



Prototyping and Experimentation: Accelerating the Adoption of Transformative Capabilities

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Emerging Capability & Prototyping (EC&P)**



Why Greater Emphasis on Prototyping and Experimentation?



Constrained Budgets—we cannot afford to procure unique or exquisite systems for every potential threat:



Advanced design and manufacturing tools enable faster and more affordable prototype development



Department's commitment to Modular Open Systems Architecture (MOSA) and standard interfaces encourage traditional and non-traditional sources of supply to offer subsystem options

Prototyping advances technology frontiers...



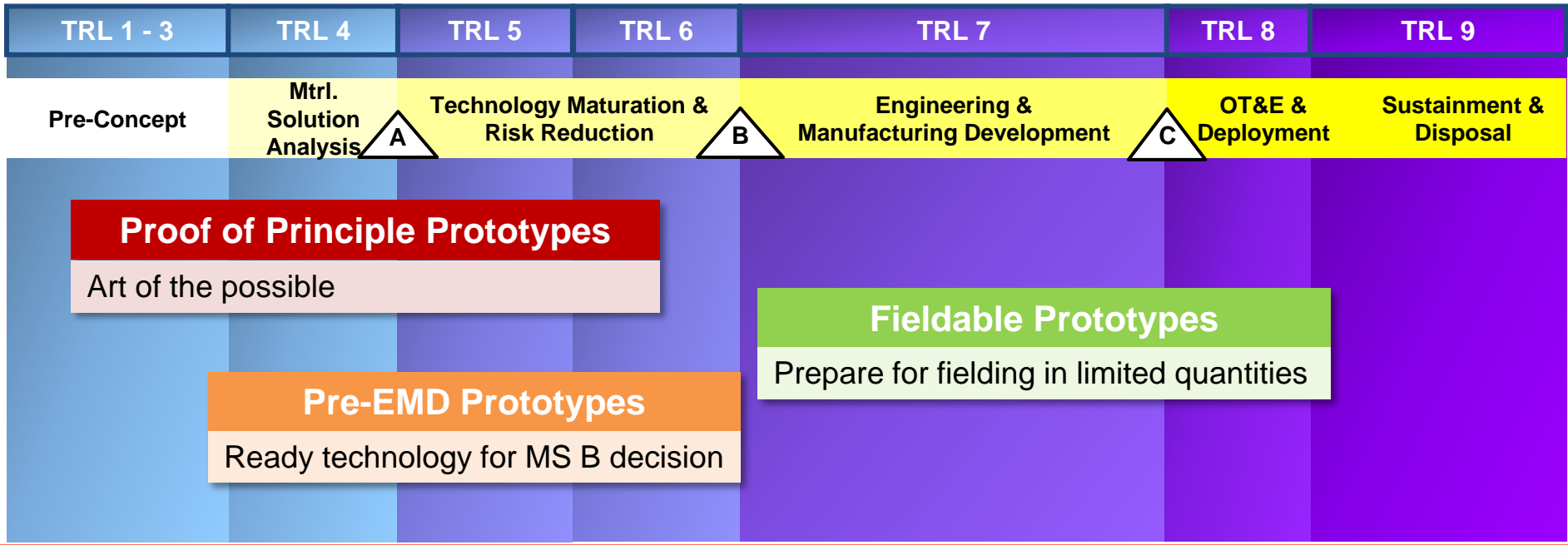
DoD Prototyping

What do we mean by Prototyping?

“A set of design and development activities intended to reduce technical uncertainty and to generate information to improve the quality of subsequent decisionmaking.”

– *On Prototyping*, RAND Corporation, 2009

Prototyping Categories





Roles of Prototyping

Technology

- Clear a specific technical hurdle
- Explore art of the possible
- Inform requirements process
- Aid technology integration

Production

- Offer rapid response to emerging capability shortfalls
- Improve development methods and manufacturing

Affordability

- Inform and validate cost estimates
- Leverage the investment of non-traditional and international performers

Supporting Policies

- Demonstrate open standards
- Promote competition throughout the product lifecycle
- Stimulate industrial base to advance the state of the practice



DoD Experimentation



What do we mean by Experimentation?

