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SEA 06 Acquisition and Commonality Directorate

Advanced Explosive Ordnance Disposal Robotic System (AEODRS)

NDIA Meeting

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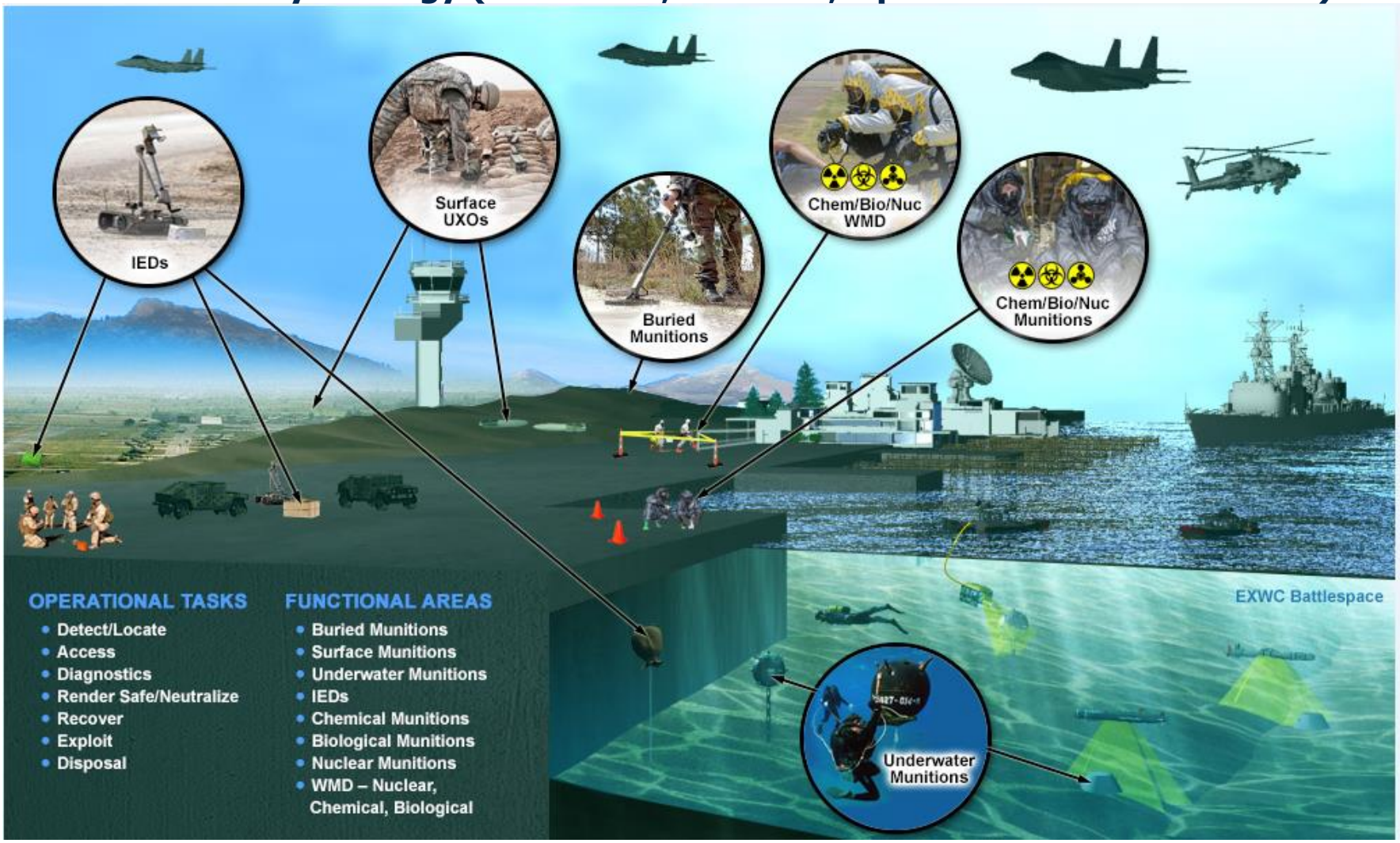
NAVSEA

