing, Autoloader, Remote Fire Control

By-Wire Vehicle Control

Powertrain Controls, Steering, ESC, Wheel Speed, Electric Braking

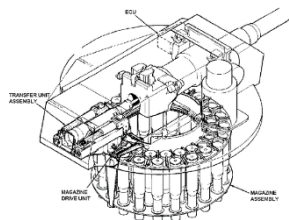
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While all systems are required to make RAS platforms function, most critical for successful military applications is Assured Control

RCV Major Technical Hurdles

In order to accelerate unmanned combat platforms there are three major technical hurdles to overcome

Remote Lethality



Autoloader for Main Armament System



Remoting Manual Fire Control Processes



Correcting Targeting Solutions Based on Latency



Safety certification for Soldier use

Unmanned Maneuver

Cross country maneuver at operationally relevant speeds



Reliable semi-autonomous behaviors



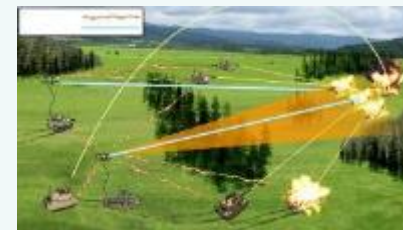
Robust by-wire actuation of mobility systems



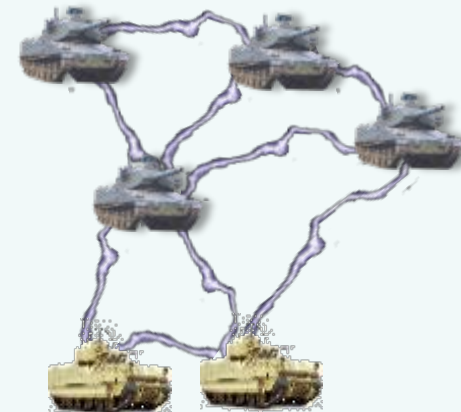
Intuitive Human Machine Interface between operators and unmanned platforms

Network

Plan on utilizing commercial communication system to support field experiments until military multi-band capable radios are available




Require low latency, secure high bandwidth communications



How Can Modeling & Simulation Help?



Robotic Combat Vehicle (RCV) Considerations

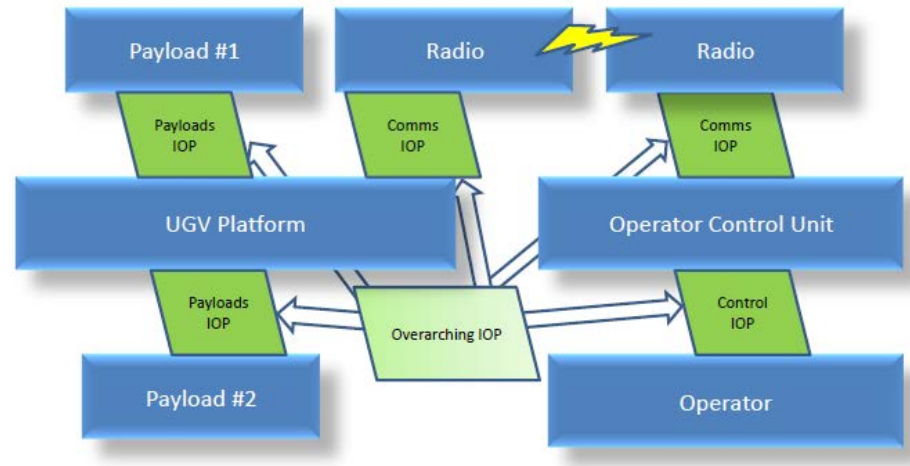
- What mission?
- What system? 
- What would the human machine interface considerations be for manual teleoperation?
- What should be the role of the human versus the machine?
- What decisions can be made by the machine and what decisions require a human?
- What subsystems should be automated?
- How does the RSTA mission change based on new technology? What about other missions?

How Can Modeling & Simulation Help?

