



**RDECOM**



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

# Robotic Systems

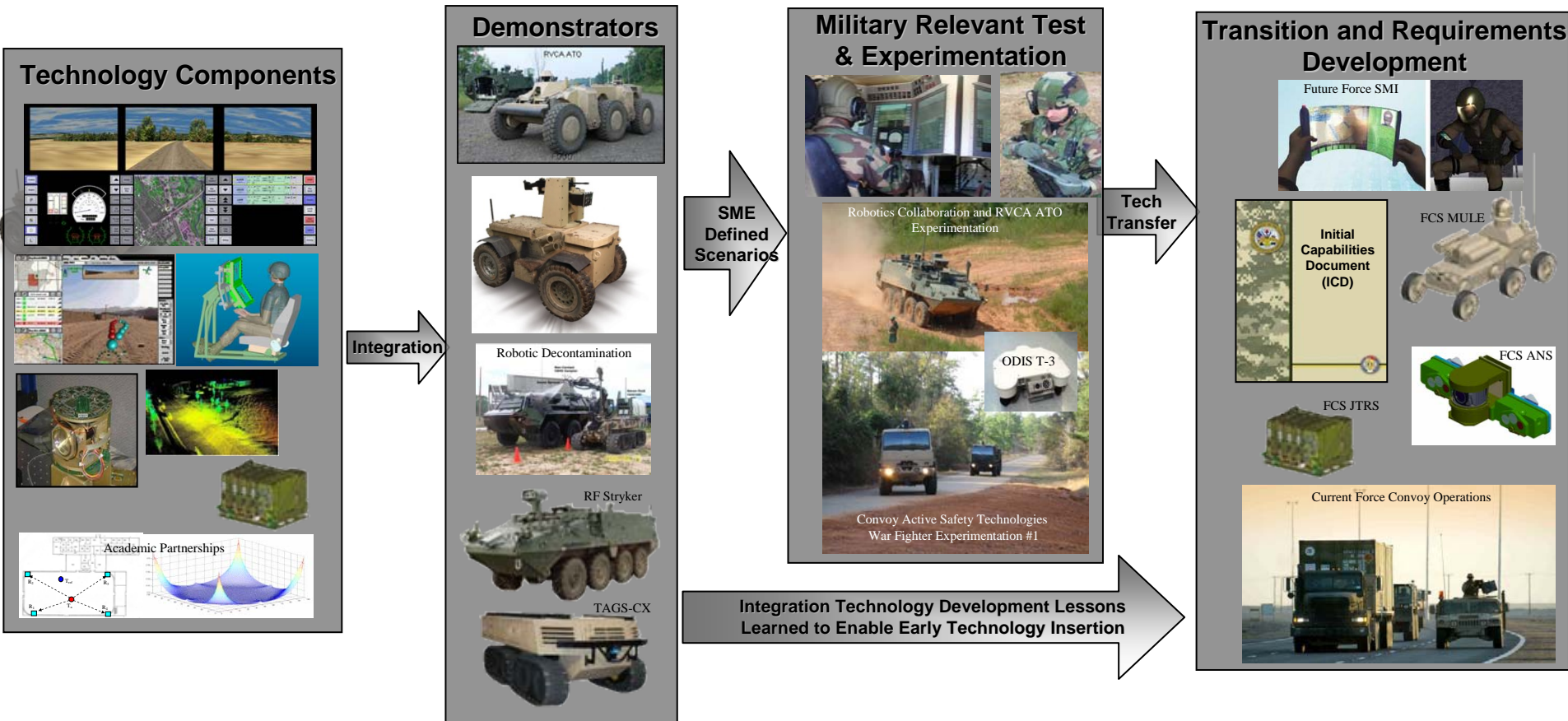
Jeff Jaster

Deputy Associate Director for Autonomous Systems

US Army TARDEC – Intelligent Ground Systems

## Mission

**Integrate, Explore, and Develop Robotics, Network and Control Components with a Focus on Customer Driven Requirements to Provide Full System Solutions to the War Fighter**