Purpose

- Provide JEOD Robotic System Update
  - AEODRS Family of Systems (FoS)
  - Autonomy and EOD Robotics
  - Cybersecurity and Robotic systems
  - Industry Engagement
  - AEODRS Business Model

EOD Operational Mission

Eliminate explosive hazards which jeopardize operations in support of the national security strategy (Peacetime, Wartime, Operations Other Than War)



Advanced EOD Robotic Systems (AEODRS)

- Modular Open Architecture Integrated Family of Systems (FoS):
  - Government-controlled interfaces (Logical (JAUS/SAE AS-4 based), Electrical, Physical)
  - Minimizes proprietary considerations when adding future capabilities and promotes competitive environment
  - Allows module developers freedom to use proprietary internal designs (Black Box)

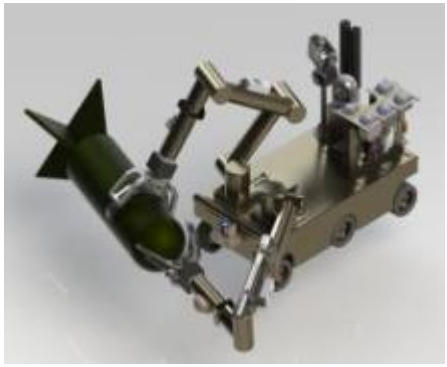
- Increment 1 (Field FY18): Remote Operations (small-sized variant):
  - Transported via backpack in remote locations (< 35 lbs)
  - Primary mission focus is on initial reconnaissance
  - Directly supports maneuver forces to incident (counter-IED dismounted patrols support)
  - Focus on development of a common architecture, autonomy, and modularity;

- Increment 2(Field FY20): Tactical Operations (medium-sized variant):
  - Transported in a response vehicle; 2-man portable (<165 lbs)
  - Primary mission focus is on in-depth reconnaissance and wide-range item prosecution.
  - Reduces warfighter downrange time for Recon, Assessment and Prosecution of IEDs and UXOs (to 1000m)
  - Replaces Man Transportable Robotic System (MK1 & MK2)

- Increment 3 (Field FY23): Base/Infrastructure Operations (largest variant):
  - Transported in a large EOD response vehicle (750 lbs)
  - Focus of this variant is on maximum load lift and the widest-range of EOD neutralization, render-safe, and other special capabilities as required.
  - Reduces warfighter downrange time for Recon, Assessment and Prosecution of IEDs and UXOs (to 1000m)
  - Provides heavy lift capability (300 lbs)
  - Replaces Remote Ordnance Neutralization System (RONS) MK 3 Program of Record

