



U.S. Army Research, Development and Engineering Command

Defense Technology Affordability Requirements (DTAR) Conference

DoD Research Laboratory Perspectives



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Dr. Stephen Lee
ARO Chief Scientist (ST)

15 February 2012

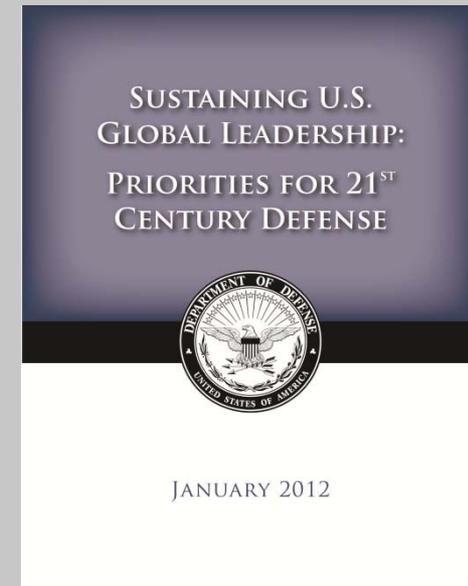


DoD Science & Technology Priorities for Planning

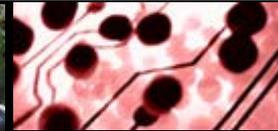
- Cyber Science and Technology
- Electronic Warfare / Electronic Protection
- Data-to-Decisions
- Engineered Resilient Systems
- Counter Weapons of Mass Destruction
- Autonomy
- Human Systems

Six Disruptive Basic Research Areas

- Synthetic Biology
- Engineered Design and Transport of Energy/Information in New Materials
- Quantum Information Science
- Computational Modeling of Human Behavior
- Cognitive Neuroscience
- Nano-Science and Nano-Engineering



... the Department will make every effort to maintain an adequate industrial base and our investment in science and technology... Over the past ten years, the United States and its coalition allies and partners have learned hard lessons and applied new operational approaches in the counter terrorism, counterinsurgency, and security force assistance arenas, most often operating in uncontested sea and air environments. Accordingly, similar work needs to be done to ensure the United States, its allies, and partners are capable of operating in A2/AD, cyber, and other contested operating environments. To that end, the Department will both encourage a culture of change and be prudent with its “seed corn,” balancing reductions necessitated by resource pressures with the imperative to sustain key streams of innovation that may provide significant long-term payoffs.



Materials &
Devices in
Extreme
Environments

Battlefield
Neuroscience

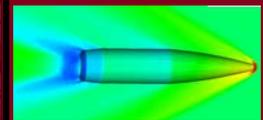
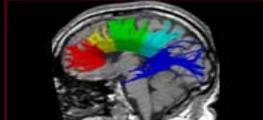
Network
Sciences

