Ground Robotics Studies and Strategic Planning

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Man is the best computer we can put aboard a spacecraft

... And the only one that can be mass produced with unskilled labor.

Wernher von Braun

Agenda

- OSD Goals for Unmanned Systems
- 2007-2008 JGRE Studies
  - Status
  - Recommendations
  - Actions
- Potential 2008-2009 Studies
- Ideas to Increase the Growth and Utility of Ground Robotics

Roadmap Goals

Goal 1. Improve the effectiveness of COCOM and coalition unmanned systems through improved integration and Joint Services collaboration.

Goal 2. Emphasize commonality to achieve greater interoperability among system controls, communications, data products, and data links on unmanned systems.

Goal 3. Foster the development of policies, standards, and procedures that enable safe and timely operations and the effective integration of manned and unmanned systems.

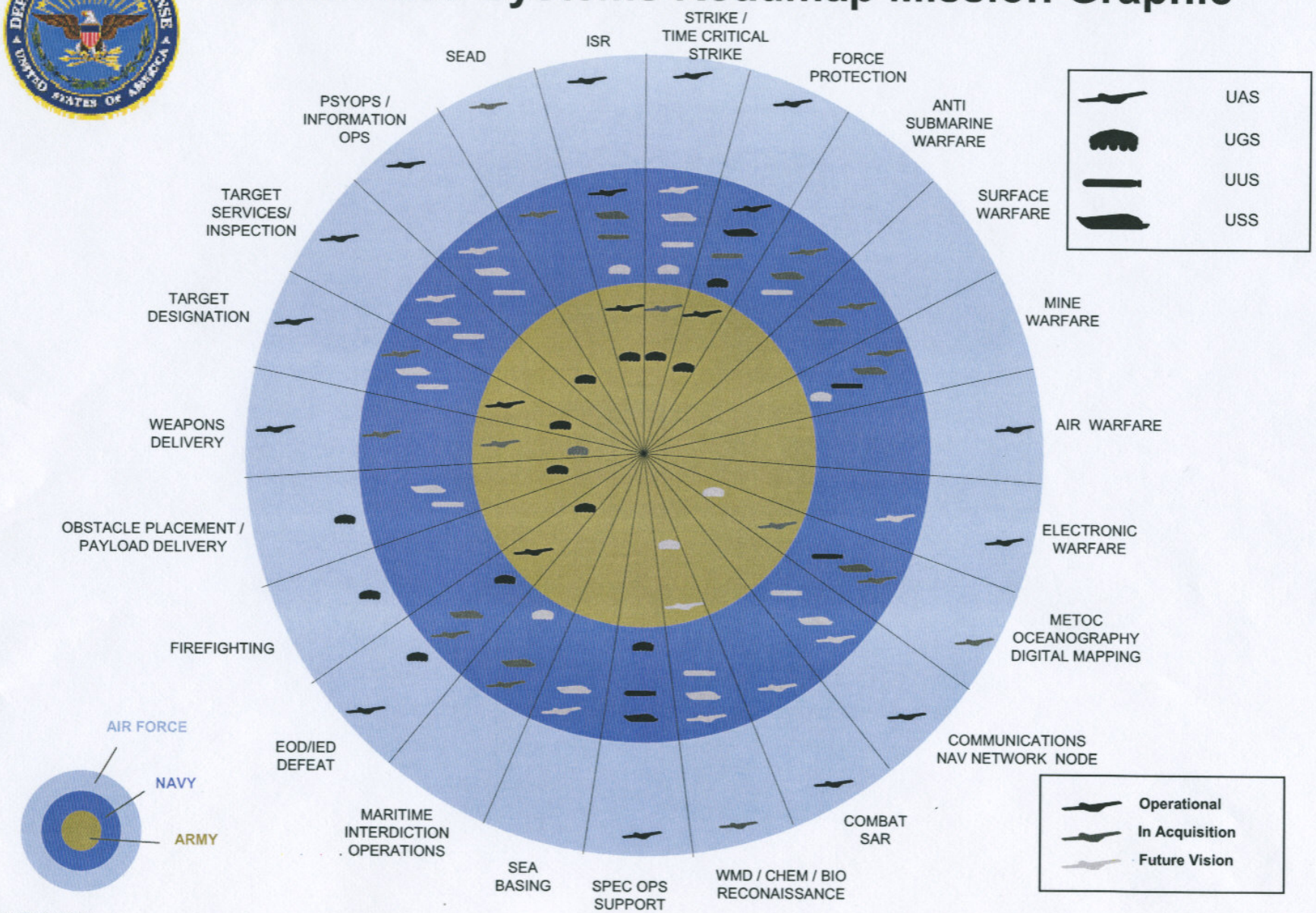
Goal 4. Implement standardized and protected positive control measures for unmanned systems and their associated armament.