AEODRS Increment 1

AEODRS Increment 2

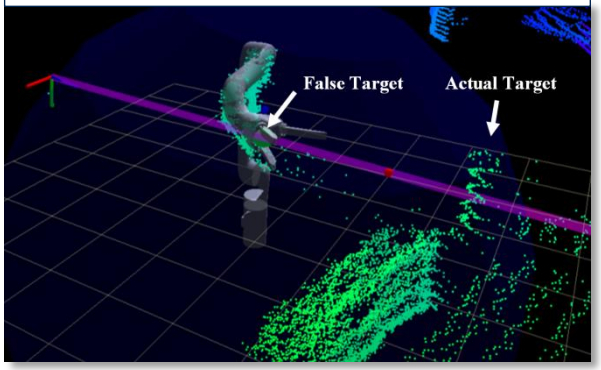


AEODRS Increment 3

Autonomy in EOD Robots

- Legacy Challenges
  - Access to proprietary interfaces
  - Limited control via legacy OCUs
  - Costly upgrades
- AEODRS Transition:
  - Risk reduction of critical technologies
  - Autonomous obstacle avoidance algorithms
  - Dual arm manipulation
  - Autonomous manipulation sensing hardware and algorithms
  - AEODRS logical architectural module to module messaging compliance
- AEODRS Autonomous Threshold (T) and Objective (O) Capabilities:
  - Autonomous mapping (World Modeling / Tele-presence - 2 Dimensional (T); 3 Dimensional (O)
  - Autonomous Navigation (GPS available environments (T) & GPS denied(O))
  - Autonomous obstacle detection (T) and avoidance (O)
  - Autonomous Manipulation Capabilities:
    - Fly-the-End Effector (T)
    - Autonomous Grasping (O)
    - Autonomous Tool Swapping (T)

Modular Point to Manipulate (NSWC IHEODTD)

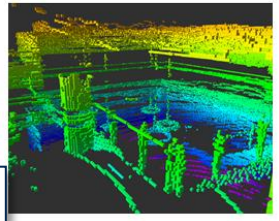


AEODRS Architecture Validation and Simulation (JHU-APL/Battelle)

Autonomous Navigation/ Obstacle Avoidance (Mitre)

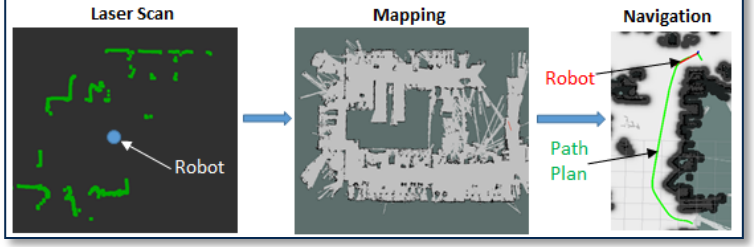
3D Mapping

In this effort, the ability to create a 3D map of the environment was implemented in addition to the 2D navigation system. This has been accomplished via the use of a 3D LiDAR which -- though currently out of scope of the current architecture requirements – increases situation awareness for the operator.



2D Mapping and Navigation

It was investigated how to increase situational awareness and reduce cognitive loading for an operator the system. This was accomplished by implementing an automated mapping and navigation system that is within the scope of the current architecture requirements.



Cybersecurity & Autonomy

Autonomy - what bad things can happen to robotics systems without cybersecurity?

- Corrupt signal - operator control unit and robotic system - disruption of mission (e.g. hijack vehicle, signal jamming; fake maps/terrain)
- Interception of classified traffic
- Insertion of malware - degrades robotic system performance and availability
- Mishandling or inducing autonomous manipulation to mishandle dangerous devices or EOD tools

Clash of Titans: Robot Makers vs. Robot Hackers

http://www.asianroboticsreview.com/home62.html

http://breakingdefense.com/2011/12/did-cyberattack-bring-down-the-beast-of-kandahar/

Challenges:

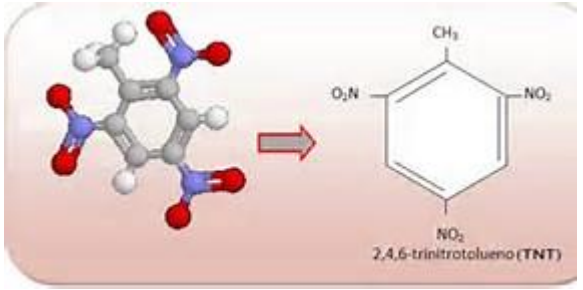
- Encrypted HOCU/UGV communications:
  - Adds latency
  - Affects video stability (screen artifacts)
  - Impacts operator reaction times
- Authenticate humans and robot availability on network
- Interoperability with other systems

DoD Cybersecurity = Prevention of damage to, protection of, and restoration of computers, electronic communications systems, electronic communications services, wire communication, and electronic communication, including information contained therein, to ensure its availability, integrity, authentication, confidentiality, and nonrepudiation. DoDI8500.01, 14 Mar 14