Hierarchical
Computing

Extreme
Energy
Science

Autonomous
Systems
Technology

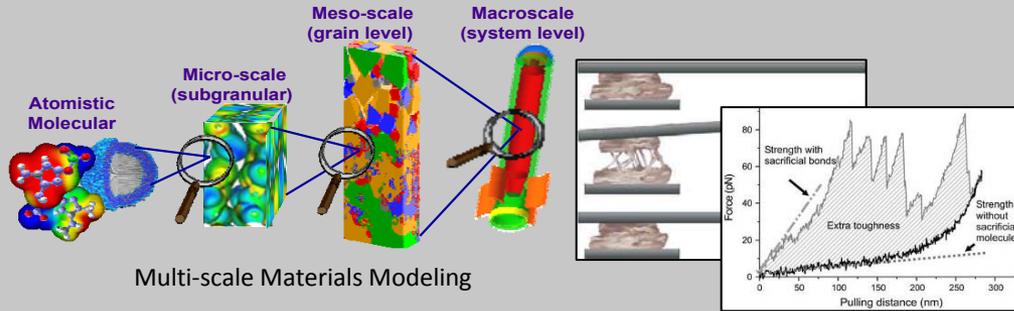
Emerging
Sciences



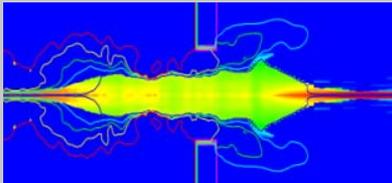
A Focus on the Future



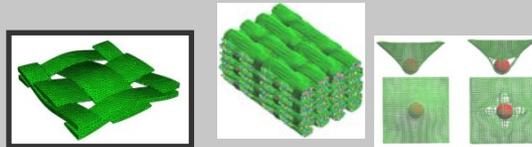
Armor and Lethality



Understanding Failure in Armors and Discovery of Novel Mechanisms



Energy Dissipation Mechanisms



3D Textile Composites: Modeling provides roadmap for tailored benefits important to structural and armor applications

Focus:

- Materials Research and Processing at all Scales
- Multi-functional materials systems (ballistic, blast, EMI, solar loading, multi-spectral signature, power, communications)
- Scientific underpinnings to support development of future survivability & lethality technologies

Warfighter Payoffs:

- New and enhanced fibers/textiles, composites, ceramics, and metals — to be fielded without loss in performance