The process of exploring innovative methods of operation, especially to assess their feasibility, evaluate their utility, or determine their limits.

– *Defining Military Experiments*, IDA, 1999

Experimentation Objectives

An experiment is a test or trial done for the purpose of discovering something unknown or validating a theoretical principle.

Discovery Experiments

Identify potential benefits, generate hypotheses

Hypothesis Testing Experiments

Prove specific “if...then” statements to be correct or incorrect

Demonstration Experiments

Recreate known truth

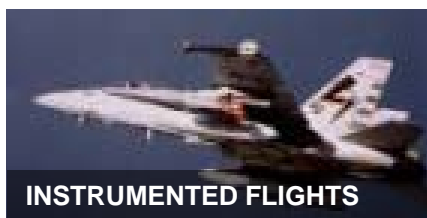
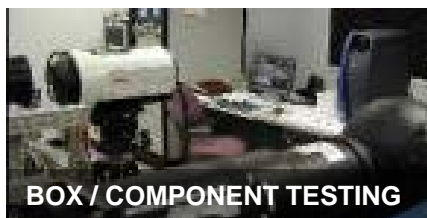


Experimentation

Leverage existing exercises, facilities, and events to achieve an operational advantage

Exemplars – Exercises, Facilities and Events

- Expeditionary Warrior Experiment (Army)
- Adaptive Red Teaming (Army)
- Capabilities-Based Test and Evaluation Environment (Navy)
- Synthetic Prototyping (Army) and Digital Thread (Air Force)
- Agile Capability Development Framework (Air Force)
- Stiletto (OSD), Thunderstorm (OSD)
- Exercises—Trident Warrior, Terminal Fury, Austere Challenge





Focus Areas for 2015-2017



Asymmetric Force Application

Asymmetric force application is the use of nontraditional technologies, tactics, and weapons to provide a clear military advantage to our forces during maneuver and engagement operations.

Space Capability Resilience

Space capability resilience responds to a sophisticated adversary's attempts to deny us access to our space-based capabilities and responds to adverse space conditions that degrade our space-based capabilities. A resilient response includes taking proactive and reactive defensive measures (avoidance), designing systems with enhanced survival features (robustness), conducting operations to replenish lost or diminished capacity (reconstitution), and helping reestablish space capability and capacity (recovery).

Electromagnetic Spectrum Agility

The increasingly wireless nature of the global economy, coupled with advances in analog-to-digital conversion, cognitive radios, smart antennas, and increased transmitter-receiver diversity, present opportunities to develop new capabilities that sustain and extend our military advantage in the EMS domain. These new capabilities will also mitigate the impact of new challenges, including an increasingly cluttered operational EMS environment.

Autonomous Systems

Autonomous systems are a "capability (or a set of capabilities) that enables a particular action of a system to be automatic or, within programmed boundaries, self-governing". Autonomous systems can improve our capability without increasing capacity by better coordinating and synchronizing current sensors and weapon systems and by maximizing the efficiency of both.

Information Operations and Analytics

Exploit commercial technology advancements in information collection and management to provide the Joint Force enhanced communications and Situational Awareness within their Area of Responsibility to disrupt and delay adversary forces from offensive operations, counter their ability to use deceptive messaging to influence U.S. / Coalition operations and develop capabilities to counter adversary cyber and C2 communications.