Roadmap Goals

Goal 5. Support rapid demonstration and integration of validated combat capabilities in fielded/deployed systems through a more flexible prototyping, test and logistical support process.

Goal 6. Aggressively control cost by utilizing competition, refining and prioritizing requirements, and increasing interdependencies (networking) among DoD systems.

Unmanned Systems Roadmap Mission Graphic



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JGRE Studies

- JAUS/STANAG Interoperability Standards Analysis
- Unmanned Systems, International Technology Assessment
- UGV Robotic Industrial, Financial and Technology Industrial Base Assessment
- Spectrum Crowding Definition
- Joint Ground Robotics Common Controller Assessment

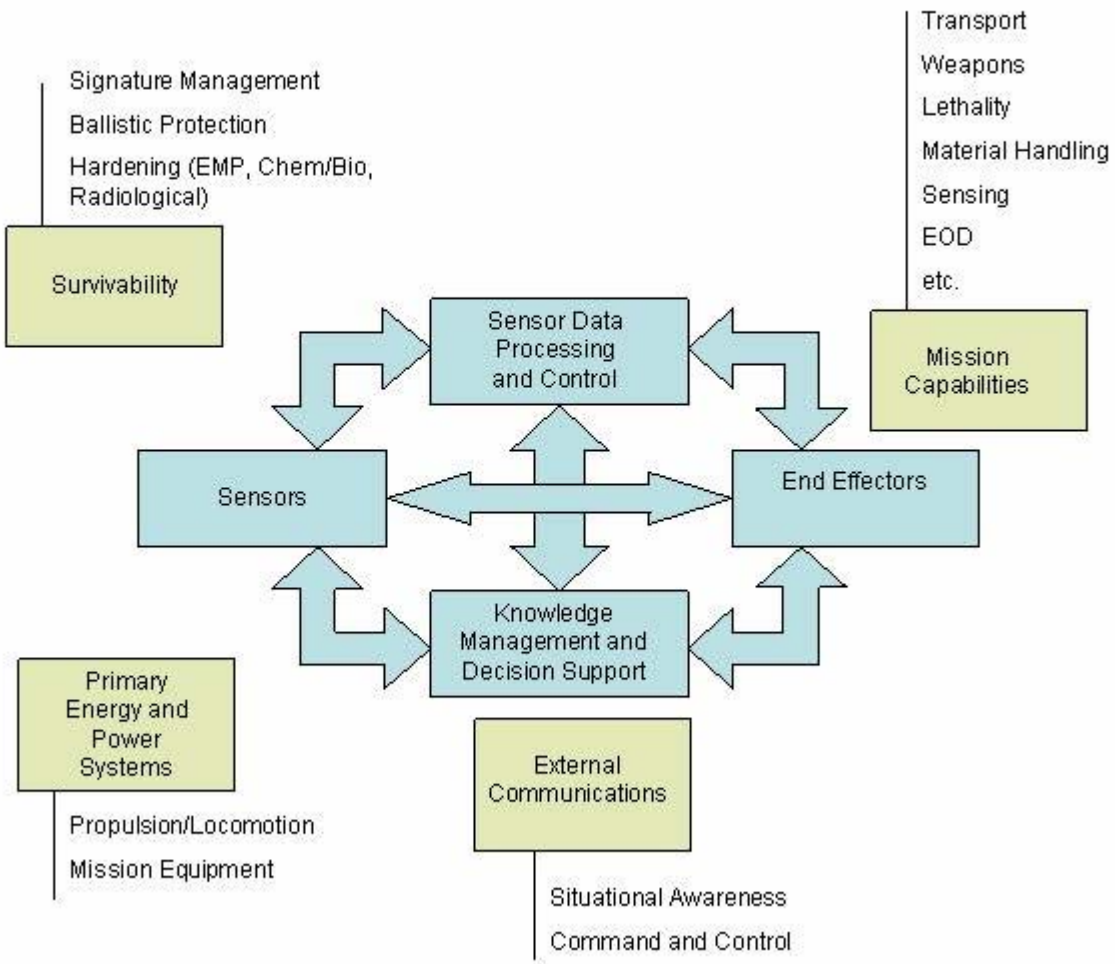
JAUS/STANAG Interoperability Standards Analysis