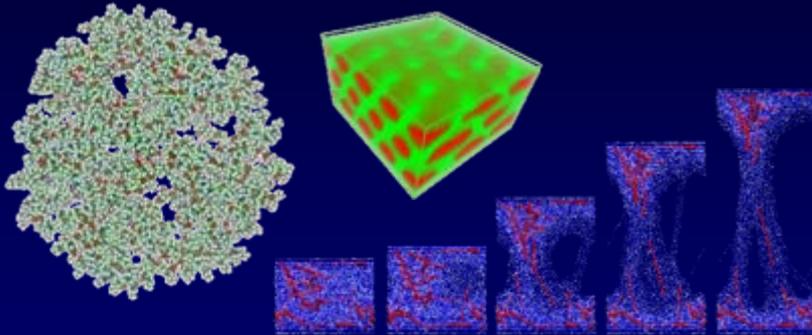


Novel Processes for Head and Body Armor Protection

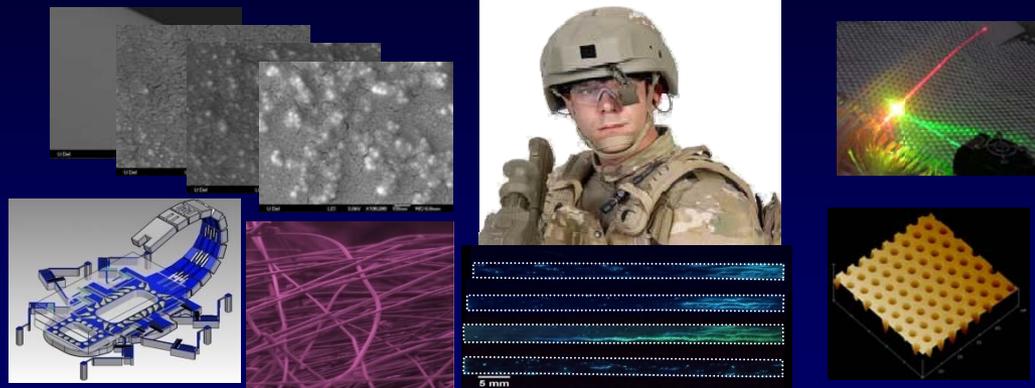


The Army is Capitalizing on Revolutionary Advances in the Materials Community

Computational Materials Science

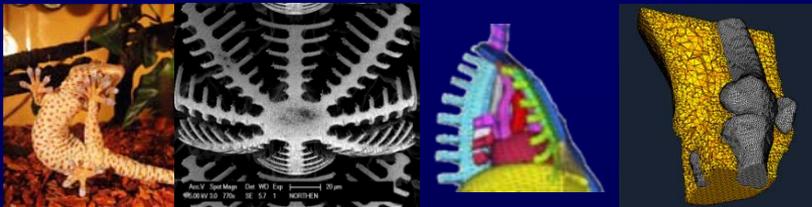


Multi-Scale Materials Science and Multifunctionality



**Bio: -materials, -mimetic,
-inspiration, -mechanics**

**Increasing sophistication of processing and
characterization techniques**



Nature: Water-harvesting desert beetle



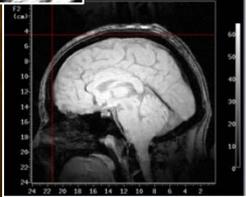
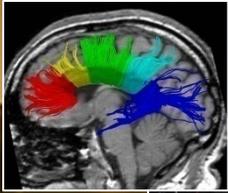
Bio-Inspired:
Modified Polymer Surface



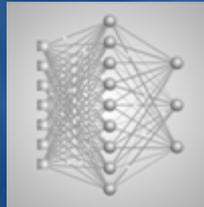
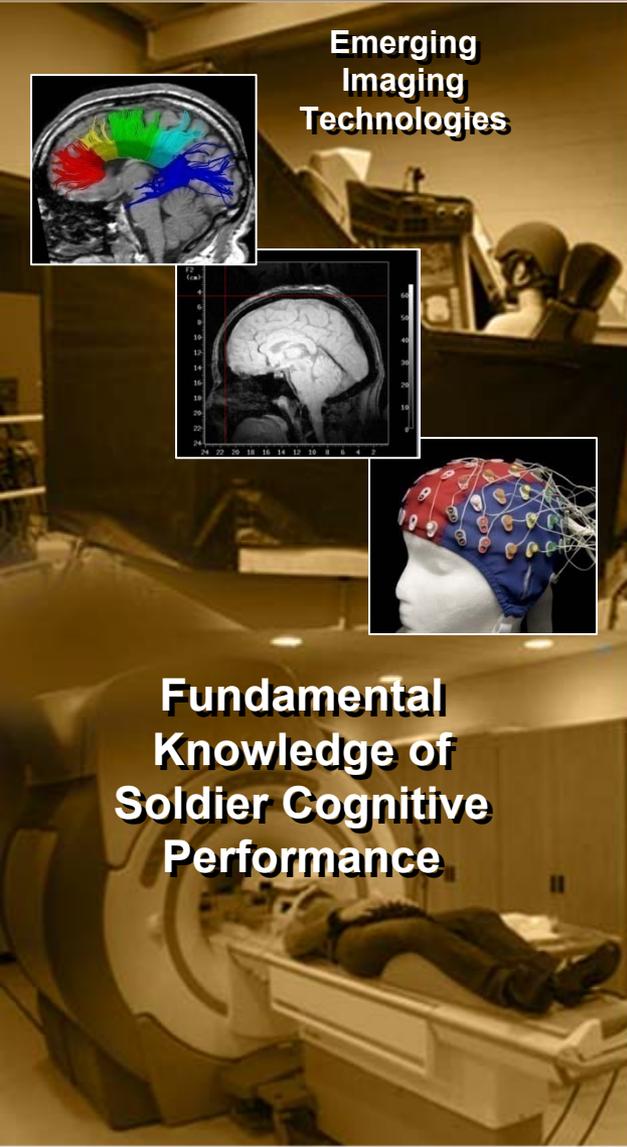
Lighter Armored Vehicles – Reduced Soldier Loads – Increased Reliability



Emerging Imaging Technologies



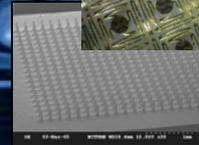
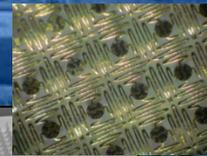
Fundamental Knowledge of Soldier Cognitive Performance