**Very busy environments**



**Other vehicles**



**Pedestrians**



**Poor lane markings**



**Animals**



**Potholes**



**Traffic signals**



**Road work**



**Very cluttered environments**



**Deep water**



**Wire, posts, and fences**



**Sharp rocks, rebar, curbs**



**Hidden hazards: rocks and holes**



**Mud, ice, snow, gravel and other traction problems**



**Tank traps**

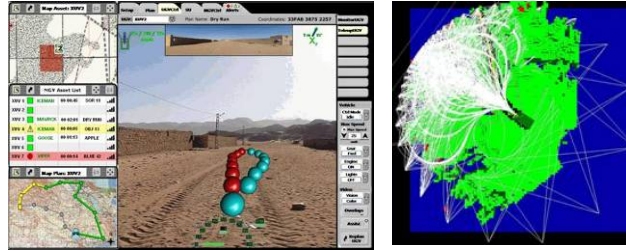


**Fog, dust, smoke, rain**

## Safe Operations and 360° SA



## Tactical behaviors



## Platform Mobility

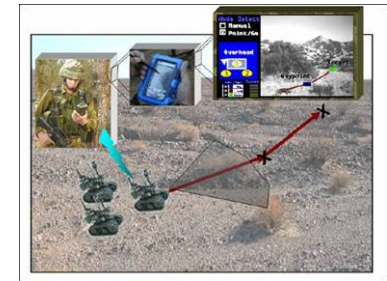


## UGV – Soldier Interfaces

### High-Speed Tele-operation



## Autonomous Control



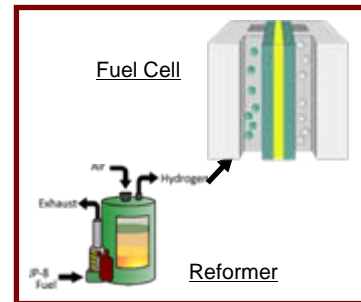
## Arm and Manipulator Articulation



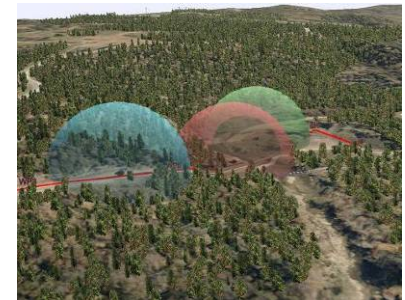
## Communications



## Power Management



## Non-LOS SA



## Basic Research



**Adaptive Coordinated Control of Intelligent Multi-Agent Teams MURI**  
Army Research Office

Univ + Gov

## Applied Research



**Robotics CTA**  
Army Research Lab

Univ + Gov  
+ Industry

## Advanced Development



**Unmanned Autonomous Collaborative Operations Research**  
Development & Engineering Centers

**Science & Technology to Meet Soldier Needs**



**Wide Angle Remote View camera**  
180 degrees x 360 degrees.  
standard camera is: 54 degrees



**TALON BB-390/BB-2590 Battery Upgrade "6-PACK"**  
-increase run time by 2 hrs



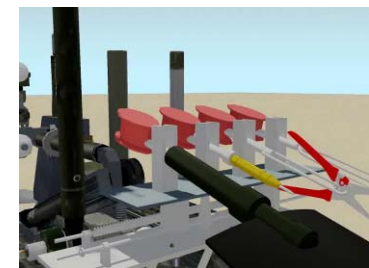
**Head Aimed Remote Viewer for EOD robot**

## Improving MTRS to Aid Soldier

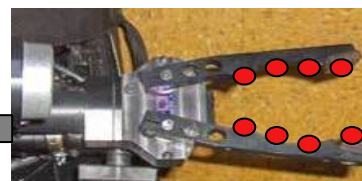
- Dexterous manipulation
- Advanced control capabilities
- Extended time on station



**EOD Disrupter Integration onto MTRS Robots**



**Autonomous Grasping for Talon Robot: Tool Retrieval**



Sensors



Pressure feedback

**Haptic Feedback for Talon Robot Gripper**



**Construction Engineering Robotic Kit (CERK)**

## Convoy Active Safety Technologies

## Under-vehicle Inspections



**Remote Mine Detection System**



**Robotic Decontamination**





## Unmanned Systems Technology Transfer

Rapid, Precise, Supportable Technology Development and Refinement to Meet Soldier's Needs.

- Sense of urgency
- Communicate the vision
- Empower action
- Create short-term wins
- Persistence



- Autonomous Detection Vehicle (Husky)
  - Capability for Supervised Autonomous Husky
- Autonomous VOIED Defeat Robotic Capability
  - Capability for Agnostic Autonomous Wheeled Vehicles
- Convoy logistics
  - Capability for Robotic Convoy Vehicles
- Persistent Stare
  - Capability for Autonomous ISR
- Robotic Wingman
  - Capability for any Tactical Vehicle to Become a UGV



***LTG Lynch's Vision: ONS/Requirements, Implementation Plan, Maximize Modeling and Simulation***



Robotic Vehicle Control Architecture

Near Autonomous Unmanned Systems  
ATO Capstone



Robotics Collaboration ATO Capstone



Convoy Active Safety Technologies (CAST)



**Robotics CTA – Technology for Near Autonomous Systems**



**Robotic Platform for Engineer Missions**



**MAST CTA - Small “Creatures for Urban Terrain”**

## Robotic Vehicle Safe Operations



**Command & Control of Robotic Entities**



**Air-Ground Collaboration**

## PAST

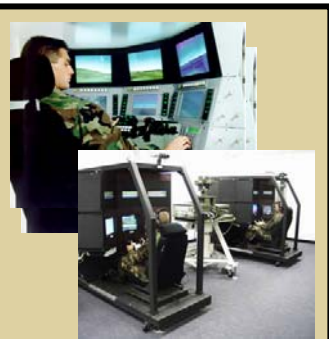
- Workload reduction
- Embedded crewstation