Confidentiality | Integrity | Availability | Non-Repudiation | Authentication

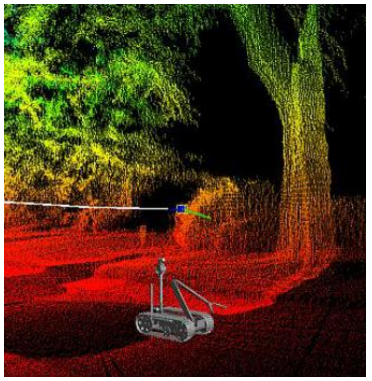
Where Industry Can Help?

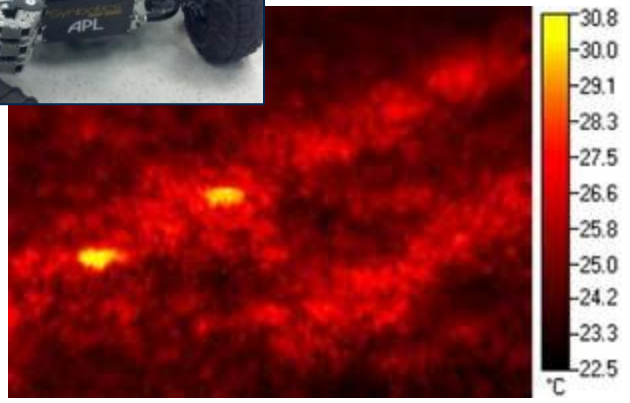
- Module Development - Demo Capability on AEODRS Research Platform & Test Bed
  - Qualify as a AEODRS Module Second Source
  - Technology Demonstrate New Capabilities for EOD forces (Appliances/ Accessories)



- New Autonomous Behaviors:
  - Feature-base Navigation
  - Operator Friendly Symmetrical Dual Manipulation Algorithms
  - Autonomous Chemical, Biological, Nuclear and Radiological Sensing and Localization

Highly Dexterous Manipulator (HDT / JHU-APL)





- Improved Sensors:
  - Buried Threat Detection (Neutron Generators)
  - Hazardous material interrogation
- Improved Communication in Difficult Environments:
  - Tunnels
  - War Torn Ruins and Rubble

Advanced EOD Robotic System

Business Model for Implementing Open Architecture

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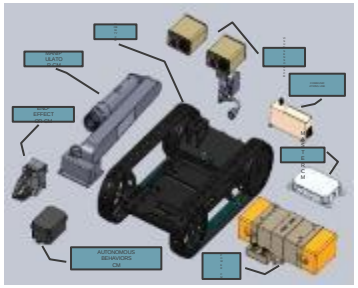
- **Government System Test Bed, Research Platform & MOCU Software Support Qualifying 2nd Sources & New Capabilities**

AEODRS Test Bed

- **Acquisition Strategy maximizes competition at module level**

- **Government-owned common system architecture & interfaces**



Modular/Plug and Play components to foster new and innovative ideas

- **AEODRS FOS Repair contract incentivizes & qualifies 2nd sources for modules**
- **Deliberate competition strategy to prevent vendor lock**
- **AEODRS Spare IDIQ contracts to nurture module competition**

INNOVATION ENABLERS

- **JSEOD ONR S&T**
- Small Business Innovation Research
- **Foreign Comparative Test**
- University and FFRDC Investment
- **Industry Research $ Development (IRAD)**

- **AEODRS FOS Improvement Investments to foster innovation & module competition**
- **Open Architecture Shortens Design Cycle to Fielding & Saves $**