- Assessed ongoing UMS standardization activities and recommend a DoD UMS standardization strategy supporting improved interoperability, safety, and cost reduction
- Key Emerging Findings / Recommendations
  - STANAG 4586 is “NATO Unclassified” which reduces the number of viable coordination solutions
    - Only NATO countries can obtain the standard
  - JAUS and STANAG 4586 agree that a Service Oriented Architecture (SOA) is required to support future interoperability needs

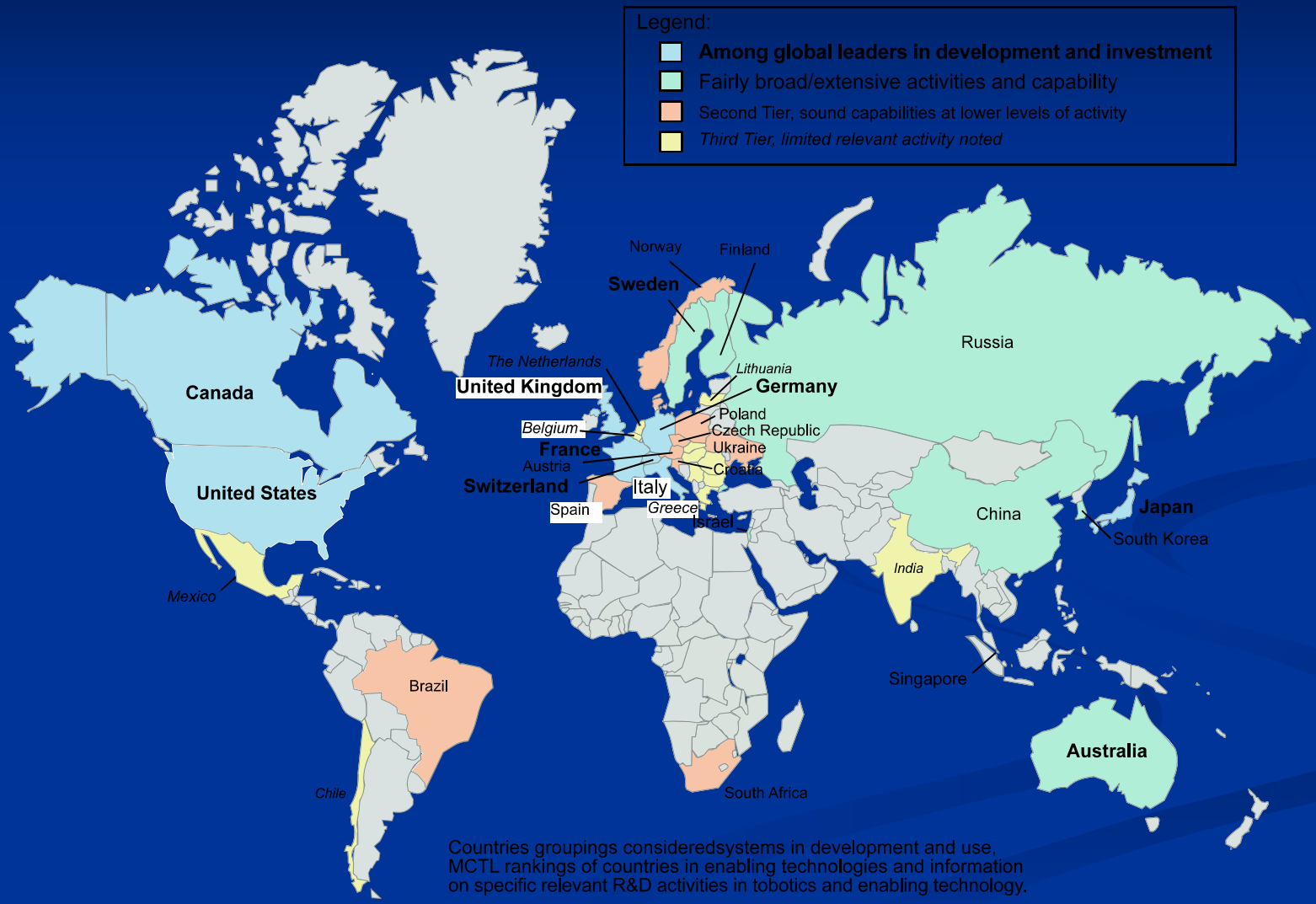
International Technology Assessment

- Provided an assessment of International R&D efforts in ground robotics
- Initial research: foreign systems, key subsystems, and enabling technologies well underway
- State-of-the-art in deployed systems appears to be substantially limited to remotely-controlled or tele-operated systems with limited autonomy
- Significant research being done within the US and abroad on increasing autonomous capabilities of ground robotics
- Distinct geographical differences in competencies and development foci as a function of research traditions, funding sources, and R&D performers

