19TH ANNUAL SCIENCE & ENGINEERING TECHNOLOGY CONFERENCE

COLLABORATING TO MAINTAIN OUR EDGE

March 20 – 22, 2018

AT&T Hotel and Conference Center

Austin, TX

NDIA.org/SET2018

WELCOME TO THE 19TH ANNUAL SCIENCE & ENGINEERING TECHNOLOGY CONFERENCE

"DoD Research, Engineering, Science, and Technology: Defense Agencies, Services, and COCOMs collaborating to maintain our edge."

For more than 40 years, the United States and its allies could count on a decisive technological advantage through DoD Science and Technology and defense industrial base independent research and development investments. We now live in a world where there is global access to technology and scientific talent. Our competitors are investing in technologies and developing capabilities that are directly designed to counter U.S. warfighting advantages. We can no longer ignore these challenges to our technological superiority.

Our adversaries have watched the way we fought in Iraq and Afghanistan. They have seen our newest equipment, watched our tactics and procedures, and observed our latest concepts of operation. They are using this knowledge to develop counters to our asymmetric advantages.

Sustaining U.S. technological superiority depends on our ability to out-innovate our adversaries, but it is also important to remember that innovation is more than just the development of leading-edge technology. It is about finding the right combination of technologies and operational and organizational constructs to achieve a decisive military advantage. Inserting and integrating new technologies into prototypes and experiments can demonstrate the new capabilities and, at the same time, help define realistic operational requirements and reduce program risk. Using this approach will enable the rapid transition and fielding of new technologies and capabilities, eliminating the "Valley of Death."

The source of new technologies may be the DoD Science and Technology program, the commercial sector, the defense industrial base independent research and development program, or SBIR/STTR investments. When coupled with the commercial best practices of combining modeling and simulation, test and evaluation, and systems engineering to develop and assess several real and virtual prototypes, there is a good chance to reduce costs and acquisition program risk.

This year's conference is structured to allow for maximum government and industry interaction opportunities. There are specific tracks for deep-dive sessions with selected communities of interest. There will be classified combatant command science and technology presentations, and presentations by representatives from the DoD Science and Technology Communities of Interest, which will provide updates on the technology roadmaps.

James Chew
Chair, NDIA Science & Engineering Technology Division
Group Director, National Security Systems, Cadence

SCHEDULE AT A GLANCE

TUESDAY, MARCH 20

General Session
Amphitheater 204
8:00 am – 5:10 pm

Networking Reception
Courtyard
5:15 – 6:15 pm

WEDNESDAY, MARCH 21

General Session
Amphitheater 204
8:00 am – 5:00 pm

Concurrent Session
Classroom 202
9:00 am – 5:00 pm

THURSDAY, MARCH 22

Classified Session
Applied Research Laboratories – UT Austin
8:00 am – 12:15 pm

TABLE OF CONTENTS

WHO WE ARE

The National Defense Industrial Association is the trusted leader in defense and national security associations. As a 501(c)(3) corporate and individual membership association, NDIA engages thoughtful and innovative leaders to exchange ideas, information, and capabilities that lead to the development of the best policies, practices, products, and technologies to ensure the safety and security of our nation. NDIA's membership embodies the full spectrum of corporate, government, academic, and individual stakeholders who form a vigorous, responsive, and collaborative community in support of defense and national security. For more information, visit **NDIA.org**

LEADERSHIP

James Chew
Division Chair

SCIENCE & ENGINEERING TECHNOLOGY DIVISION

WHO WE ARE

The Science & Engineering Technology (S&ET) Division was formed to examine all aspects of science and technology affecting national defense. The division provides a venue for discussion of the nation's defense needs by examining existing capabilities and suggesting ways to overcome deficiencies in defense research and development (R&D). Individuals from industry, government, and academia have the opportunity to examine vital information in an open forum on technical needs and planned efforts. The division is dedicated to raising interest in meeting Department of Defense technology requirements through creative research and advanced development across industry, government, and academia.

EVENT INFORMATION

EVENT WEBSITE

NDIA.org/set2018

EVENT CONTACT

Elizabeth Richards, CMP
Meeting Manager
(703) 247-2588
erichards@ndia.org

PLANNING COMMITTEE

James Chew
Event Chair

Robert Baker
Session Chair

Mark Stephen
Session Chair

Dr. Michelle Atchison
Session Chair

Roger Garay
Session Chair

EVENT THEME

DoD Research, Engineering, Science, and Technology: Defense Agencies, Services, and COCOMs collaborating to maintain our edge.

SURVEY AND PARTICIPANT LIST

A survey and list of attendees (name and organization only) will be e-mailed to you after the symposium. NDIA would appreciate your time in completing the survey to help make our event even more successful in the future.

SPEAKER GIFTS

In lieu of speaker gifts, a donation is being made to the Fisher House Foundation.