## PRESENT

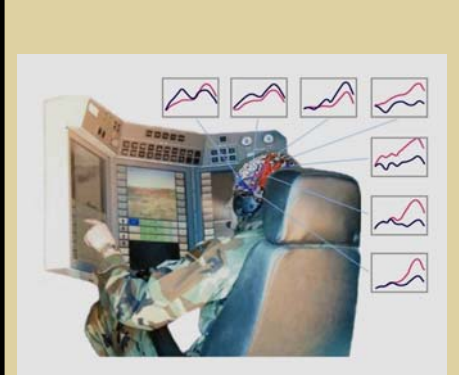
- Robotic control (mounted, dismounted)
- Driving aids (Soldier assist)
- Scalable, portable Interface

## FUTURE

- Soldier monitoring and task assist
- Intelligent agents
- 360 degree situational awareness



Dismounted Controller





- Safer operations of UGVs in proximity to pedestrians and vehicles
- Increase in vehicle autonomy to enable less supervisory burden
- Increased UGV situational awareness
- Robust Soldier/robot and robot/robot teaming behaviors
- Robust UGV performance in all environments/conditions
- Simulation of platform, payload and algorithms in relevant operational environment



**FY 2009**

Perception & Control Technologies,  
Tactical/Mission Behavior Technologies,  
TRL=5

**FY 2012**

Perception & Control Technologies,  
Tactical/Mission Behavior Technologies,  
TRL=4

Perception & Control Technologies,  
Tactical/Mission Behavior Technologies,  
TRL=6

unclassified

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

# Improved Mobility and Operational Performance through Autonomous Technologies (IMOPAT) ATO



360/90 Day/Night  
Near-field Sensor Coverage



Soldier Monitoring  
& State Classification

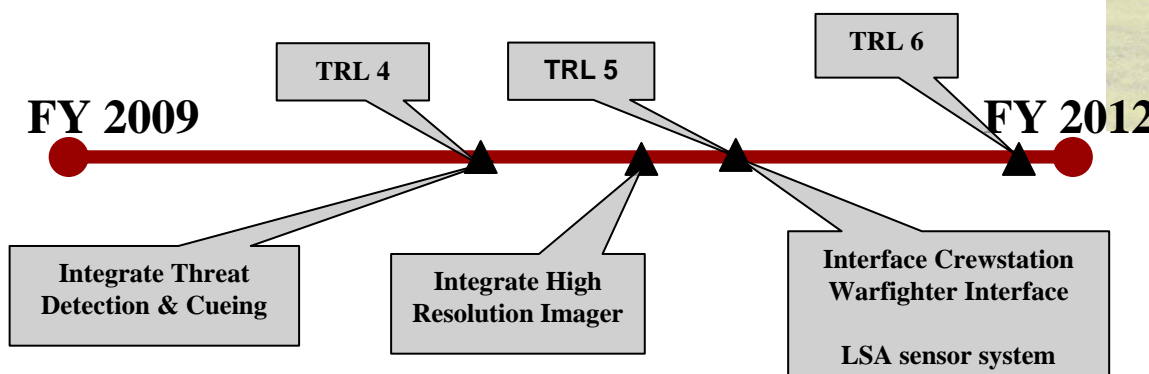
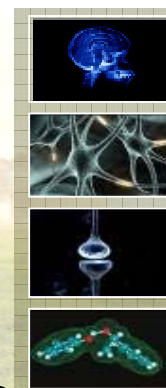


Advanced  
Crew Stations



**Enhance, Integrate and Demonstrate  
360/90 LSA/Assisted Mobility/Human  
Dimension to Maximize Indirect Vision  
360/90 LSA and Mobility Capabilities  
(Secure Mobility)**

- Focus on closed-hatch operations, indirect vision
- 360/90 degree local area awareness
- Improved mobility via non-LADAR and LADAR based solutions
- Improved assessment and integration of operator performance in real-time
- Increase situational awareness for all crew members



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

# Robotics Way Ahead – Current to Future

- Affordable common robotic kit for manned/unmanned operations of current force vehicles
  - Incremental insertion of safety and automation capabilities
- Manned-unmanned and UAV-UGV collaboration for enhanced company operations
- Open systems architecture and joint interoperability
- Multi-mission capable family of robotic platforms
- Safe semi-autonomous operations in complex/dynamic environments
- Scalable autonomy based on terrain and mission understanding
- Robotic security for maneuver elements



Credibility • Capability • Cost

- Focused on the Soldier
- Applying Today's Technology for Immediate Results
- Developing Technology for the Future to provide U.S. Forces a Vital Edge
- Partnering with Others to Insure the Best Available Materiel for Our Troops