Key Elements of Ground Robotic Technology



Overview of Activity in Ground Robotics



Countries groupings consideredsystems in development and use, MCTL rankings of countries in enabling technologies and information on specific relevant R&D activities in tobotics and enabling technology.

UGV Robotic Industrial Base Assessment

- Determined short & long term ability of the U.S. industrial base to support the production of UGV systems to meet current and emerging DoD requirements
- Lack of competition for UGVs
  - Results in higher prices
- Limited environmental testing or high-rate production capability
- Majority of suppliers using COTS subsystems
- Barrier for smaller companies that traditionally have not performed DoD work in the past
- Most companies agree that JAUS will take UGV/Robotics to the next step

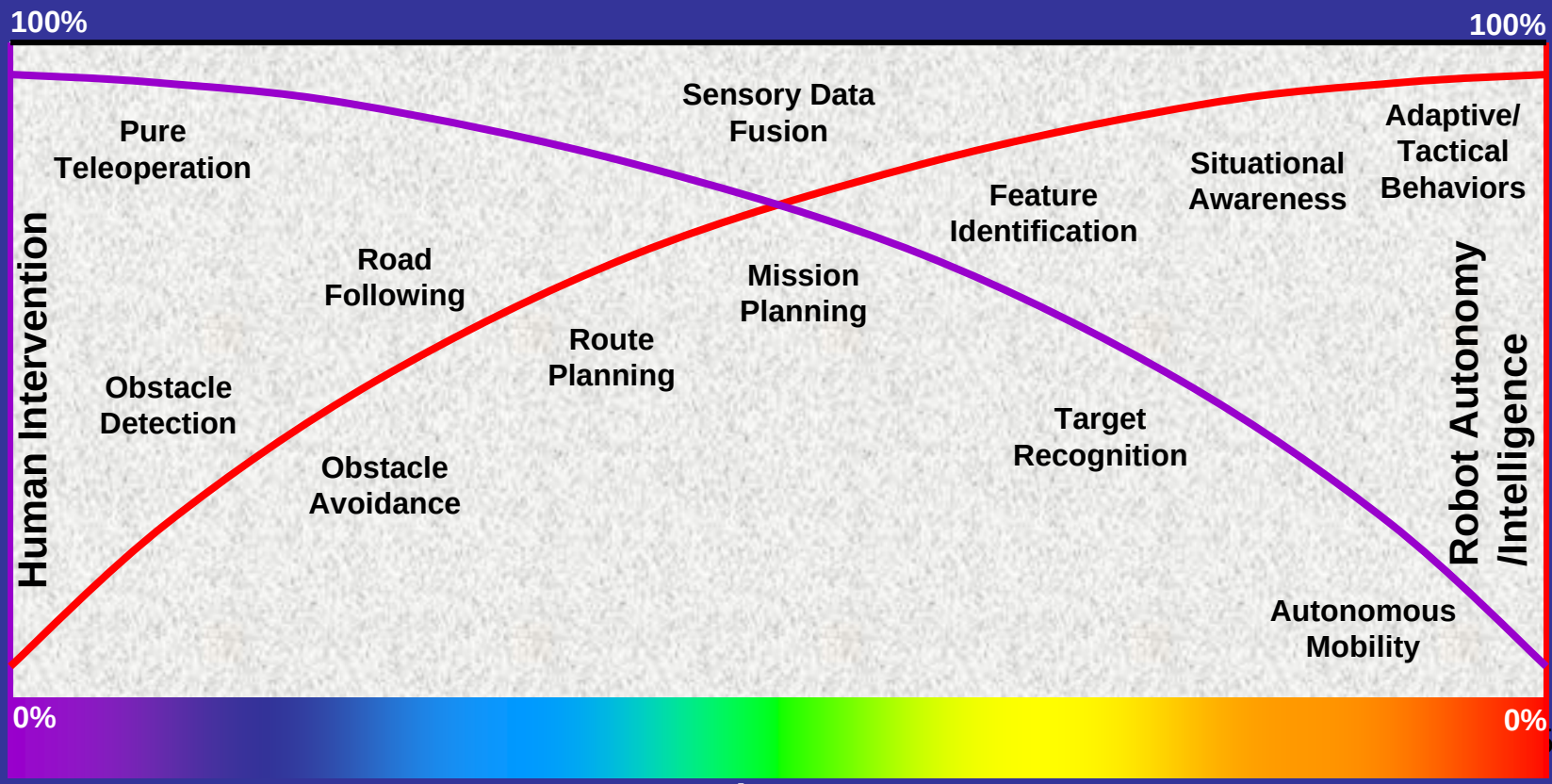
Spectrum Crowding Definition

- Provide a comprehensive review of the spectrum requirements and factors impacting the communications links of existing unmanned ground systems and those under development
- Joint Spectrum Center (JSC) of the Defense Spectrum Organization assisting to define potential UGS/V communications-electronics system problems with regard to spectrum availability, utilization and interference
  - Comprehensive review will provide spectrum requirements and factors impacting the communications links of existing and developing UGS/V with a view toward increasing the reliability and operational effectiveness of unmanned systems

Common Controller Assessment

- Study was to recommend characteristics and definition of a Universal Controller/Architecture (URC/A) considering current systems for robotic control, operational implications, future growth and needs, and technological paths forward
- Study assumed that a common controller is necessary
- All identified past and ongoing robot controller programs were reviewed and evaluated
- Characteristics and definition of a Universal Robot Controller/Architecture were drafted with reasoning and support

Robotic Evolution



Potential 2008-2009 Studies

- UxV System Reliability
- UxV Interoperability
- UxV Sensors / Payloads
- UxV Systems / Subsystems

UxV System Reliability

- Study the fielded support elements, e.g. spares, maintenance, training, to determine the impact and trade-off of designed-in reliability on the total cost of ownership and user reliance on robotic systems
- Evaluate current and ongoing UGV programs and gather lessons learned from UGVs and UAS programs used in OEF and OIF