HARASSMENT STATEMENT

NDIA is committed to providing a professional environment free from physical, psychological and verbal harassment. NDIA will not tolerate harassment of any kind, including but not limited to harassment based on ethnicity, religion, disability, physical appearance, gender, or sexual orientation. This policy applies to all participants and attendees at NDIA conferences, meetings and events. Harassment includes offensive gestures and verbal comments, deliberate intimidation, stalking, following, inappropriate photography and recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome attention. Participants requested to cease harassing behavior are expected to comply immediately, and failure will serve as grounds for revoking access to the NDIA event.

AGENDA

TUESDAY, MARCH 20

7:00 am – 5:10 pm	**REGISTRATION** AMPHITHEATER PRE-FUNCTION AREA
7:00 – 8:00 am	**CONTINENTAL BREAKFAST** AMPHITHEATER PRE-FUNCTION AREA
8:00 – 8:15 am	**WELCOME REMARKS** AMPHITHEATER 204 **James Chew** Chair, NDIA Science & Engineering Technology Division Group Director, National Security Systems, Cadence
8:15 – 9:30 am	**KEYNOTE ADDRESS** AMPHITHEATER 204 **Mary Miller** Performing the Duties of the Assistant Secretary of Defense for Research and Engineering
SESSION ONE:	**OPPORTUNITIES FOR COLLABORATION** AMPHITHEATER 204 **Robert Baker** Session Chair Deputy Director, Plans & Programs, OASD(R&E)
9:30 – 10:00 am	**Prototyping – A Path to Agility, Innovation, and Affordability** **Dr. Charles Perkins** Acting Deputy Assistant Secretary of Defense, Emerging Capability & Prototyping
10:00 – 10:30 am	**NETWORKING BREAK – DISPLAYS AND COMMUNITY OF INTEREST (COI) POSTERS OPEN** PATIO
10:30 – 11:00 am	**The DoD Test & Evaluation/Science & Technology Program** **George Rumford** Test & Evaluation/Science & Technology Program Manager, Defense Test Resource Management Center
11:00 am – 12:00 pm	**The DARPA Science & Technology Program** **Dick Urban** Special Assistant to the Director, Defense Advanced Research Projects Agency (DARPA)

12:00 – 1:00 pm	**NETWORKING LUNCH** TEJAS DINING ROOM
1:00 – 1:40 pm	**The DTRA Science & Technology Program** **Dr. Rhys Williams** Director, Research & Development, J9, Defense Threat Reduction Agency (DTRA)
SESSION TWO:	**SERVICE SCIENCE & TECHNOLOGY PROGRAMS** AMPHITHEATER 204 **Mark Stephen** Session Chair Strategic Technology Development, Lockheed Martin Missiles & Fire Control
1:40 – 2:40 pm	**The Army Science & Technology Program** **Jeffrey Singleton** Director of Technology, Assistant Secretary of the Army (ALT)
2:40 – 3:10 pm	**NETWORKING BREAK – DISPLAYS AND COI POSTERS OPEN** PATIO
3:10 – 4:10 pm	**The Naval Science & Technology Program** **Dr. David Walker** Director of Technology, Office of Naval Research
4:10 – 5:10 pm	**The Air Force Science & Technology Program** **Jeffrey Stanley** Deputy Assistant Secretary of the Air Force (Science, Technology, and Engineering)
5:10 pm	**ADJOURN FOR THE DAY**
5:15 – 6:15 pm	**NETWORKING RECEPTION (HOSTED BEER AND WINE)** COURTYARD

WEDNESDAY, MARCH 21

7:00 am – 5:00 pm

REGISTRATION
AMPHITHEATER PRE-FUNCTION AREA

7:00 – 8:00 am

CONTINENTAL BREAKFAST
AMPHITHEATER PRE-FUNCTION AREA

8:00 – 8:10 am

OPENING REMARKS
AMPHITHEATER 204

James Chew
Chair, NDIA Science & Engineering Technology Division
Group Director, National Security Systems, Cadence

8:10 – 8:40 am

MICROELECTRONICS PANEL
AMPHITHEATER 204

Dan Marrujo
Moderator
Chief Strategy Officer, Defense MicroElectronics Activity

John Behnke
Former CEO, Novati

Robyn Benevides
Director, Micron

Vern Boyle
Vice President, Advanced Technology, Northrop Grumman Mission Systems

Jeff Eggers
Mission Assurance Executive, National Reconnaissance Office

SESSION THREE: COMMUNITIES OF INTEREST (COI)
AMPHITHEATER 204

Dr. Michelle Atchison
Session Chair
Associate Vice Chancellor Federal Relations, University of Texas System

8:40 – 9:00 am

The Role of the Communities of Interest

Dale Ormond
Principal Director, Research, Office of the Assistant Secretary of Defense

