Unmanned Ground Systems

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Purpose

- Purpose:
  - As directed, update the AMCB on progress of Unmanned Ground Systems and Army / Marine Corps collaboration efforts

- Background:
  - Due to the proliferation of unmanned ground systems on the battlefield and the rapid advances in associated technologies, it is imperative that Army and Marine Corps efforts avoid duplication where able. To this end, there has been significant collaboration to date on UGV's.

- BLUF:
  - Army and USMC continue to work together on UGV's.
  - Future collaborative efforts will require resources to foster cooperation.

Agenda

- Collaborative Efforts to Date
  - Overview of the Joint Unmanned Systems ICD
  - Joint Ground Robotics Integration Team (JGRIT)
- Current Requirements
  - Army
  - Marines
- Way Ahead
  - JGRIT Resourcing
  - JROC Staffing of the ICD

Definitions

Unmanned Systems: Provides an overarching and unifying strategy for the development and employment of interoperable Unmanned Systems across the domains (Air, Ground, Maritime) and every Warfighting Function. Unmanned Systems improvements in ***modularity, scalability, autonomy, interoperability, coordination,*** and ***collaboration*** will provide increased ***persistence, endurance,*** and ***protection*** for the Force.

Unmanned Ground System consist of a powered physical system with no human operator on aboard the principal platform, which can act, either operated remotely or with some degree of autonomy, to accomplish assigned tasks. Unmanned Ground Systems may be mobile or stationary, can be smart learning, self-adaptive, and includes all associated supporting components such as Operator Control Units (OCU).

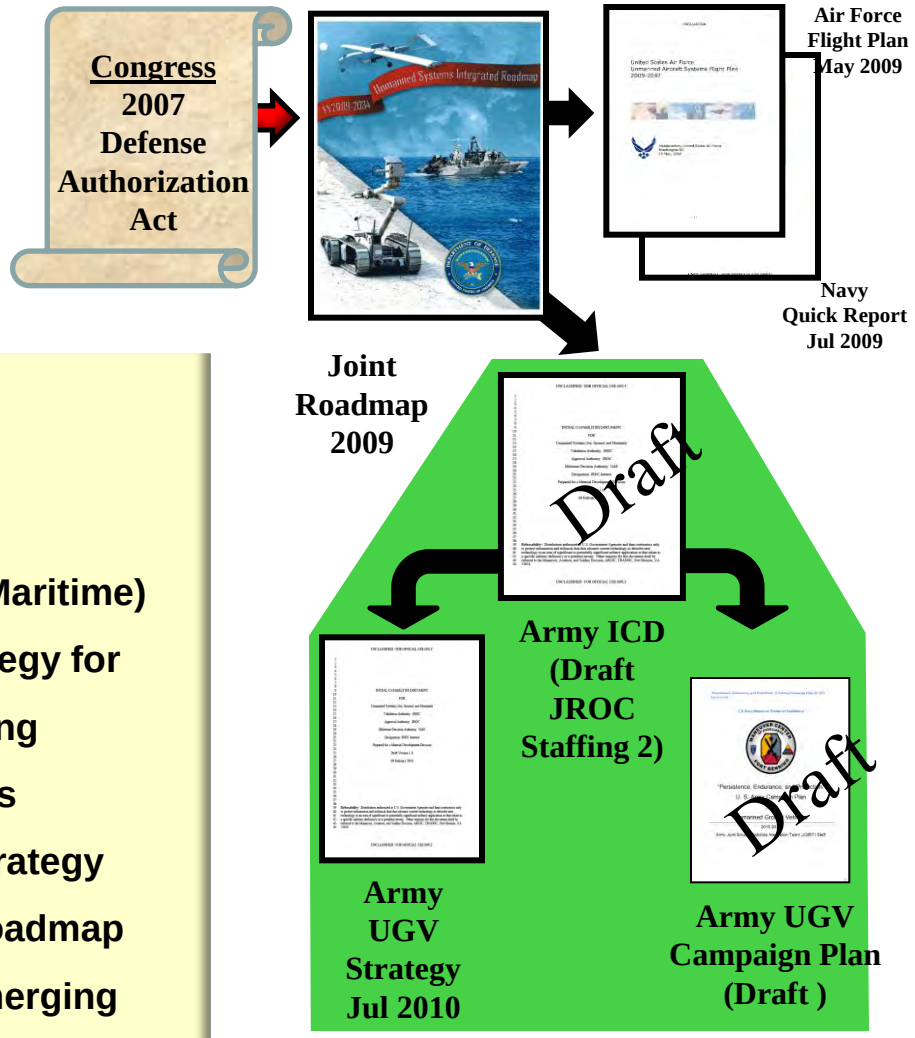
Subcategories of Unmanned Ground Systems include **unmanned ground vehicles (UGV)**, and unattended munitions and sensors.

The single most important benefit of Unmanned Systems is their contribution to Soldier survivability.