Advanced Cognitive Classification Algorithms

Advanced Operational Neuro-Cognitive Measurement

MEMS & Nano-Scale Neural Sensors

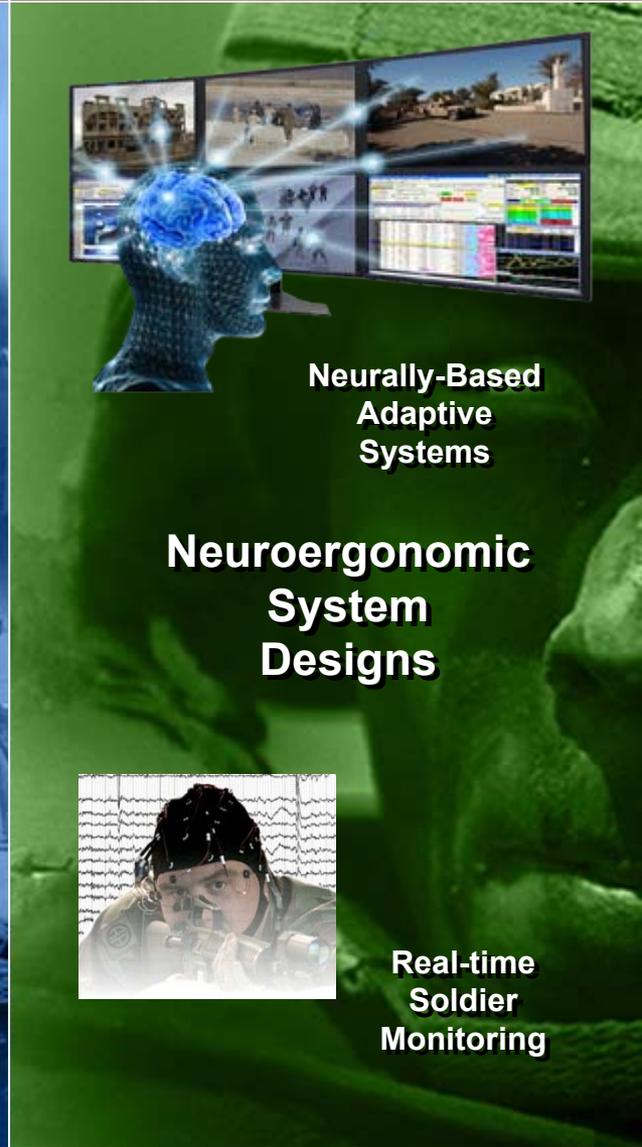


Neurally-Based Adaptive Systems

Neuroergonomic System Designs

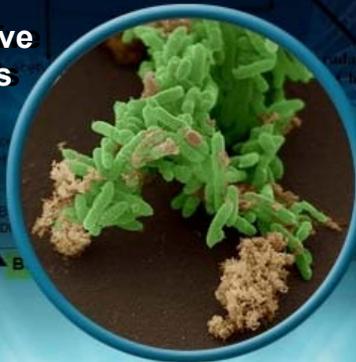


Real-time Soldier Monitoring

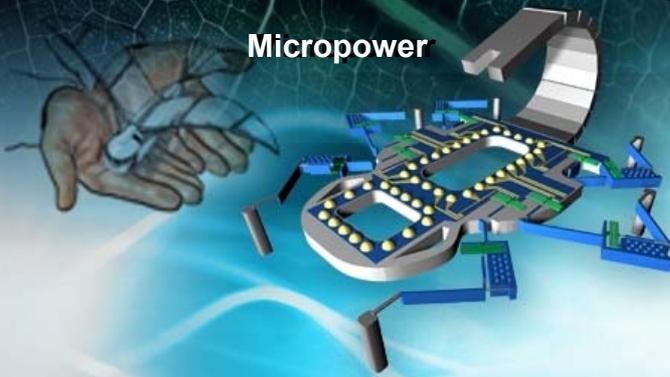




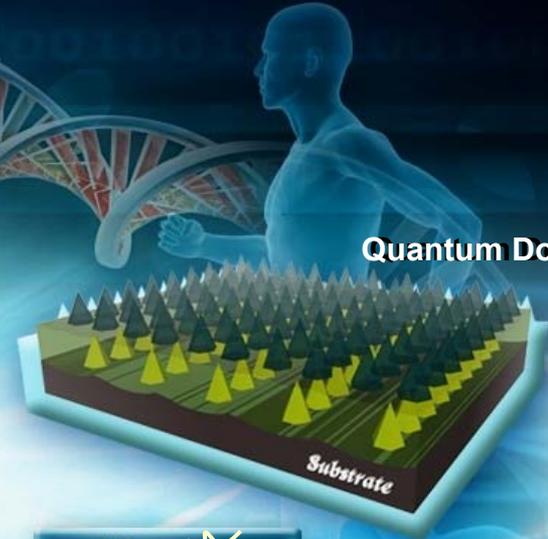
Alternative Bio Fuels



Micropower

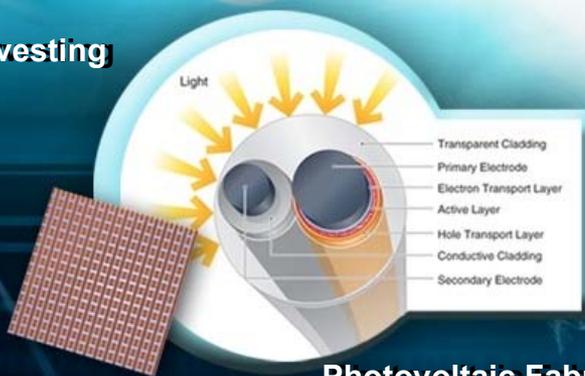


Quantum Dot

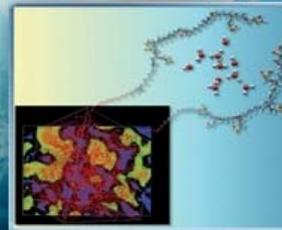


POWER & ENERGY

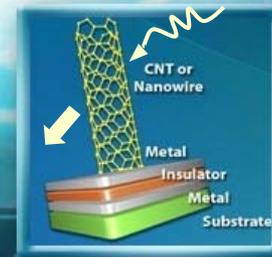
Energy Harvesting



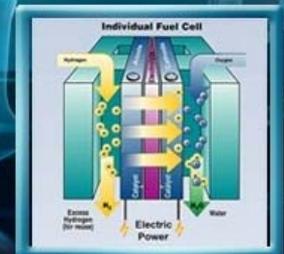
Photovoltaic Fabric



Model Membrane



Rectennas

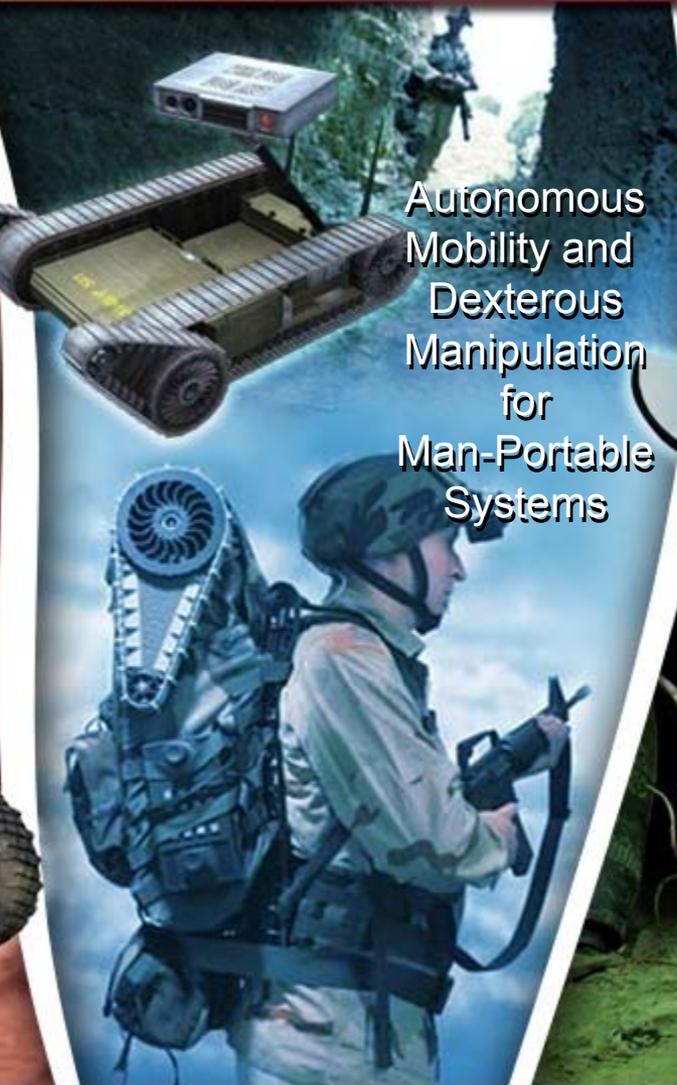


Bio Battery

Ubiquitous P&E, Micro to Meso Scale, Reduce Resupply, Power Flexibility



Large-Scale Robotics
Technologies supporting
Maneuver Forces



Autonomous
Mobility and
Dexterous
Manipulation
for
Man-Portable
Systems



Micro-Autonomous
System Technologies
breeding a new
class of Soldier assets