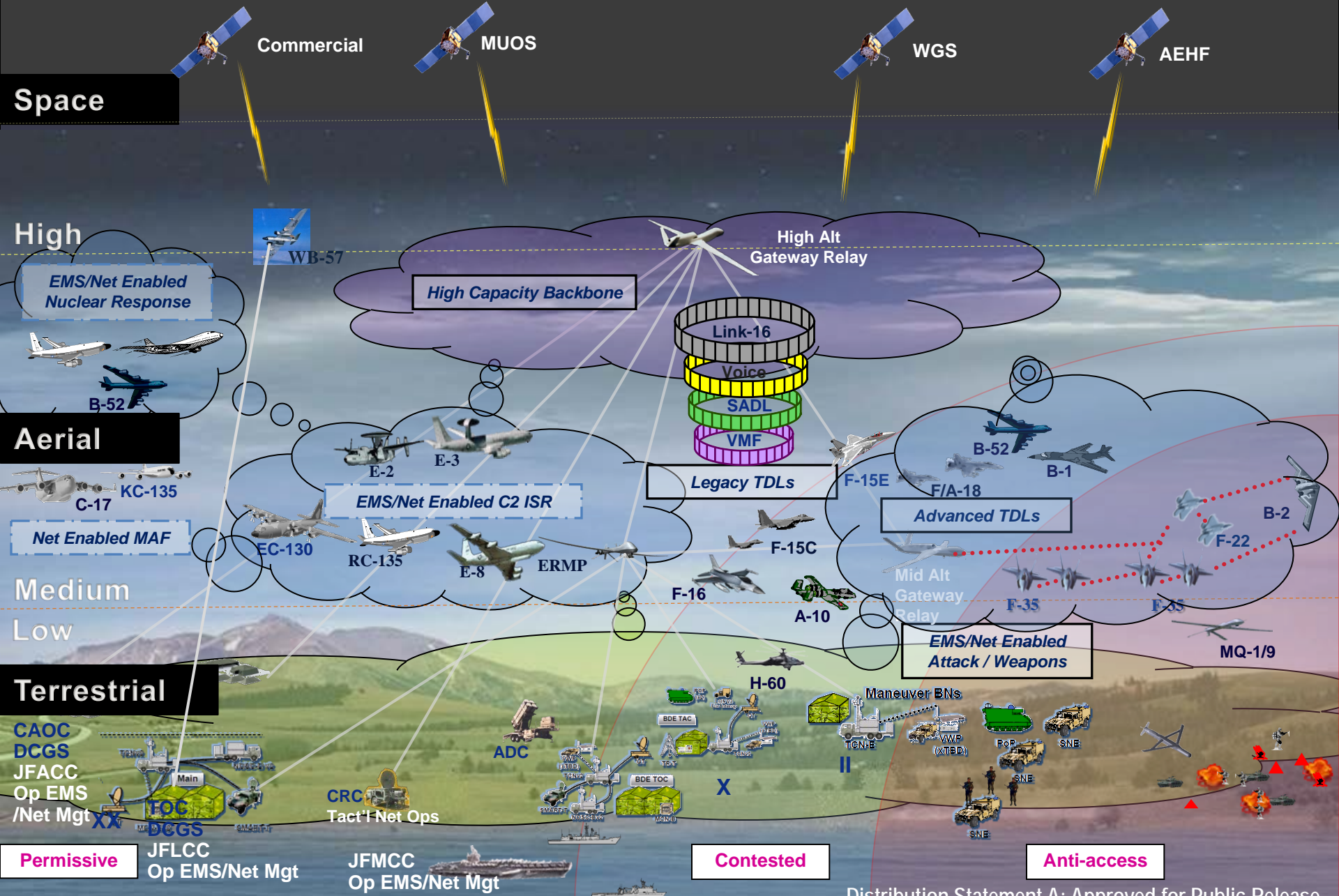
EC&P Project Focus Area



Electromagnetic Spectrum Agility: Capabilities that allow Department of Defense (DoD) forces to operate with freedom of maneuver in the electro-magnetic spectrum (EMS). Operations include:

- Gaining and attaining access to spectrum for friendly forces, denying and/or degrading spectrum to our adversaries
- Conducting EM deception operations to degrade an adversary's understanding of our intent and capability
- Otherwise preventing the adversary from leveraging the EM domain to conduct operations in other domains (i.e., air, space, maritime, land and cyber)
- New effects in the EMS domain to include directed energy and radio frequency disruption