UxS Background

- 2001 NDAA goal that one-third of operational ground combat vehicles be unmanned by 2015
- 2003 FCS ORD established initial strategy and requirements for: SUGV, Armed Robotic Vehicle (ARV)-Heavy & MULE program (Transport, ARV-Assault (Light) & Counter-Mine variants)
- 2009 Joint Unmanned Systems Roadmap (2009-2034) priorities:
  1) Reconnaissance and Surveillance
  2) Target identification and designation
  3) Counter mine and EOD
  4) CBRN Reconnaissance
- DRAFT Army Unmanned Systems ICD (Air, Ground, Maritime) (2010-2035) provides a new single over-arching strategy for modular, interoperable, coordinating, and collaborating Unmanned Systems across the Warfighting Functions
- July 2010 Army Unmanned Ground Vehicle (UGV) Strategy
- DRAFT UGV Campaign Plan (2011-2036) and UAS Roadmap (2010-2035) describe the strategy for ongoing and emerging Unmanned Systems programs

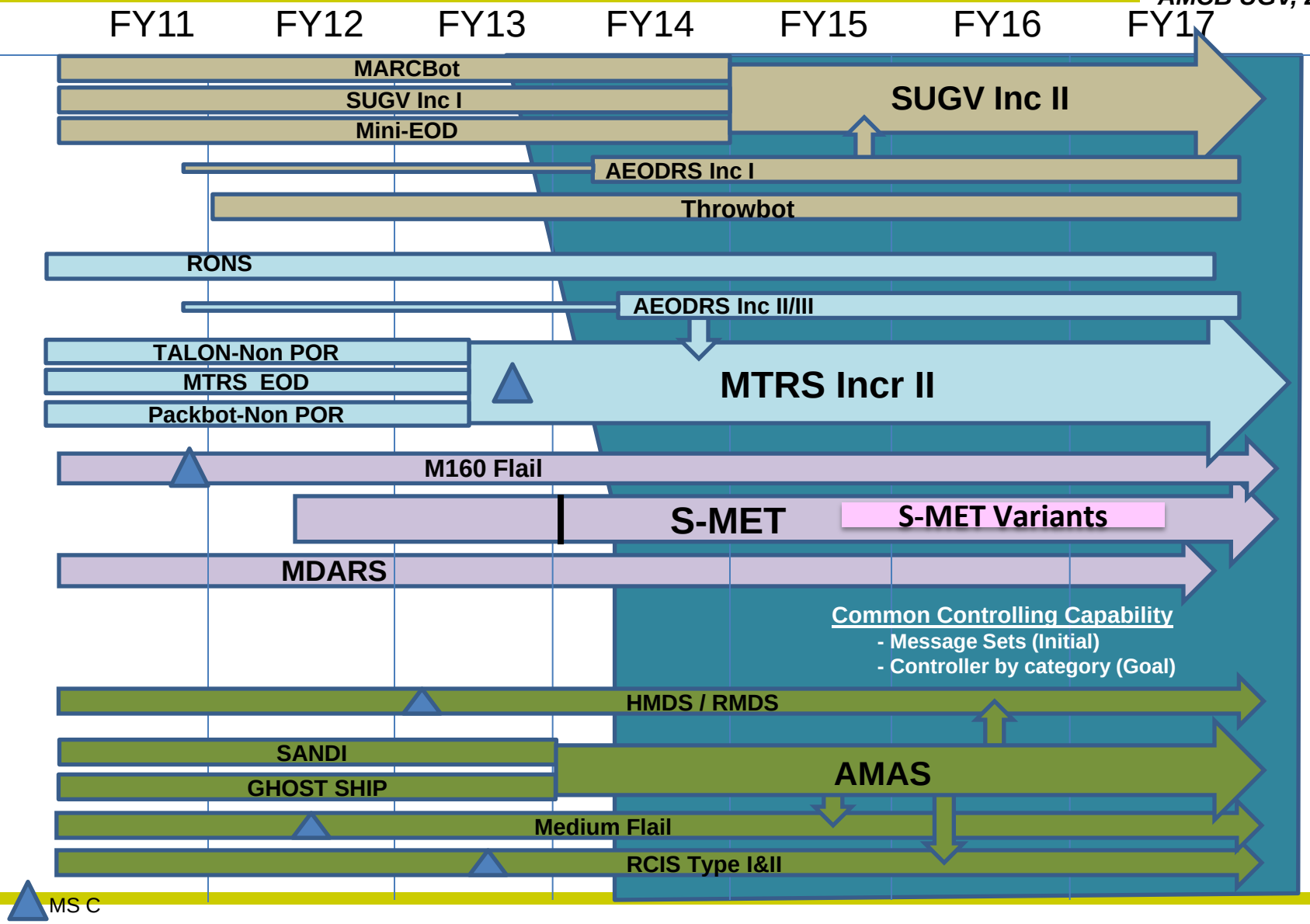
AMCB UGV, 2011



Army UGV Programs Strategy

Supported by the UGV Campaign Plan

AMCB UGV, 2011



TRADOC Ground Robotics Mission

- The Maneuver Center of Excellence (MCOE) is designated as the TRADOC lead for Ground Robotics. As the lead, the MCOE is the TRADOC integrator for all plans, initiatives, and developments required to field Ground Robotic capabilities.

- MCOE will synchronize development, sustainment, fielding, and training efficiency for all ground robotics in the Army.

    - Serve as TRADOC integrator for all plans, initiatives, and developments required to field Ground Robotic capabilities.

    - Synchronize development, sustainment, fielding, and training efficiency for all Ground Robotics in the Army.