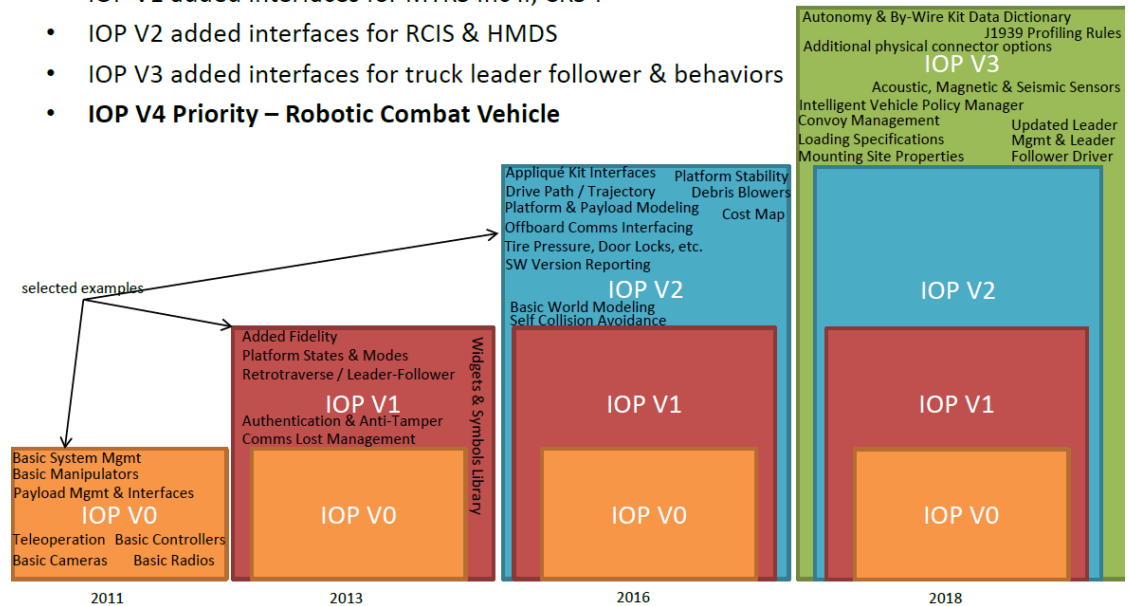


RAS-G IOPs Basic Overview

- Robotics & Autonomous Systems, Ground (RAS-G) Interoperability Profiles (IOPs)
- Defines software messaging & hardware interfaces between major subsystems of unmanned ground systems



- IOP V0 provided interfaces for capabilities already fielded
- IOP V1 added interfaces for MTRS Inc II, CRS-I
- IOP V2 added interfaces for RCIS & HMDS
- IOP V3 added interfaces for truck leader follower & behaviors
- **IOP V4 Priority – Robotic Combat Vehicle**

