



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

GM-TARDEC Vehicle Intelligence Collaboration Meeting

December 16, 2010

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- Provides full life-cycle engineering support and is provider-of-first-choice for all DOD ground combat and combat support vehicle systems.
- Develops and integrates the right technology solutions to improve Current Force effectiveness and provide superior capabilities for the Future Force.

*Ground Systems Integrator
for the Department of Defense*



Responsible for Research, Development and Engineering Support to **2,800** Army systems and many of the Army's and DOD's Top Joint Warfighter Development Programs

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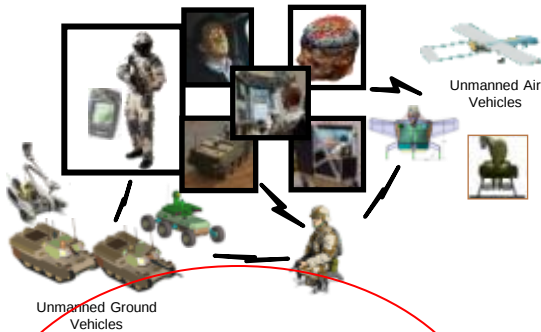
**Ground Systems
Power & Mobility Integration**



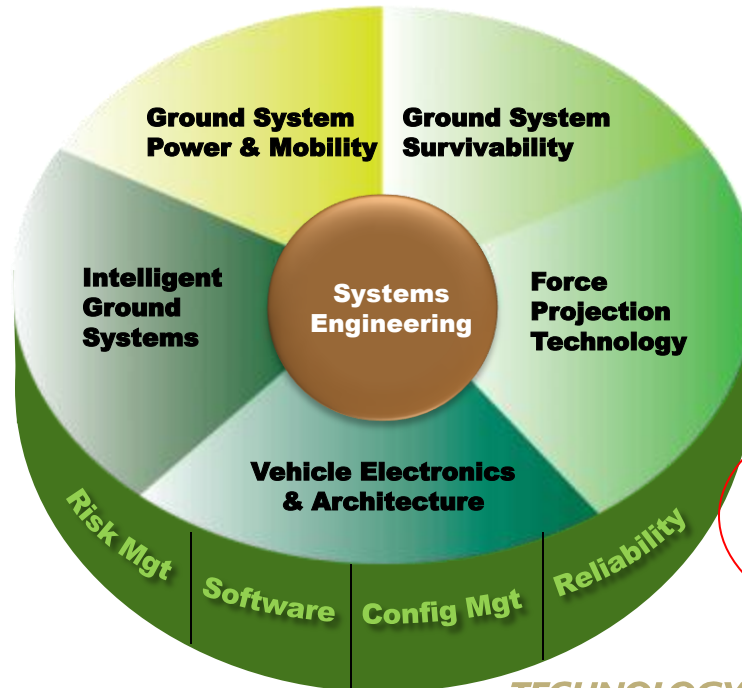
**Ground Systems
Survivability Integration**