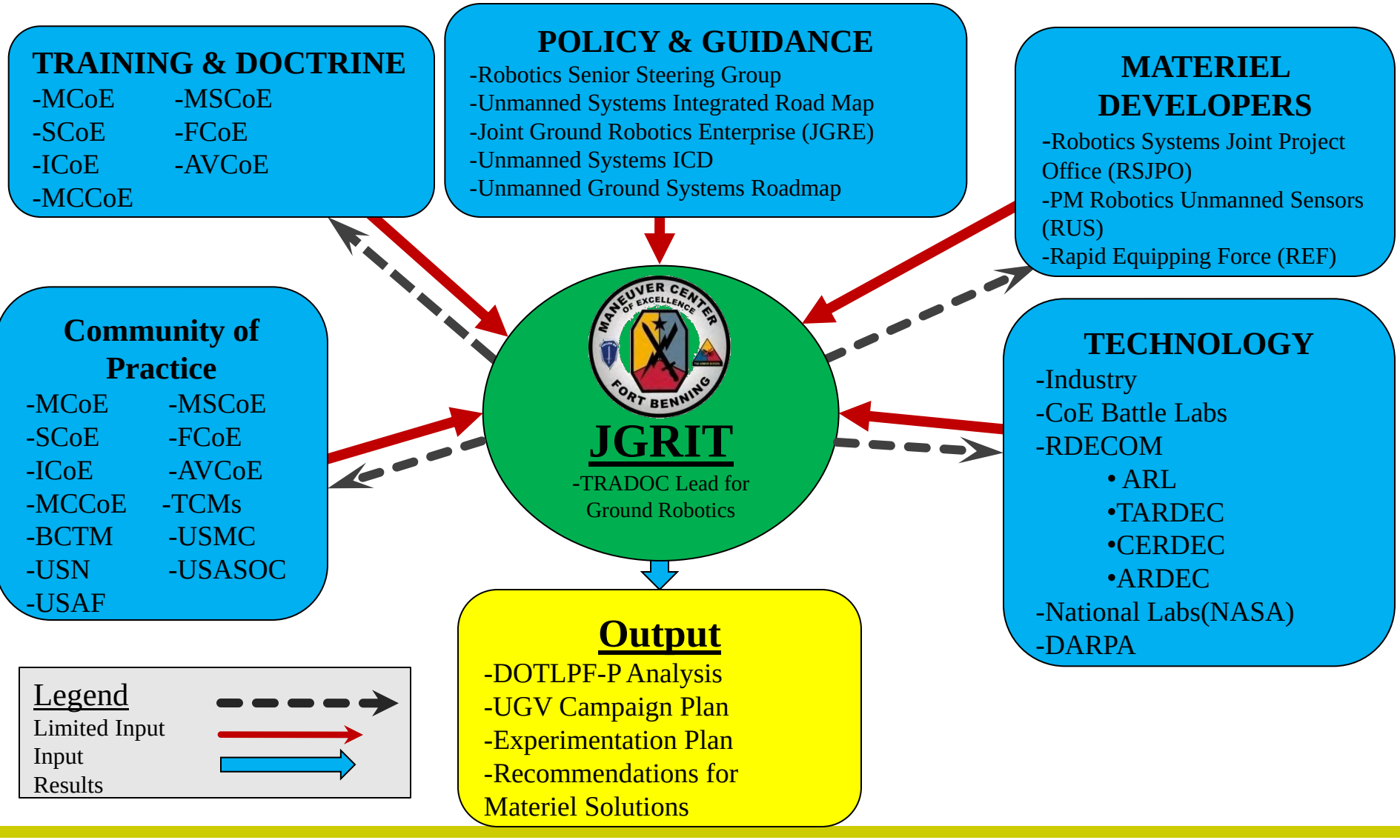
    - Establish a Joint Ground Robotics Integration Team (JGRIT) to conduct Unmanned Ground Vehicles (UGV) DOTMLPF analysis and establish way ahead for organizing, training and equipping the Army to address current and future threats mitigated by UGVs

JGRIT

- MCoE is the TRADOC “Lead” to:
  - Synchronize and coordinate UMS efforts
  - Identify and make aware of redundant efforts
- Involves the USMC and other services

Joint Ground Robotics Integration Team (JGRIT)

AMCB UGV, 2011



ARMY Requirments

Small Unmanned Ground Vehicle

SUGV-310

XM-1216 POR

Path Forward

Small Unmanned Ground Vehicle (SUGV)

DESCRIPTION/CHARACTERISTICS:

The SUGV SO1 is a small, man-packable robotic system, weighing less than 30 lbs, consisting of a robotic Operator Control Interface, a robotic chassis platform with video capability, digital communications relay modules (plug in/out), and advanced sensors/mission modules, and both a soft case and ruggedized storage container.

The SUGV SO1 provides the Warfighter enhanced situational awareness during combat operations, and a standoff capability in urban terrain enabling accurate reconnaissance, detection and acquisition of targets of interest.

BOIP: One per platoon in 7 IBCTs (266)

PM: PM RS-JPO

REQT DOCUMENTATION:
E-IBCT CPD approved Apr 09

FUNDING: PEO-I

PERFORMANCE: Meets SUGV Increment 1 performance

SCHEDULE: Field 1 IBCT in 2011, 3 in 2012, and 3 in 2013

OVERALL ASSESSMENT:
Does not meet AAO.

XM1216 (SUGV INC 2)

DESCRIPTION/CHARACTERISTICS:

The XM1216 is a small, robotic system, weighing less than 35 lbs (threshold) and 20 lbs (objective), consisting of a robotic Operator Control Interface, a robotic chassis platform with video capability, digital communications/audio relay modules (plug in/out), and advanced sensors/mission modules, and both a soft case and ruggedized storage container. The XM1216 provides the Warfighter enhanced situational awareness during combat operations, and a standoff capability in urban terrain enabling accurate reconnaissance, detection and acquisition of targets of interest.