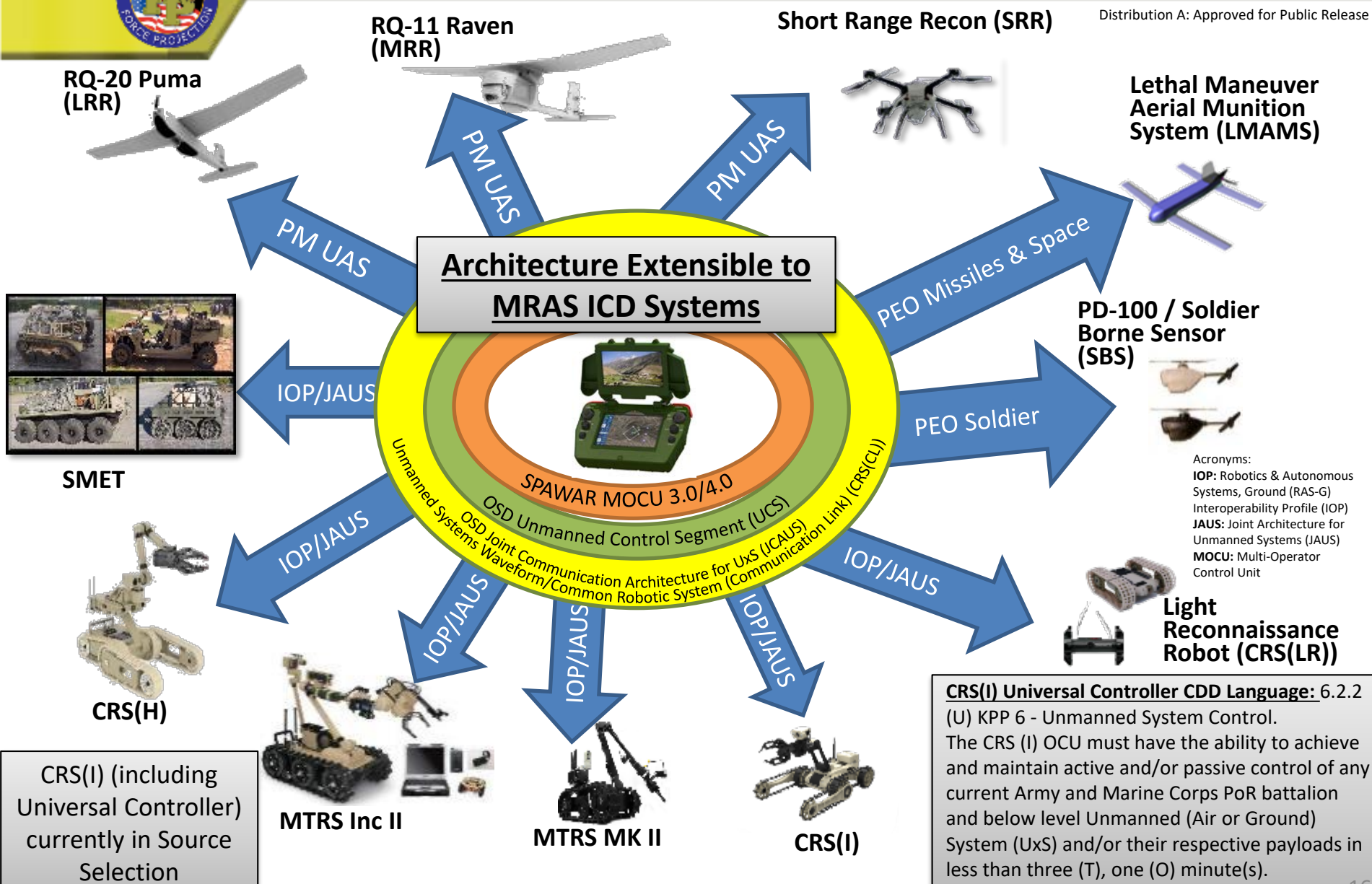


IOP V3.0 Release February 2018

Existing Universal Controller Requirements & Architecture



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CRS(I) (including Universal Controller) currently in Source Selection

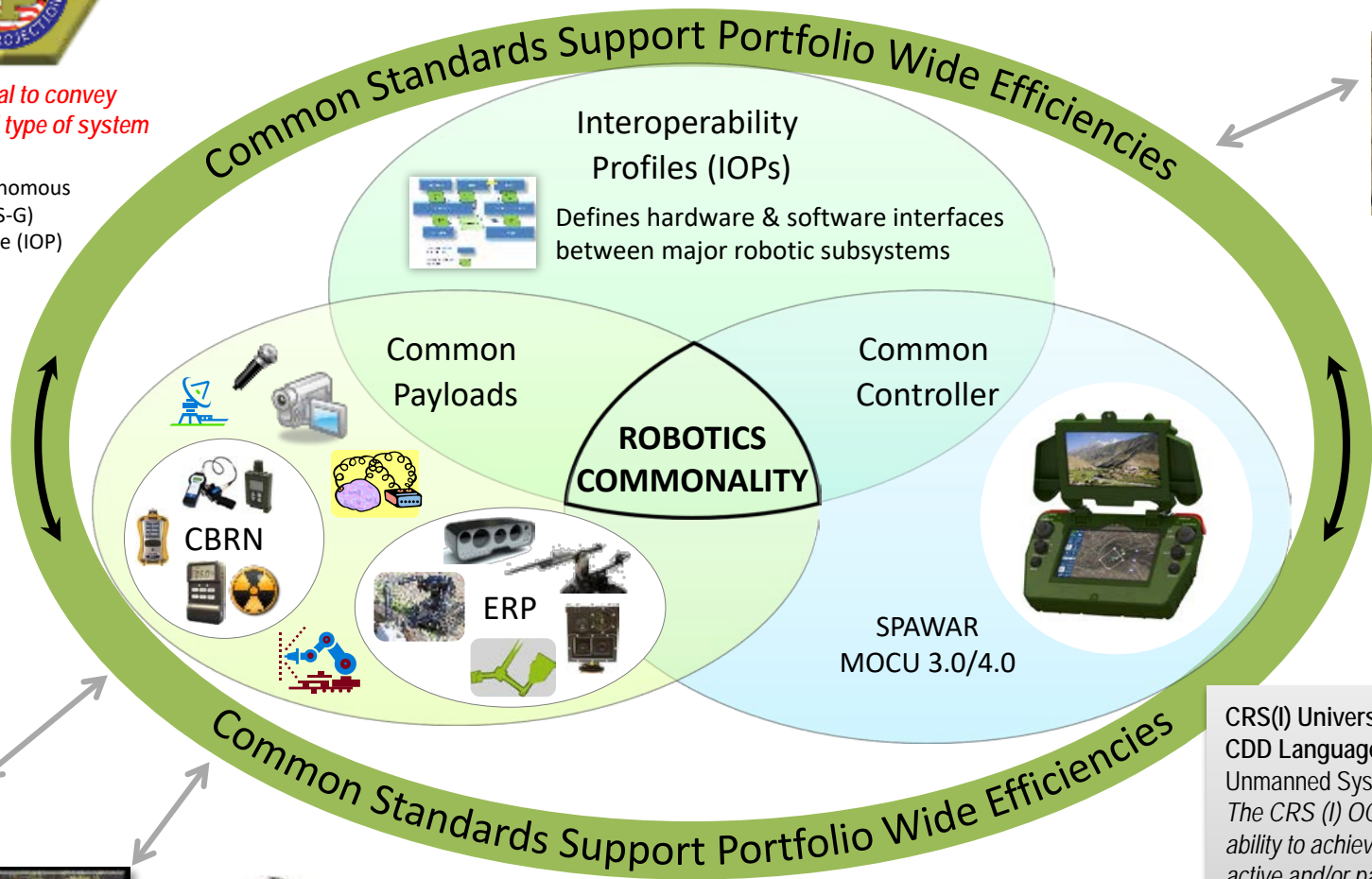
All graphics are notional to convey the general size and type of system