Providing the Soldier with superior situational awareness



Technologies for Future Soldiers...

- **Enhanced protection and lethality**
→ *multi-functional lightweight materials enabled by multi-scale modeling*
- **Information to Soldiers**
→ *network science, data to decision, and advanced computing*
- **Smaller, lighter, less power intensive sensing devices**
→ *novel energy harvesting and innovative materials*
- **Enhanced situational understanding and protection**
→ *autonomous systems at maneuver and man-portable scales*
- **Improvements in Soldier-system overall performance**
→ *operational neuroscience and advanced simulation and training technologies*

...providing Soldiers with the decisive edge.



BACKUP



Mission

Provide innovative science, technology, and analyses to enable full spectrum operations.

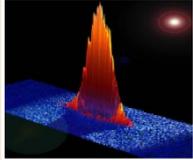
Vision

America's Laboratory for the Army: Many Minds, Many Capabilities, Single Focus on the Soldier

Mission accomplishment requires deep understanding of:

- state of the art
- the threat
- how Army will deploy technology

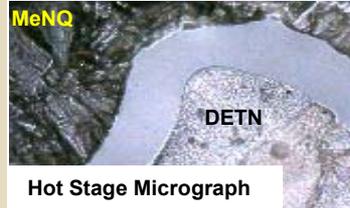




New State of Matter for Revolutionary Sensors and Detectors



Tilt Rotor



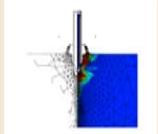
Hot Stage Micrograph
DEMNI – Insensitive Munitions



Ballistic Survivability



IED Countermeasures



Multiscale Computation for Impact Dynamics



FIDO for Explosives Detection



ANS Robotics LADAR



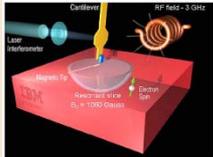
EPS



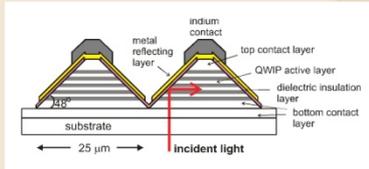
Language Translation



Persistent Surveillance



Single Electron Spin MRFM



C-QWIP FPAs



Flexible Displays



Advanced RF



Human-Figure Workspace Modeling for MRAP

Basic Science

Evolving Technologies

Current Ops

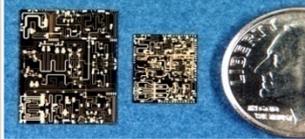
Technology Maturity



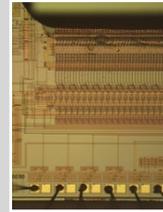
Legacy Accomplishments



- | ENIAC Digital Computer
- | Proximity Fuze
- | Integrated Printed Circuit Board
- | Photolithography enabling integrated circuits
- | Special Armor for M1 tank
- | Lithium primary batteries
- | M829A2 "silver bullet" KE Penetrator