REQT DOCUMENTATION: SUGV CDD in staffing

FUNDING: PEO-GCS

PERFORMANCE: TBD

SCHEDULE: TBD

OVERALL ASSESSMENT: TBD

BOIP: 1 per platoon (6,108)

PM: PM RS-JPO

Lighten the Load Initiatives

Squad Mission Equipment Transport (SMET) CDD

Project Workhorse – (REF, MCoE, NAG, ARCIC, Lockheed Martin)

Squad Multi-purpose Equipment Transport (SMET)

AMCB UGV, 2011

DESCRIPTION/CHARACTERISTICS:

The S-MET is an unmanned robotic platform that provides transport of equipment and/or supplies in support of dismounted maneuver. The Squad Multipurpose Equipment Transport (S-MET) will provide the maneuver squad with an unmanned capability which will offload the Soldier approach march load. The S-MET capability will significantly reduce the mission equipment load of the an Infantry Soldier. The S-MET should be capable of carrying the equipment currently required by a nine-man squad for a 96 -hour operation. The S-MET should have the capability to recharge the squad's radio and other batteries to support required operations. The S-MET should be capable of operating in three control regimes; tele-operation, semi-autonomous and autonomous. Semi-autonomous navigation will include wireless leader/ follower and waypoint navigation. The speed of the S-MET will allow for the squad to maintain its momentum during all operations. The S-MET will support mobility requirements across the range of mobility operations.

BOIP: 1 per IBCT Maneuver Squad

PM: RS- JPO

REQT DOCUMENTATION: CDD completed 1 Star Staffing

PERFORMANCE: Favorable user feedback from LUT at Fort Benning

FUNDING: TBD

SCHEDULE: Will be submitted for 14-19 POM

Autonomous Mobility Appliqué

AMCB UGV, 2011

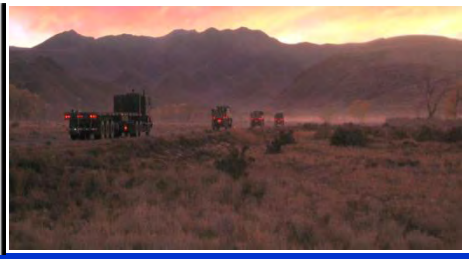
Appliqué Kit

Robotizing Tactical Vehicles

AMAS JCTD

AMCB UGV, 2011

Operational Problem: The current and future force will face an operational environment based on uncertainty, anti access and aerial denial threat tactics. This environment increases Soldier risk due to interdiction of US Lines Of Communication via hit-and-run and standoff attacks. As a result, these threats increase responsibility of drivers and passengers to maintain situational awareness along unsecured routes.



Specifics:

Year 1 Integrate and Deploy Appliqué System

Operation: Convoy w/2 Each MTVR, LTV, HEMTT, and M915 w/trailer.

Capability: Driver Assist, Leader/Follower

Technical Deliverables: Open Architecture and Interfaces, Standardized Metrics and Test Procedures, Framework for Validation of Realistic Requirements, LRU plug and play with Limited Adjustments

Year 2 Increase levels of Autonomy and Expand Platforms

Operation: Extend to MATV, HMMWV, PLS, and FMTV w/trailer

Capability: Enhanced Driver Assist, Limited Tele-Operations

Semi Autonomous Leader

Technical Deliverables: Scalable Autonomy, Self Calibrating LRUs, Improved Standardized Metrics and Test Procedures,

Conduct operational utility assessment

Requirement:

- Appliqué for current Light, Medium and Heavy Wheeled vehicles
- Levels of autonomy including Waypoint Navigation, Leader/Follower, Supervised Autonomy, Driver Assist, Remote Control.
- Behaviors to include Collision Avoidance, Lane Departure, ODOA, Vehicle Tracking, Road/Lane Following, Semi Autonomous Convoying, Adaptive Cruise Control
- Operate within CREW Environment and Spectrum
- Operate in Day, Night (black out), inclement weather, dust and limited visibility environments
- Increased safety, situational awareness

Competing Technology: Potential Technology:

- CAST, CAMS, ANS, MARTI, Blind driver, TerraMax

Transition: Transition Manager – RS JPO

FY13 MDD/AOA Study Guidance

Solicitation Preparation and Acquisition Strategy for CDD

OR

Development of CPD

FY14 (Transition Year)

- Milestone B
- EMD Contract Award(s)

OR

- CPD AROC/JROC Approval

Funding:

ORG	Year One	Year Two	TOTAL
JCTD Participants	6.020M	6.595M	12.615M
OSD/RFD	3.500M	4.200M	7.70m
		TOTAL	20.315M

Transition Strategy

AMAS JCTD

Year One
- Contract Award
- 1st Tech Demo
- ATEC Reports

Year Two
- 2nd Tech Demo
- Operation Utility Assessment (OUA)
- ATEC Reports

Risk Reducers:
- Push AMAS Program Schedule to the Left
- Accelerate Technical Maturation
- Provide Open Architecture and Interfaces
- Standardized Metrics and Test Procedures
- Framework for Validation of Requirements
- Lessons Learned

AMAS CDD/CPD

Year One
- CDD Staffing

Year One
- AROC/JROC Approval
- POM Line Establishment
- MDD Preparation

Year Two
- MDD
- AOA Study Guidance
- Solicitation Preparation and Acquisition Strategy for CDD

OR
- Development of CPD

Year Three (Transition Year)
- Milestone B
- EMD Contract Award(s)

OR
- CPD AROC/JROC Approval

The AMAS JCTD will provide Risk Reduction to the AMAS Program

Micro UGVs
(Throwable Lightweight Robots)