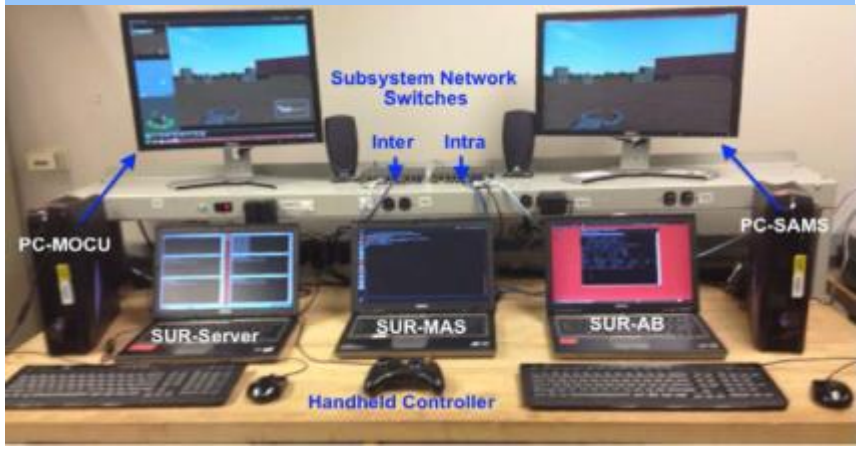
Avoid Vendor Lock & Lowers Total Ownership Cost Via Module Competition and Innovation

Accessing AEODRS Johns Hopkins Applied Physics Laboratory Test Bed

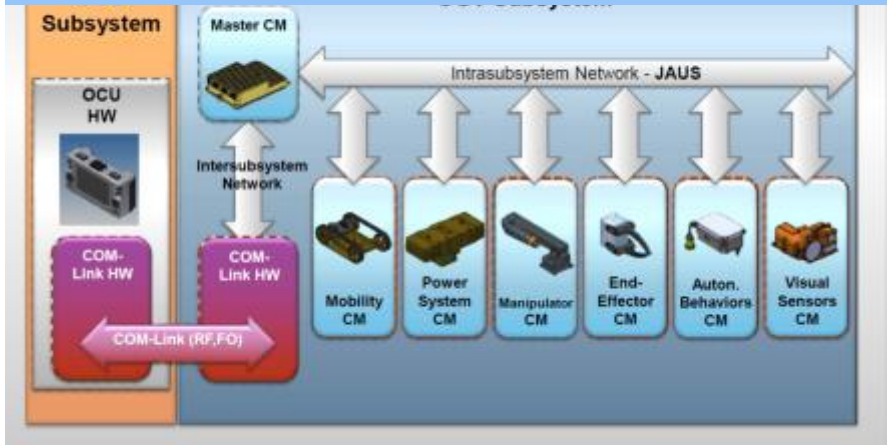
- Verifies AEODRS logical architectural module to module messaging compliance
- Email a request for access to AEODRS-STB-Support@jhuapl.edu
- Include…
  - First and last name, Company
  - Preferred email notification address
  - Telephone number
- JHU provides:
  - Username and Password via Phone
  - Site addresses and special access for CM-AB via email