Value of Commonality

Graphics are notional to convey the general size and type of system

Acronyms:
IOP: Robotics & Autonomous Systems, Ground (RAS-G) Interoperability Profile (IOP)
JAUS: Joint Architecture for Unmanned Systems (JAUS)
MOCU: Multi-Operator Control Unit



Future Robots



CRS(H)



SMET



MTRS Inc II



Talon 5a



CRS-I

CRS(I) Universal Controller CDD Language: 6.2.2 (U) KPP 6 - Unmanned System Control.
The CRS (I) OCU must have the ability to achieve and maintain active and/or passive control of any current Army and Marine Corps PoR battalion and below level Unmanned (Air or Ground) System (UxS) and/or their respective payloads in less than three (T), one (O) minute(s).



Discussion



Framing the Army's Robotics and Autonomous Systems (RAS) Strategy

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.



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

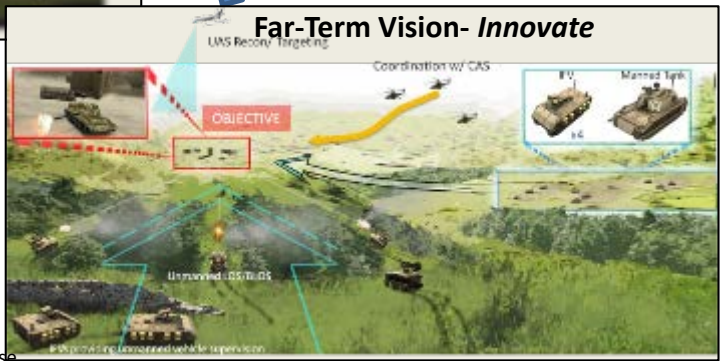
- Near-Term Objectives:**
- Leader-Follower Convoy Technology Employment
 - Lighten the Soldier load
 - Enhance stand-off from threats and improve situational awareness

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

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**.