Proliferation of Systems

High Demand in theater

- REF- 700
- JIEDDO- JUONS 4000

No Program of Record

Path Forward

- Place into CDRT
- Develop CPD

MARINE Requirements

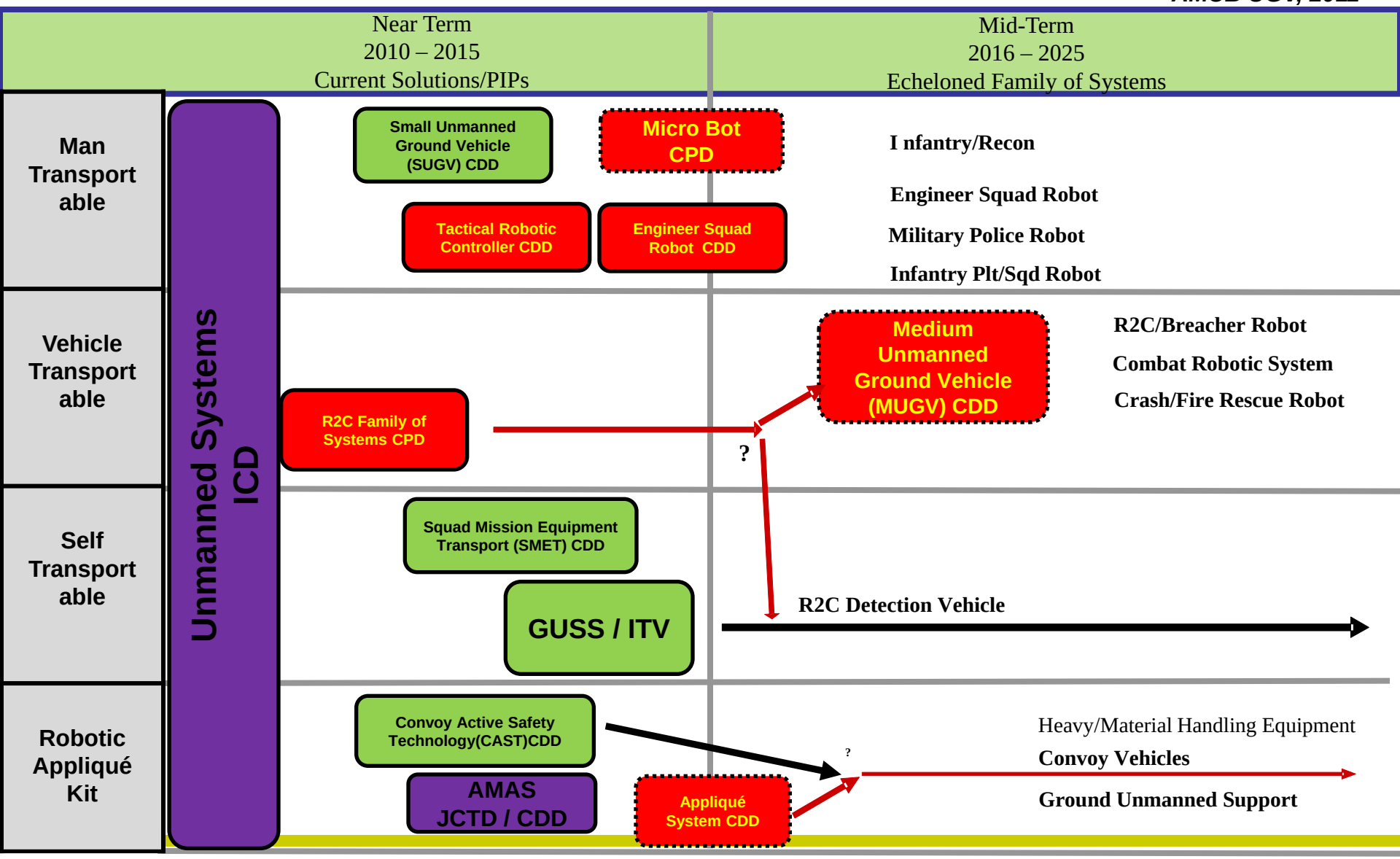
USMC UGS Strategy Capability Timeline

AMCB UGV, 2011

	Near Term 2010 – 2015 Current Solutions/PIPs	Mid-Term 2016 – 2025 Echeloned Family of Systems	Far-Term 2026 – 2035 Integrated System of Systems
Man Transportable	Small-UGV Micro-Bot		Nano-Bot
Vehicle Transportable	Medium-UGV	Humanoid	
	Tactical Robotic Controller		
Self Transportable	Medium UGV GUSS		
Robotic Appliqué Kit	Automated Navigation System (Appliqué)	Exoskeleton	
	REMOTELY OPERATED	SUPERVISED AUTONOMY	FULL AUTONOMY

USMC UGS Strategy
Future Applicability

AMCB UGV, 2011



R2C Robot

As of 1 Sep 2011

Program Designation:

Increment I R2C FoS:
Procurement/harvesting for first 5 years with the existing iRobot 510 FasTac (20 year lifecycle with 5 year refresh)

Description:
Small Robot

- Provides stand off detection and reduction of explosive obstacles.

- Protects Marines against mines, explosive obstacles, and small arms fire by taking them out of the engagement area.

- Can be employed in both mounted and dismounted operations.