9:00 – 9:20 am

Biomedical (ASBREM) CoI Presentation

RDML Mary Riggs, USN
Director, Research and Development, Defense Health Agency

9:20 – 9:40 am

Advanced Electronics CoI Presentation

Dr. Romeo del Rosario
Associate Director (A) Sensors & Electron Devices Directorate, U.S. Army Research Laboratory

9:40 – 10:00 am

Space CoI Overview Presentation

Dr. Jaime Stearns
Deputy Capability Lead for Space Superiority, Air Force Research Laboratory

10:00 – 10:30 am

NETWORKING BREAK – DISPLAYS AND COI POSTERS OPEN

PATIO

10:30 – 10:50 am

Materials & Manufacturing Processes CoI Presentation

Dr. John Beatty
Materials and Structures Staff Specialist, USD-R&E Weapons Systems

10:50 – 11:10 am

Air Platforms CoI Presentation

Dr. Bill Lewis
Director for Aviation Development, U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC)

11:10 – 11:30 am

Weapons Technologies CoI Presentation

Dr. David Lambert
Chief Scientist, AFRL/RW Munitions Directorate, Air Force Research Laboratory

11:30 – 11:50 am

Ground & Sea Platforms CoI Presentation

Dr. John Pazik
Head, Expeditionary Maneuver Warfare and Combating Terrorism, Science and Technology Department, Office of Naval Research

11:50 am – 1:00 pm

NETWORKING BUFFET LUNCH

TEJAS DINING ROOM

1:00 – 1:20 pm

Autonomy CoI Presentation

Kris Kearns
Senior Advisor for Autonomy S&T, 711th Human Performance Wing/Human Performance Directorate

1:20 – 1:40 pm

Command & Control, Communications, Computers, and Intelligence CoI Presentation

Dr. Stephen Russell
Director, Science and Technology/Chief Technology Officer, SPAWAR

1:40 – 2:00 pm

Cyber CoI Presentation

Dr. Bharat Doshi
Senior Research Scientist, Cyber Security, U.S. Army CERDEC

2:00 – 2:20 pm	**Electronic Warfare CoI Presentation** **Dr. Jeffrey Boksiner** Senior Research Scientist for Electronic Warfare Technology, Intelligence & Information Warfare Directorate, U.S. Army CERDEC
2:20 – 2:40 pm	**Energy and Power Technology CoI Presentation** **Dr. Dave Drazen** Staff Specialist, Energy and Power Technology, OUSD-R&E/Research
2:40 – 3:10 pm	**NETWORKING BREAK – DISPLAYS AND COI POSTERS OPEN** PATIO
3:10 – 3:30 pm	**Human Systems CoI Presentation** **Dr. Kevin Geiss** Director, Airman Systems Directorate, 711th Human Performance Wing, Air Force Research Laboratory
3:30 – 3:50 pm	**Sensors CoI Presentation** **Dr. James Campbell** Deputy Director, Science and Technologies Division, Night Vision & Electronic Sensors Directorate, U.S. Army CERDEC
3:50 – 4:10 pm	**DoD R&E Journal** **Roger Garay** Enterprise Portfolio Analyst, Defense Technical Information Center
4:10 – 5:00 pm	**INDUSTRY INPUT TO AIR FORCE IP STRATEGY PANEL** **Mark Stephen** Moderator Strategic Technology Development, Lockheed Martin Missiles & Fire Control **Mark Borowski** General Counsel, United States Air Force **Joseph Gordon** Division Chief, United States Air Force S&T Management Division **Kelly Hennig** Manager of Strategic Planning, Northrop Grumman Corporation **Dr. Alison Brown** President & CEO, NAVSYS Corporation **Dr. Matt Sorenson** Office of Innovation and Strategic Investment, The University of Texas System
5:00 pm	**ADJOURN FOR THE DAY**

THURSDAY, MARCH 22

CLASSIFIED SESSION – APPLIED RESEARCH LABORATORIES – UT AUSTIN

Pre-registration and submission of clearance required to attend this session; no concurrent unclassified session will be offered.

Limited parking available - transportation will be provided from the AT&T Hotel and Conference Center

6:40 am

MEET SHUTTLE 1 OF 2 FOR TRANSPORTATION TO APPLIED RESEARCH LABORATORIES

AT&T HOTEL AND CONFERENCE CENTER LOBBY

7:00 – 8:00 am

REGISTRATION AND CONTINENTAL BREAKFAST

APPLIED RESEARCH LABORATORIES LOBBY

7:15 am

MEET SHUTTLE 2 OF 2 FOR TRANSPORTATION TO APPLIED RESEARCH LABORATORIES

AT&T HOTEL AND CONFERENCE CENTER LOBBY

8:00 – 8:10 am

OPENING REMARKS

APPLIED RESEARCH LABORATORIES AUDITORIUM

James Chew
Chair, NDIA Science & Engineering Technology Division
Group Director, National Security Systems, Cadence