Resilience and Situational Awareness in Congested, Contested EMS Environment





Increasingly Complex Spectrum Operating Environment

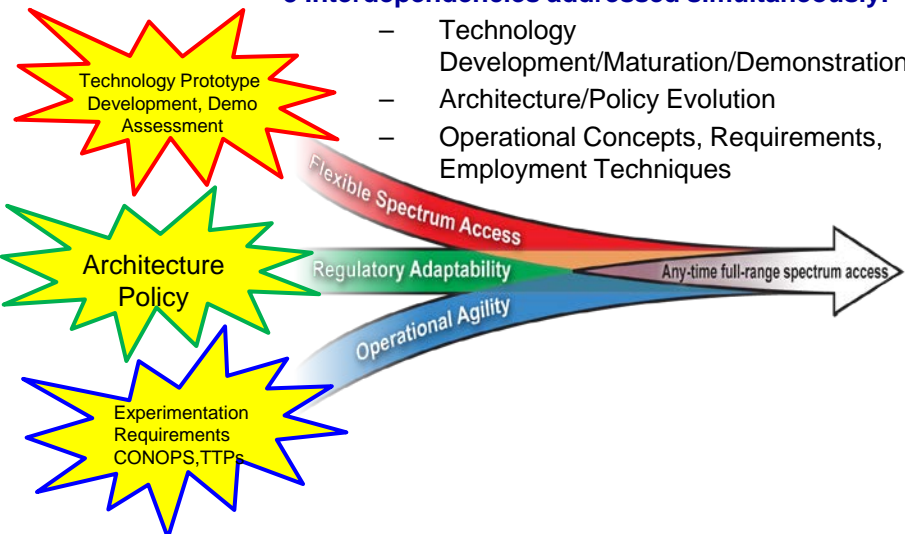


- **Electronic Warfare threats have become more complex, cheap, commercial, agile, flexible and operate across wide bands of spectrum including in non-Federal bands**
- **Increasing DoD bandwidth needs for capabilities such as higher resolution radar, streaming video/persistent ISR, agile datalinks and radios, etc.**
- **Ever increasing complexity of spectrum sharing environment**
- **Sharing with non-traditional partners (e.g., airborne systems sharing with fixed and mobile commercial systems, satellite and radar sharing with commercial broadband systems)**
- **Must maintain the ability to test, train, exercise, and operate domestically and globally**
 - Based on technology, M&S/engineering analysis, testing, coordination



Spectrum Access R&D Program

3 Interdependencies addressed simultaneously:



- Technology Development/Maturation/Demonstration
- Architecture/Policy Evolution
- Operational Concepts, Requirements, Employment Techniques

The **Spectrum Access R&D Program (SAR&DP)** was initiated via *partnership between ASD(R&E), DoD CIO and Joint Staff J6* to develop and implement innovative spectrum technologies:

- Mitigate risks associated with the third Advanced Wireless Services (AWS-3) repurposing of DoD spectrum to commercial use and associated transition
- Enhance Operational Capability to maintain resilience in the EMS environment



national spectrum consortium

DoD Engagement with Spectrum Marketplace:

- **\$1.25B Other Transaction Agreement (OTA)** to conduct R&D, prototyping & experimentation in support of Spectrum Access
- NSC Supported Technical Concept Submission and Assessment to inform Investment Portfolio
- Technology Development Projects tasks within OTA competed among members:
 - Request for Initiative Proposals & FEDBIZOPS Announcements
 - Competing Proposals evaluated similar to FAR process
 - Tasks awarded & negotiated based on evaluation results

- Over 180 Organizational Members
- Membership includes Major Defense firms, small businesses, academia, major commercial firms (e.g., AT&T, Nokia, Disney/ABC TV Group)
- Administrative Agent to assist with conducting business with DoD



SAR&DP Operational Impacts



The Spectrum Access R&D Program (SAR&DP) was established to provide technology enablers to strategically “maneuver” in the spectrum and ensure access by DoD systems that transmit and receive:

Globally—

- **Improve spectrum situational awareness and command and control (C2) at operational tempo**
- **Improve spectrum management at operational tempo**
- **Provide interference mitigation to address future spectrum congestion**
- **Provide interference mitigation to address adversary access to advanced technology to contest our ability to access spectrum**
- **Support increasing military, federal, commercial, and machine-to-machine bandwidth demand**

Domestically—

- **Ability to “train as DoD needs to fight”**
- **Ability to test and evaluate future systems**
- **Implement relocation, compression, and/or sharing arrangements at platform level**



Summary

EC&P Program Priorities

- Better Buying Power 3.0
- Defense Innovation Initiative
- NDAA FY16 and FY17

Focus Areas

- Asymmetric Force Application
- Space Capability Resilience
- Autonomous Systems
- Information Operations & Analytics
- Electromagnetic Spectrum Agility

Emphasis on Prototyping & Experimentation

Constrained Budgets



Advanced Design & Manufacturing Tools



DoD Commitment to MOSA



Accelerating the adoption of transformative capabilities.