**Development of
Force Projection Technology**



**Maturation of Ground
Robotics &
Vehicle Situational
Awareness**



**Vehicle Electronics &
Architecture Integration**

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- **High speed mobility**

- Improved high speed, high accuracy perception & actuation

- Reliable, scalable data fusion

- **Safe operations**

- Safety Assessment and Certification for Autonomous Systems

- Detect & classify stationary people & objects

- Collision avoidance & route planning

- **Design for tactical behavior flexibility**

- Understanding of environments

- Decision processing & workload management

- Expected & rational behaviors in new scenarios

- **Collaboration**

- Conduct collaborative missions with mixed manned/unmanned force

- Collaborative air-ground operations

- Low latency, High Bandwidth Communications



Technical Approach

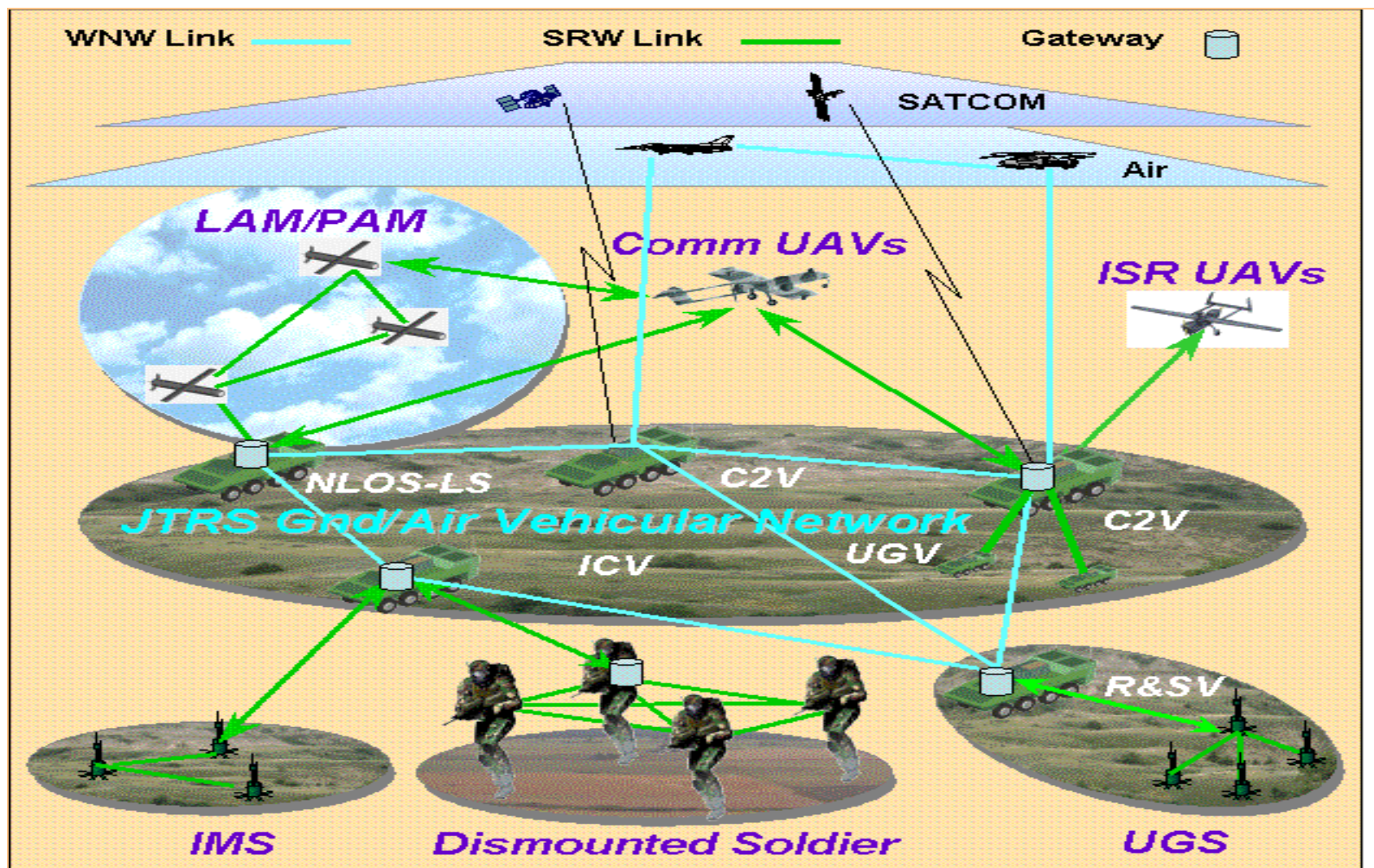


- Develop the tools, techniques, and autonomy “kits” to maximize mounted and dismounted control of UMS and optimize Soldier-robot and robot-robot ground & air teams.
- Use of Benchmarking and Design to Requirements.
- Focus on “affordable” technologies- sensors & sensor fusion, actuators, autonomy & by-wire conversion kits as well as information sharing with other vehicles & assets.
- Focus on robust, reliable, safety-critical architectures and designs.

General Topic Areas for discussion:

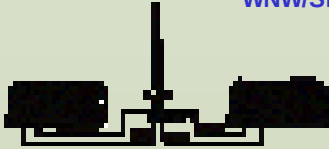
- Connected Vehicle Technologies & Ad Hoc Vehicle Networks
 - High Bandwidth Communication Latency reduction techniques and methods
- Safety Critical Systems Design & Assessment
 - Testing methodology to certify autonomous systems “safe for Soldier use” needs to be developed.
- Conversion of existing platforms to UMS (By-Wire)
- Sensing Technologies
 - “Negative” Object Detection and Avoidance, etc
- HMI issues for manned/unmanned vehicle control
 - User monitoring, workload management, etc.

- **Army “market” is different from automotive**
 - Quantities much smaller : hundreds, thousands, tens of thousands of vehicles
 - Unit cost is much less important
 - Maintenance and “sustainment” costs are important
 - Supplier relations are more regulated and much more difficult
 - Unique requirements
 - Shipping by C130
 - Air drop
 - Many add-on systems in the field, little configuration mgt of vehicles
 - Vehicles are very old technology, by automotive stds: very little electronic vehicle controls (bowden cable accel pedal)