  - Examine a non master-slave concept where control algorithms on the whole will promote all swarm or other like-functioning robots to accomplish their task
  - Understand how communication bandwidth effects rate of how fast systems will accomplish their tasks

UxV Interoperability

- Multi-Robot Control
- Near-Autonomous UxV Systems
- Enhanced Human/Robot Interaction and Teaming
- 3-D Map Visualization
- Intelligent Mobility
- Obstacle Avoidance
- Standards (e.g. JAUS, STANG 4586, et.al.)
- Data Links
- Cognitive Science Application to Operator Training and Performance

UxV Sensors / Payloads

- COTS Sensors Catalog
  - Performance, Reliability, Cost, Modularity, Technology Insertion/Refresh Ability, Open System Architecture Compatibility, Maturity, etc.
- Lethal and Non-Lethal Payloads and Controls
- Restrictions
  - ITAR
- Current and Possible Future Rules of Engagement Capabilities and Gaps

UxV System / Subsystem Applications

- Examine UxV Systems and Subsystems in development or fielded by NASA, DOE NSA, CIA, NIST for applicability to DoD missions
- Determine best process to collaborate on development of common use systems / subsystems for purposes of speed to the user, interoperability, reduced cost, common training (if possible)

What Inhibits the Growth and Utilization of Ground Robotics?

- Acquisition Policy
  - Joint Capabilities Integration Development System (JCIDS) defines the process to become a Program of Record (POR)
    - For Items like ground robotics, the JCIDS/5000 Process is long, restricts easy introduction/fielding of new concepts by its rigid budget and planning process

What Inhibits the Growth and Utilization of Ground Robotics?

- Non-Acquisition Approaches
  - Examples: JCTD, QRF, INP, TTI, FCT, etc.
  - These approaches are primarily for demonstration of technology
  - Do not include Life Cycle planning or logistics support
  - Limited funding
  - May require Cost Sharing
  - May require Technology Readiness Level (TRL) of 6-7 at entry and must achieve TRL of 8-9 within 2 years
  - Some are limited to less than $2M without a commitment of production from a POR, etc.
  - These programs can help but are not the answer

What Inhibits the Growth and Utilization of Ground Robotics?

- Short-Term Thinking
  - Procurements for OIF/OEF are short durations, heavily COTS-laden, and many lack Life Cycle Planning, Logistics Support, and Systems Engineering
  - These elements are necessary to gain the confidence of the Warfighter in the field or the Sponsor in the Pentagon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