Backup Charts



Emerging Capabilities Technology Development (ECTD)



Proof of Principle Prototypes

Discovery Experiments

Infrared Motion Detection (IrMD) Using Existing EO/IR Assets



RWS Auto Prioritization, Targeting, and Operator Cueing (RAPTOR)

Spectral Management



Emerging Capabilities Technology Development (ECTD)

- Pursue risk-reducing technology prototypes and demonstrations of cutting edge land, sea, air and space systems for joint and Service users
- Proof-of-Principle prototypes; < 36 months, < \$6M
- POC: Mr. Jon Lazar -- jon.e.lazar.civ@mail.mil

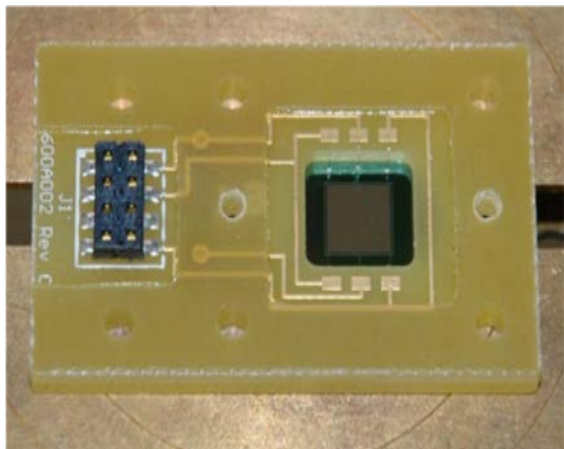


Quick Reaction Special Projects (QRSP)



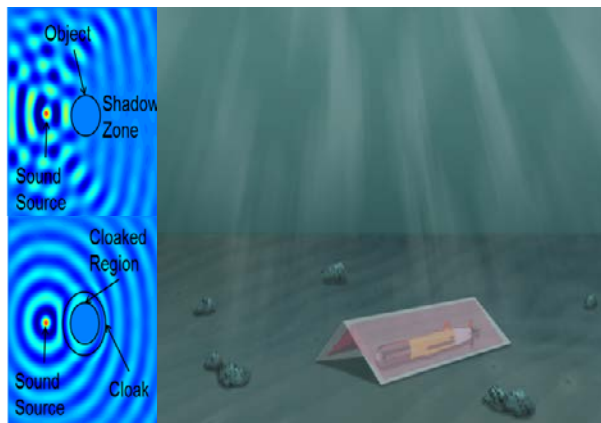
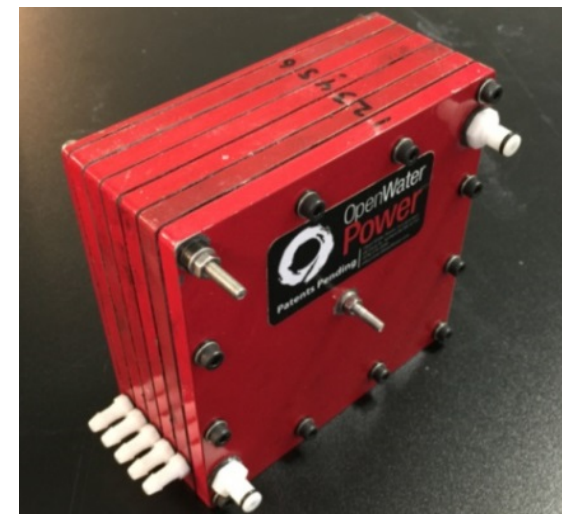
Pre-EMD Prototypes

Solid State Neutron Detector (SSND)



Demonstration Experiments

Aluminum-Seawater Fuel Cell



Acoustic Cloaking for Minimizing Target Detection

Quick Reaction Special Projects (QRSP)

- Mature emerging technologies for operational use.
- QRF – Conventional warfare needs focusing on A2/AD (ex: IWAS); < 12 months, < \$3M
- RRF – Irregular warfare needs with global focus (ex: ANDE); < 18 months, < \$1.5M
- POC: Mr. Jon Lazar -- jon.e.lazar.civ@mail.mil