Performance Parameters: (R2C CPD Change 1)
- Reliability
- Availability
- Weight
- Operating Environment
- Wireless Range
- Cabled Range
- Endurance
- Arm Length
- Arm Lift
- E3
- Radio

Acquisition Objectives:
AAO: 104 (FoS Inc II 25 Jul 11)
Unit Cost: $93,349
PMC Cost: $19.52M

Program Documents:
CPD: R2C FoS Inc I 27 Aug 09
R2C Change 1: 23 Mar 11
R2C FoS Inc II: 25 Jul 11
MCSAMP: Updating
LCCE: Updating
Program Initiation: Complete
TOPIC Update: Updated as needed under R2C FoS

Funding ($M)	PRIOR	FY11	FY12	FY13	FY14	FY15	Total
RDT&E		0.2	0.0	0.0	0.0	0.0	0.20
PMC		1.6	10.0	6.3	0.0	0.0	17.90
OMMC		0.0	0.0	0.2	0.8	0.8	1.80
TOTAL		1.80	10.00	6.50	0.80	0.80	19.90
Procured		9		95			104
Repair Test Assets		9					9

Engineer Squad Robot

- USMC Engineer Squad Robot program as it relates to SUGV Family

Tactical Robotics Controller (TRC)

Key Capability

AMCB UGV, 2011

Processing

- 1.8 Ghz, Dual Core Processor (Expandable to 2.2Ghz)
- (-40C to +85C) Operation
- Guaranteed support until 2015
- 128GB SSD
- 4GB RAM
- Currently most powerful CPU utilized in a body-worn UxV controller

Controls

- 6.5" Transflective Screen
- 850 nits brightness
- Weight: 2.5lb
- Optimized controls for both UAV / UGV Control

System Packaging

- Attach point to standard Assault Pack
- 1 cable operation, all controls accomplished via handcontroller (on/off etc.)
- 2 BB-2557 battery operation, hot-swappable
- Total Weight: 8lb