Research Platform

AEODRS System Test Bed



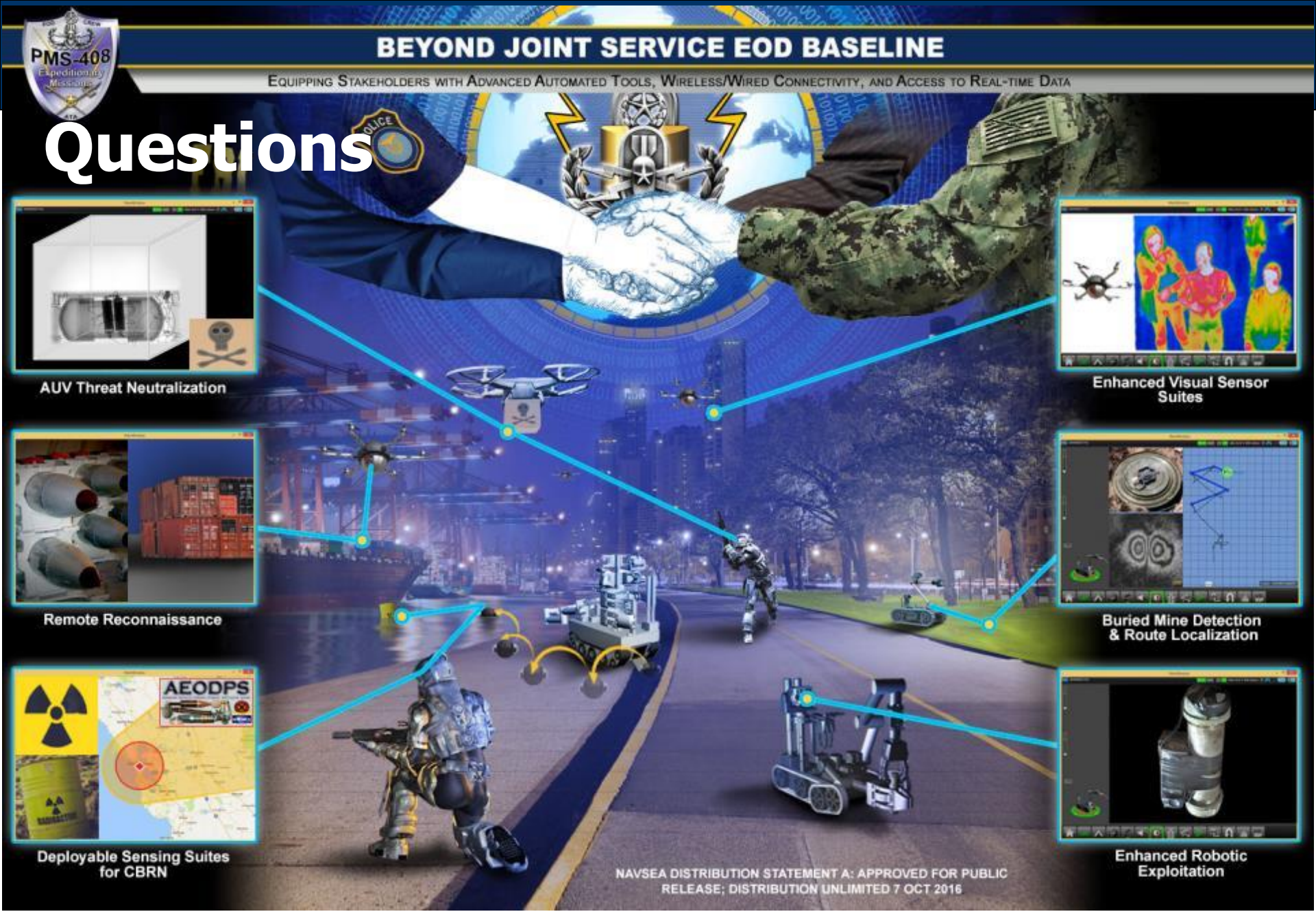
Virtual AEODRS System



Summary

- AEODRS is the next generation EOD Robotic System
- Autonomy opens up opportunity and new CONOPs
- Cybersecurity in DoD is a reality - Cyber Attacks real
- Demonstrated Capability – Lowers Risk (Test Bed)
  - Technology Improvement at Module Level
  - Industry making a better mouse trap
- Beyond AEODRS Baseline – What Missions Sets can expand capabilities

Questions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Expeditionary Missions
BEYOND JOINT SERVICE EOD BASELINE
EQUIPPING STAKEHOLDERS WITH ADVANCED AUTOMATED TOOLS, WIRELESS/WIRED CONNECTIVITY, AND ACCESS TO REAL-TIME DATA
AUV Threat Neutralization
Enhanced Visual Sensor Suites
Remote Reconnaissance
Buried Mine Detection & Route Localization
AEODPS
Deployable Sensing Suites for CBRN
Enhanced Robotic Exploitation
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