Joint Capability Technology Demonstration (JCTD)



Pre-EMD Prototypes

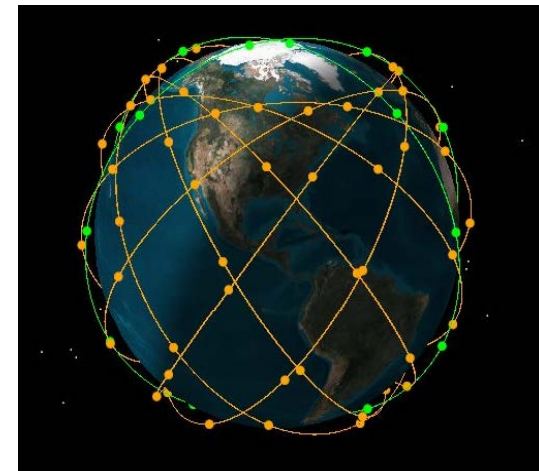
Hypothesis Testing Experiments

Autonomous Mobility Applique System (AMAS)



High Speed Container Delivery System (HSCDS)

Kestrel Eye



Joint Capability Technology Demonstration (JCTD)

- Foster innovation, contribute to accelerated acquisition and weapon system affordability while providing the Joint Forces with a decisive technical advantage
- Pre-EMD and Fieldable Prototypes / Demonstrations; < 48 months, < \$100M
- POC: Mr. Elmer Roman – elmer.l.roman.civ@mail.mil



Foreign Comparative Test (FCT)



Pre-EMD Prototypes

Pilot Physiological Monitoring and Warning System

Pilot Oxisensor



Demonstration Experiments

Soldier-Sniper Weapon Observation Reconnaissance Device



Soldier Power with Inductive Recharge and Intelligent Textiles

Foreign Comparative Test (FCT)

- Evaluate foreign prototype technology to adapt / transition for DoD use
- Pre-EMD prototype and non-development item demonstrations; < 24 months, < \$2.5M
- POC: Col (S) Sean Bradley – sean.a.bradley.mil@mail.mil



Rapid Innovation Fund (RIF)

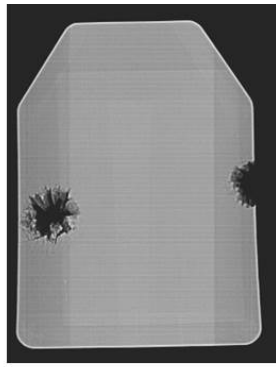


Fieldable Prototypes

Encapsulated Body Armor



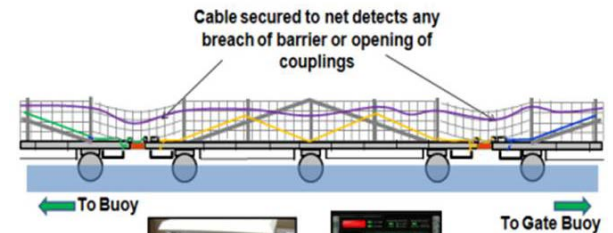
w/o Encapsulation



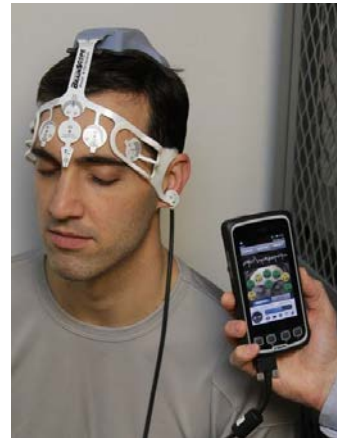
with Encapsulation

Demonstration Experiments

Port Security Barriers Intrusion Detection System (PIDS)



Alarm Panel & Display



Miniature Deployable System for Rapid TBI Screening

Rapid Innovation Fund (RIF)

- Accelerate the fielding of innovative technologies into military systems pursuant to Small Business Innovative Research projects, technologies developed by the DoD labs, and other innovative technologies
- Award preference to small businesses: < 24 months, < \$3M
- POC: Mr. Thomas (Dan) Cundiff – thomas.d.cundiff.civ@mail.mil