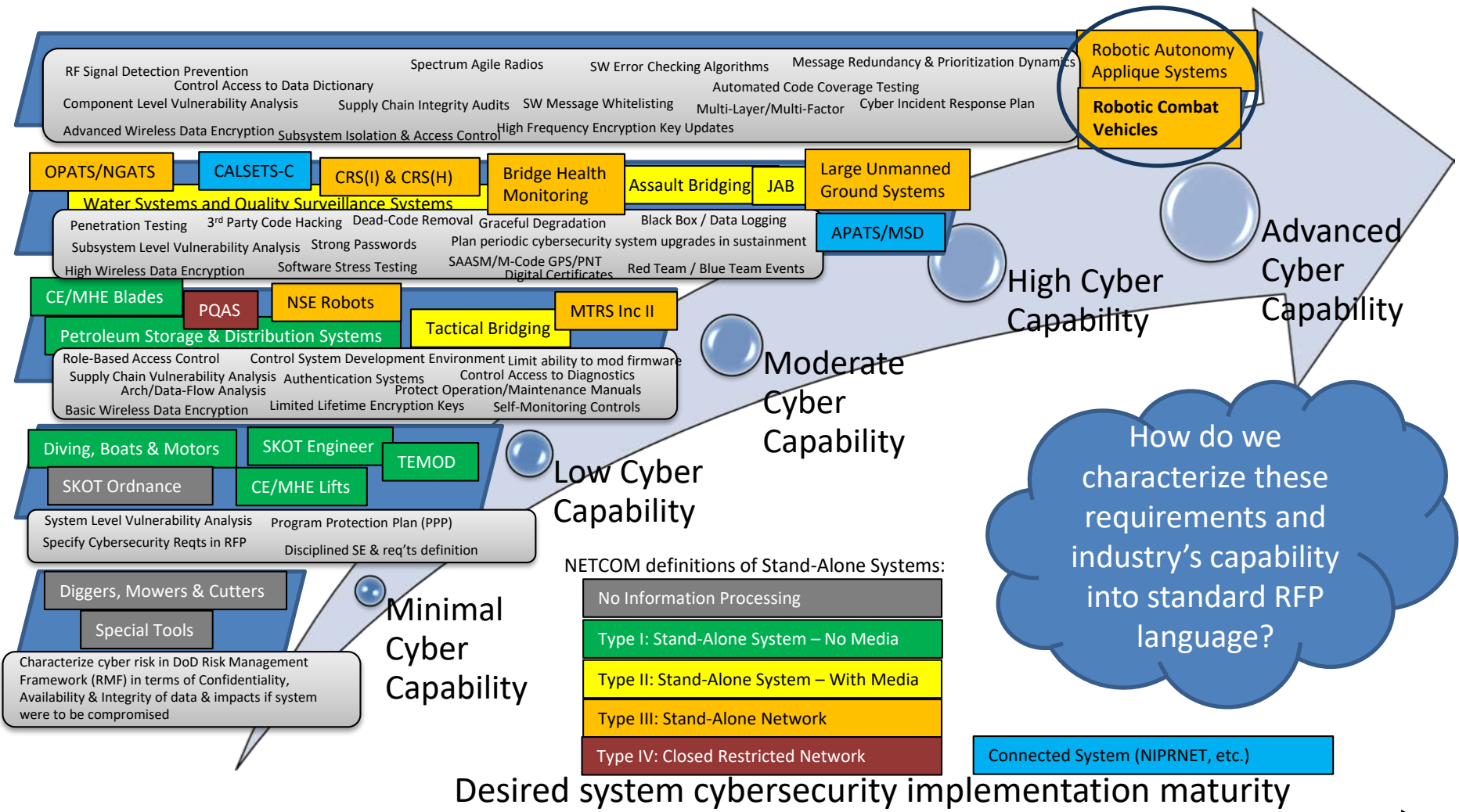


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PM FP Cybersecurity Considerations

PM FP needs industry's help in defining this



Note: Color coded programs above are unofficial PM office anticipated classifications

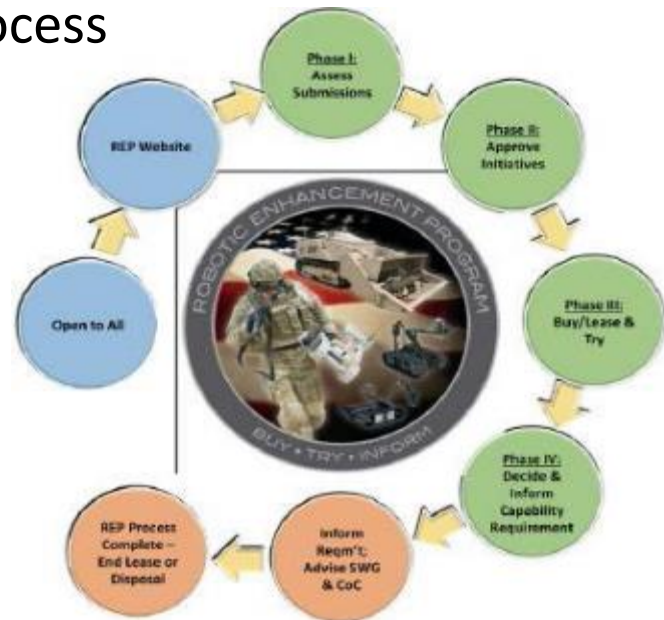


Robotic Enhancement Program (REP)

- “Buy/lease, try and inform” - evaluate state-of-the-art robotic systems and/or payloads that are Government-Off-The-Shelf (GOTS), Commercial-Off-The-Shelf (COTS) and Non-Developmental Items (NDI) to inform the requirement and acquisition process

- Status:

- REP Cycle 16.1 – 18.1
 - Proposals submitted: 186
 - Proposals Selected: 50
- REP Cycle 18.2
 - Additional proposals submitted: 43
 - CoC occurred on 21 March 2018.
 - 5 proposed initiatives approved.



REP Cycle 19.1 proposal submission windows closes 1 MAY 2018.
 REP Submission Site: <http://www.peocscs.army.mil/rep.html>