LOW COST OTM COMMS

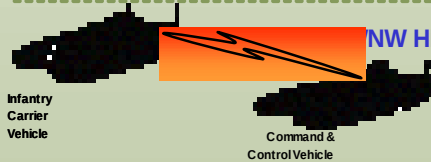
WNW/SRW TRI - BAND



PLATFORM
ANTENNA
REDUCTION

2 -PORT LOW PROFILE

REDUCED VISUAL
SIGNATURES



NW HIGH GAIN

IMPROVED
LINK
CONNECTIVITY

BODY WEARABLE

IMPROVED
MANEUVER TACTICS
& WIDEBAND COMMS



Tactical Network &
Communications Antennas

Directional Antennas

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- **Issues**

- **Poor communications environment**
 - Lack of frequency regulation in some foreign countries
 - Jamming and active countermeasures
 - Cluttered, urban terrains
 - Many different communication devices on vehicles, little coordination between devices
- **Available power on vehicles is usually limited**
- **Robustness and maturity of technology**

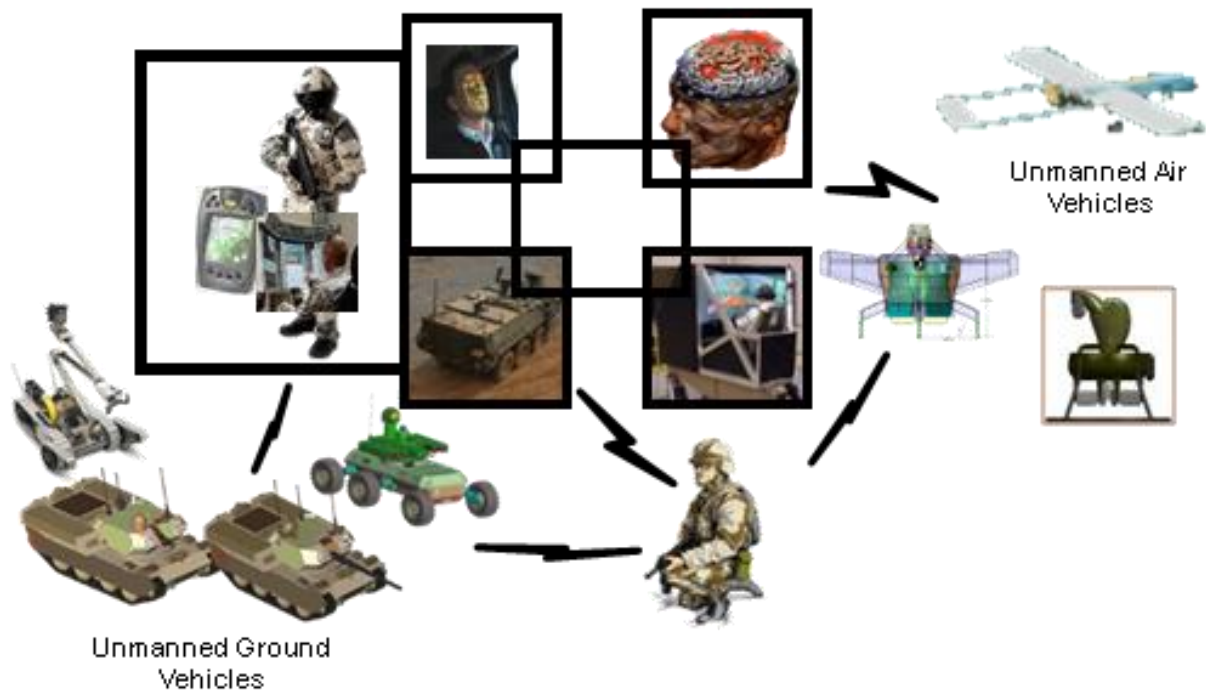
- **Local Vehicle to Vehicle Communications**
 - Road conditions
 - Road Hazards
 - Emergency vehicle maneuvers
 - Distressed vehicle
 - Other local situational awareness items that can reduce the risk of other vehicles.

Issues:

- **Measurement and definition of safety considerations**
 - Need to develop methods to perform standardized Safety Assessment and Certification for Autonomous Systems
- **Mix of analog, digital, and mechanical controls on vehicles**
- **Different vehicle configurations in the field – many unknowns**
- **Interaction of vehicle safety and survivability**
- **Interaction with Army Safety organizations**

- **Issues**

- **Measurement and definition of “autonomy”**
 - ALFUS
 - Future Combat Systems
- **Robustness of autonomous technologies**
- **Robustness of robotic platforms**
- **Trust in automation**
- **Lack of a detailed Army plan or strategy for development and introduction of technologies to the field**





Human-Machine Interaction



- HMI issues for manned/unmanned vehicle control
 - Soldier workload is increasing as additional functions and technologies are being introduced
 - Multiple platforms & multiple functions per platform may exceed operator ability to control. Monitoring and managing workload is necessary, along with simplifying control and display data.
 - Motion sickness is also a consideration in many teleoperation/ autonomy functions.