Focusing S&T investments on Marine Corps needs in coordination with our Acquisition and Requirements Partners
Ground Autonomy Vision

**Current Capability:** Remote control single purpose platform; line-of-sight operations; all manipulation and decisions made by the operator

**Objectives:**

- **Affordability**
- **Contextual understanding**
- **Day/night perception**
- **GPS-denied navigation**
- **Path-planning in complex terrain**
- **Real-time adaptive behaviors**
- **Warfighter-UGS interaction**

**Objective:** Provide the USMC with affordable technologies that enable revolutionary advances in vehicular autonomy.
Approach

- **Affordability**: Bring low-cost autonomy for tactical ground vehicles to Technology Readiness Level (TRL) 6

  Low-cost autonomy ➔ ubiquity ➔ operational innovation

- **Platform independence**: Develop enabling technologies and design concepts that can be adapted to existing vehicle platforms.

- **Expeditionary focus**: Concentrate test and development efforts on complex, highly cluttered, unimproved off-road, and austere environments.

- **Diverse participation**: Open, modular architecture with Government ownership/rights.
Key Investment Areas

Perception

Intelligence Enablers and Architectures

Human-Machine interaction

Systems Engineering
Perception

Robust Traversability in Complex Terrain

Adaptive and Modular Multi-Terrain Mobility Planner

- Improved autonomous navigation
- Platform independent

Faster autonomous tactical maneuver
Perception

Night Ops with EO Perception

- EO+illumination
- GPS Denied Navigation
- Visual feature tracking
- IMU
- Encoders
- Low cost thermal
- Localization and mapping estimator

Sensor Fusion for Robust Perception

Low-cost, high fidelity, day/night perception
Intelligence Enablers

High-Level Reasoner

Contextual understanding and machine situational awareness/understanding
Human-Machine Collaboration

Trust in Adaptive Autonomous Systems

CONTINUUM

Integrates three key functionalities:
- human cognitive model
- adaptive agent to assist cognition
- high-assurance supervisor

Reduce cognitive load and enable trust
### 2013 Test
- EO-only percep. (TRL 5)
- Daylight operation
- Material Classification
- SwRI test site

### 2014 Test
- Multimode percep. (TRL4)
- Fixed illumination
- GPS denied rel. local.
- Context-based reasoning

### 2015 Test
- Multimode percep. (TRL5)
- Dynamic illumination
- Complex Terrain Travers.
- High-level Reasoning

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### 2016 LMUA
Multimode perception (TRL 6)
Day/Night operation
Safe & Ready for Operational Environment