Currently the best power/weight ratio of any UxV body-worn controller

Unmanned Control Targets

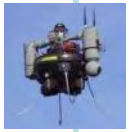
SWITCHBLADE

SHRIKE

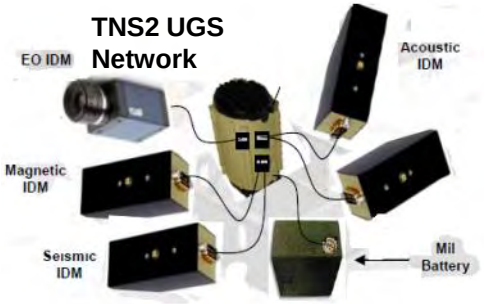
WASP UAV

RAVEN UAV

T-HAWK UAV



MAARS/ TALON



Autonomous GUSS Vehicle

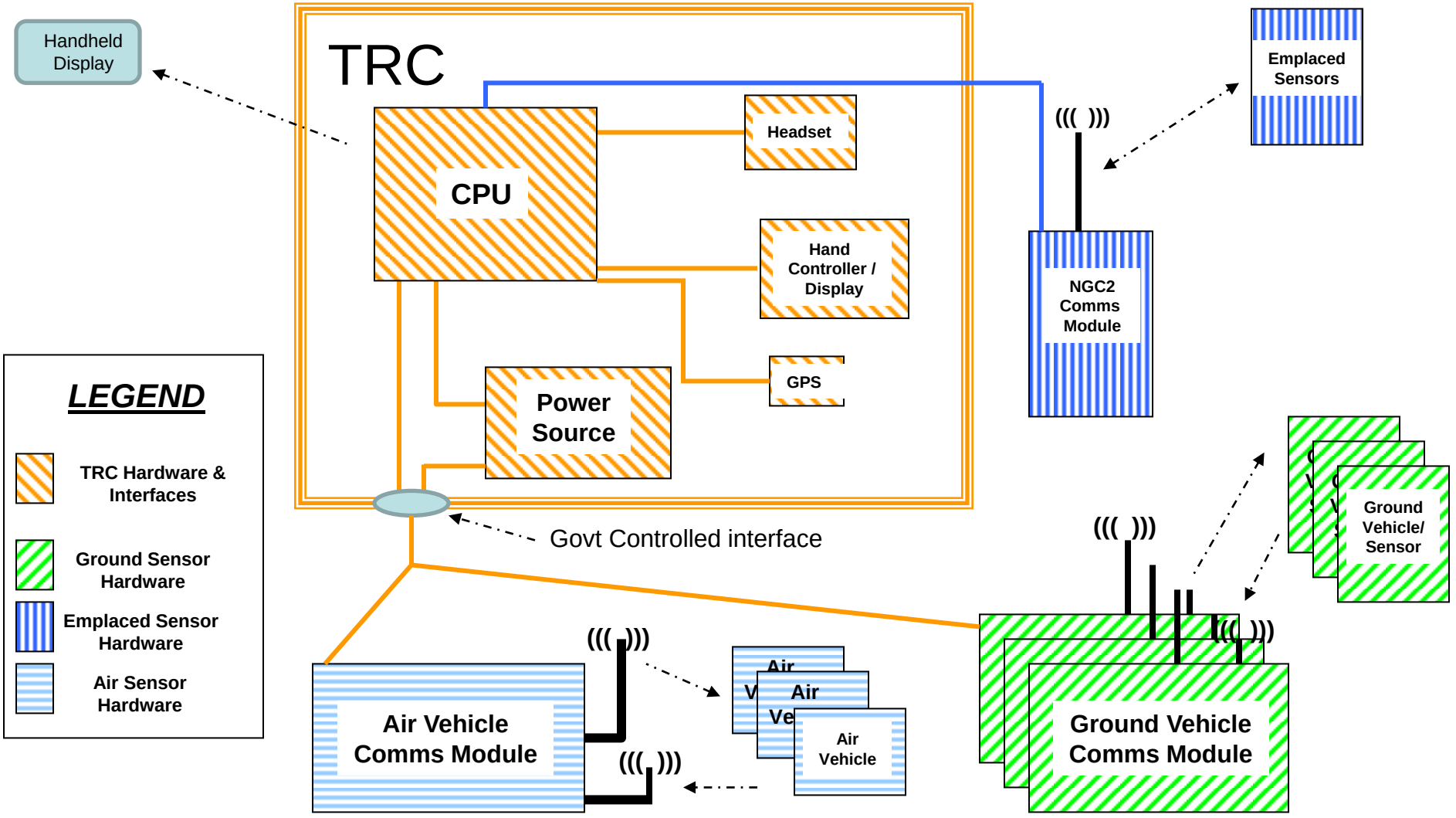
TRC Schedule

Principal Events & Activities	FY 2011 (O N D J F M A M J J A S)	FY 2012 (O N D J F M A M J J A S)	FY 2013 (O N D J F M A M J J A S)	FY 2014 (O N D J F M A M J J A S)
Continue Tactical Robotic Controller (TRC)				
Integrate UAS w/ TRC	AV Products	AMPR/OTUSN		
Integrate UGV w/TRC	GUSS/CRS/LS3			
Integrate ground sensors w/ TRC Trellisware	IOPD/RIGSS			
Continue maintenance, engineering, and sustainment of TNS2 components in support of Experimentation				
TNS2 LTA 2, LTA 3, LTA 4, LTA 5	▲ ▲	▲ ▲		
EMO LOE 1 (C4ISR), EMO LOE 2 (CSSD-X), EMO LOE 3 (FIRES)		▲ ▲	▲	

TRC Basic Architecture

(Functional)

AMCB UGV, 2011



Update on Progress

Completed:

- Took delivery of 4 Block 1 TRC's
- Placed order for 3 Additional Block 1 TRC's
- Completed LTA in March 2011 demonstrating TNS2 architecture
- Started development of Cursor-On-Target messaging between TRC's
- Demonstrated asset positions via COT messages
- Started integration with GUSS UGV

Future:

- TNS2 / C4 LTA with Trellisware Cub Radio's
- LTA with TRC controlling GUSS UGV
- C4ISR LOE in February 2012

Ground Unmanned Support Surrogate (GUSS)

Objective:

- Deliver Autonomous Vehicle Capability to EM LOE 1 and EM LOE Log that enhances Company level operations in logistics and mobility. (ECO LOE 4 & ELTA completed)

Delivered Capabilities:

- Off-road Capability equivalent to host vehicle.
- Modes: Supervised Autonomous, Tele-Op, or Driver On Board Capability with no Mission Interrupt.
- Fully compatible with the Tactical Robot Controller.
- Size- ATV w/1200 Pound Payload Plus (2) man FP det and (2) litters
- Capable of carrying (2) Cas Evac Litter.
- Speed: 10kmph max/ Range min: 10Km.
- Upgrades being tested: IR camera, anti-tampering devices, omni-directional tires, battery and LADAR relocation, enhanced computer box cooling, rifle racks, external Jerry-Can hangars, and CASEVAC changes.

Technical Approach:

- Leverage LOE 4 and E-LTA to enhance GUSS capability for EM campaign plan.
- Deliver two enhanced GUSS (Polaris) platforms for FY12 experimentation.
- Migrate GUSS (Polaris) to USMC ITV.
- Integrate the Tactical Robotic Controller (TRC)

Performers:

- MCWL
- NSWC-DD
- Virginia Tech & TORC
- QinetiQ North America

SCHEDULE:

Tasks	FY11	FY12	FY13	FY14
GUSS LTA III	▲			
TRC Integration	▲	▲	▲	
GUSS LTA IV / V	▲	▲		
EMO LOEs		▲	▲	
GUSS LOG ITV	▲			▲

Cargo Unmanned Ground Vehicle

AMCB UGV, 2011

Objective:

- Deliver autonomous MTVR vehicle capability to EM LOE-2 Logistics to determine if emerging robotic technology can be exploited to substitute manned vehicles with un-manned vehicles in order to reduce the exposure of Marines to lethal attacks.

Delivered Capabilities:

- Non-user-intensive autonomous “Point A to Point B” Navigation, with the vehicle leading the convoy.
- Vehicle is capable of executing “Follow Me” mission.
- Little to no input required.
- Off-road Capability Equivalent to armored MTVR.
- Switch between Autonomous, Limited Assist, Tele-Op, or Driver On Board Capability with no Mission Interrupt.
- Speed min: 35 MPH, with standard armored MTVR range.

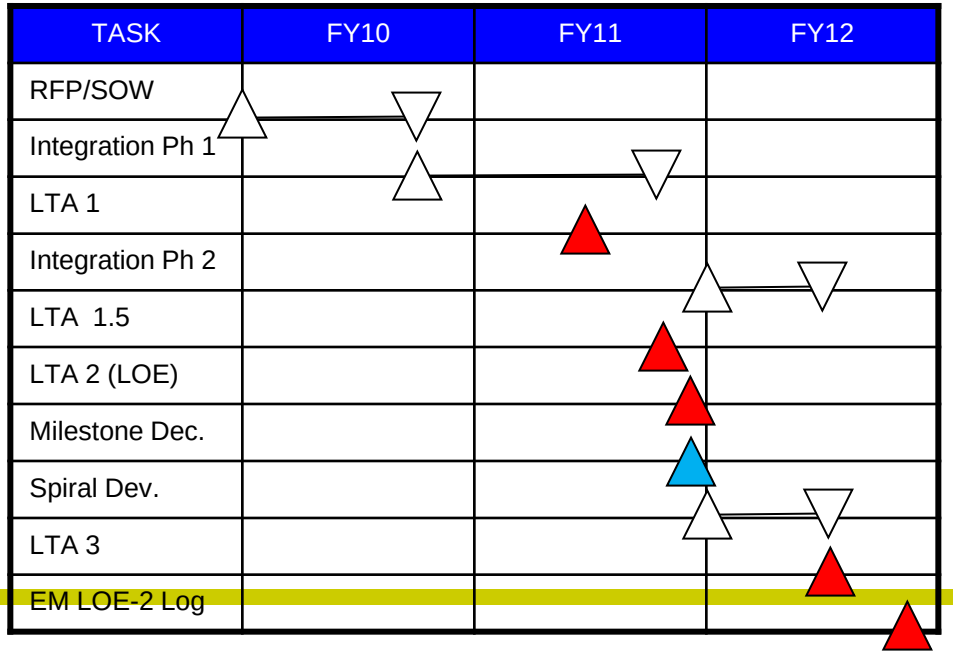
Technical Approach:

- Team with Oshkosh to initially produce 1 autonomous vehicle & 1 Operator Control Unit-equipped vehicle.
- LTA 1 and LTA 1.5 to test initial capability.
- LTA 2 for ConOps & TTPs.
- Brief incremental development to refine system performance.
- Integrate autonomy system onto an additional MTVR (“One-to -Many” operator control).
- Final LTA prior to inclusion in EM LOE-2 Log.

Performers:

- Marine Corps Warfighting Laboratory (MCWL)
  - NSWC Dahlgren Division
- Joint Ground Robotics Enterprise (JGRE)
- Vendor (Oshkosh)
  - National Robotics Engineering Center at Carnegie Mellon University Robotics Institute (NREC)
  - Teledyne Scientific & Imaging
- Program Executive Officer Land Systems USMC
- 2nd Marine Logistics Group, II Marine Expeditionary Force

SCHEDULE:



Legged Squad Support System (LS3)

AMCB UGV, 2011

Objectives:

- Develop a quadruped unmanned system for dismounted squads, increasing their combat capability while requiring minimal human interaction and control.

Delivered Capabilities:

- Phase I (Design and Build)
  - Completion of (2) LS3 platforms, “walkout” and preliminary testing
  - Successful maneuver across even terrain for 400m and uneven terrain for 100m utilizing a variety of gaits (walk, trot, run).
  - Allow maximum 70dB noise signature, with 40dB quiet mode.
  - Achieve accurate detection and classification of both good and poor footholds over a 50m x 2m natural terrain.
  - Track up to 5 squad members at 10 Hz as moving obstacles.
- Phase II
  - Maneuver while carrying 400 lb or more payload over 20 miles in 24 hours, unrefueled, with total weight (including payload, fuel) <1250 lb.

Technical Approach:

- Develop a quadruped unmanned system for dismounted squads, increasing their combat capability while requiring minimal human interaction and control.

Performers:

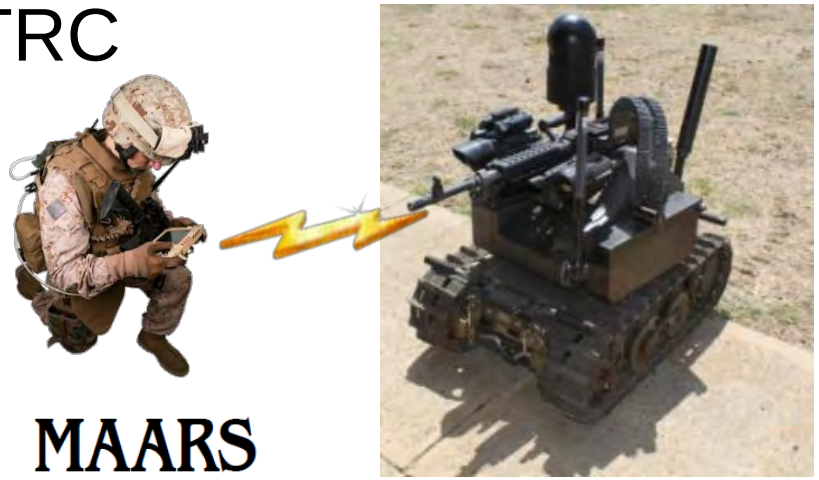
- DARPA
- Boston Dynamics
  - NREC
- Marine Corps Warfighting Laboratory

SCHEDULE:

Tasks	FY11	FY12	FY13	FY14
CDR	▲			
LTA 1		▲		
LTA 2			▲	
LTA 3			▲	
LOE 1				▲

Combat Robotic System (CRS)

TRC



MAARS

Modular Advanced Armed Robotic System

Objective:

Deliver a Combat Robotic System (CRS) Capability to MCWL Experimentation that Enhances Company Level Firepower, ISR, and Non-lethal Effects.

Delivered Capabilities:

- Remotely Operated, Multiple Mission Payloads, Lethal & Non-lethal Weapons Platform
- Integration with TNS2 through the Tactical Robotic Controller (TRC)
- Advanced ISR / Situational Awareness
- Base Platform Future Experimentation
- Rapid Payload Change Out

Technical Approach:

- Procure MAARS platform with EARS/ RSTA/ weapons payloads
- Incorporate lessons learned from Limited Objective Experiment 4 Summer FY10
- Integrate and test with Tactical Robot Controller (TRC) at LTA 2 - 4 prior to Extended LTAs FY 12/13

PERFORMERS:

- MCWL, NSWCDD, RSJPO, QinetiQ NA

SCHEDULE:

TASK	FY10	FY11	FY12	FY13
MAARS ECO LOE 4	▲			
Upgrade MAARS		▲———	△	
CRS/TRC LTAs		▲	△	△
MAARS Delivered			△	
E-LTA			▲	▲

Way Ahead

- MOA/Charter for AMCB Unmanned Systems
- JGRIT Resourcing
  - Personnel
  - Charter
- Staffing Unmanned Systems ICD
- Strategy

Questions???