Continuing a Legacy of Firsts



- | Quantum Well Infrared Photodetectors
- | Autonomous Navigation for Unmanned Systems
- | Explosive Fill for Insensitive Munitions
- | Flexible Displays
- | Electric Armor
- | M855A1 Enhanced Performance Round



Focus on the Future

Materials & Devices in Extreme Environments

Battlefield Neuroscience

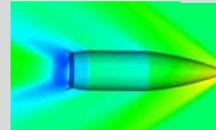
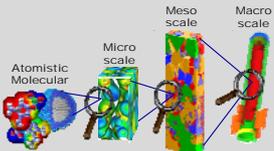
Network Sciences

Hierarchical Computing

Extreme Energy Science

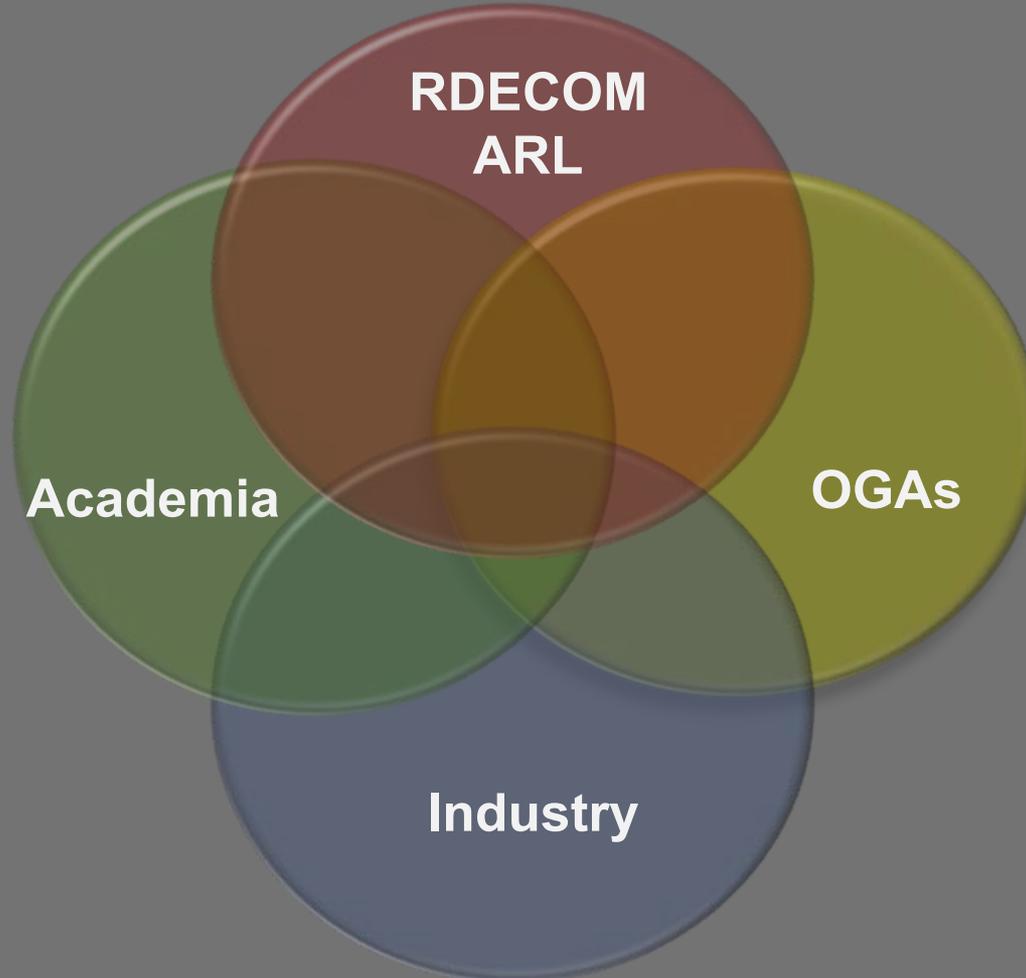
Autonomous Systems Technology

Emerging Sciences





Extensive Network



MURIs	Contracts
UARCAs	CRDAs
CTAs	SBIR
CRAs	TSAs
COEs	