SESSION FOUR: CAPABILITIES NEEDED BY THE COMBATANT COMMANDERS

APPLIED RESEARCH LABORATORIES AUDITORIUM

Roger Garay
Session Co-Chair
Enterprise Portfolio Analyst, Defense Technical Information Center

James Chew
Session Co-Chair
Chair, NDIA Science & Engineering Technology Division
Group Director, National Security Systems, Cadence

8:10 – 8:30 am

How Capabilities are Developed and Delivered to the Combatant Commanders

James Chew
Chair, NDIA Science & Engineering Technology Division
Group Director, National Security Systems, Cadence

8:30 – 9:00 am

United States Central Command (USCENTCOM)

Brett Scharringhausen
Chief, Discovery & Integration, USCENTCOM CCJ8-Science & Technology

9:00 – 9:30 am	**United States Special Operations Command (USSOCOM)** **Howard Strahan** Deputy Director, HQ USSOCOM, SOF-AT&L
9:30 – 10:00 am	**United States Transportation Command (USTRANSCOM)** **Lou Bernstein** Research, Development, Test & Evaluation Program Director, USTRANSCOM
10:00 – 10:30 am	**NETWORKING BREAK** APPLIED RESEARCH LABORATORIES LOBBY
10:30 – 11:00 am	**United States Africa Command (USAFRICOM)** **Peter Teil** Command Science Advisor, USAFRICOM
11:00 – 11:30 am	**United States Northern Command (USNORTHCOM)** **Robin Brunner** Technical Advisor, J8 Science & Technology, NORAD and USNORTHCOM
11:30 – 11:45 am	**CLOSING REMARKS** APPLIED RESEARCH LABORATORIES AUDITORIUM **James Chew** Chair, NDIA Science & Engineering Technology Division Group Director, National Security Systems, Cadence
11:45 am	**CONFERENCE ADJOURNED**
11:45 am – 12:15 pm	**BOXED LUNCHES AVAILABLE** APPLIED RESEARCH LABORATORIES LOBBY
12:00 pm	**MEET SHUTTLE 1 OF 2 FOR TRANSPORTATION TO AT&T HOTEL AND CONFERENCE CENTER** APPLIED RESEARCH LABORATORIES ENTRANCE
12:30 pm	**MEET SHUTTLE 2 OF 2 FOR TRANSPORTATION TO AT&T HOTEL AND CONFERENCE CENTER** APPLIED RESEARCH LABORATORIES ENTRANCE

BIOGRAPHY

MARY MILLER

Performing the Duties of the Assistant Secretary of Defense for Research and Engineering

Ms. Mary J. Miller is currently Performing the Duties of the Assistant Secretary of Defense for Research and Engineering. In April, 2016, she joined the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics as the Principal Deputy Assistant Secretary of Defense for Research and Engineering (PD ASD(R&E)). As the PD ASD(R&E), she is responsible for the Department of Defense (DoD) strategies and supporting plans to develop and leverage technologies needed to ensure continued U.S. technological superiority. She provides leadership, establishes policy and guidance for the development and execution of the DoD Science and Technology (S&T) enterprise, with an annual budget in excess of $12 billion. She oversees matters from basic science and capability prototyping to research and engineering at the 63 DoD laboratories; promotes coordination and cooperation across DoD, between DoD and other federal and non-federal agencies and organizations and ensures technological exchange with allied and friendly nations.

Prior to that she served three years as the Deputy Assistant Secretary of the Army for Research and Technology (DASA(R&T)). As DASA(R&T), she was responsible for policy and oversight of the Army's research and technology program, which spans 16 Laboratories and Research, Development and Engineering Centers, employs nearly 12,000 scientists and engineers and has a yearly budget that exceeds $2.4 billion. Ms. Miller was charged with identifying, developing, and demonstrating technology options that inform and enable effective and affordable capabilities for Soldiers. She was also responsible for developing an S&T strategy that is responsive to Army needs from the near term (5 years) stretching out through the far term (more than 20 years). Her S&T portfolio covered basic research through the development and demonstration of components, subsystems, Manufacturing Technology, and technology system prototypes.

Between 2010 and 2013, Ms. Miller served as the Deputy Program Executive Officer for Soldier, where she was the principal civilian for the Department of the Army responsible for the design, development, procurement, fielding, and sustainment of a portfolio with more than 460 products/systems and a $3 billion budget. Her work encompassed virtually everything a Soldier wears or carries.

From 2005 to 2010, Ms. Miller served as the Director for Technology, within the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology. There she was responsible for the oversight and coordination of the Army's S&T efforts to transition technology in support of Army acquisition programs. She also served as the U.S. National Representative on the Weapons Panel of The Technology Cooperation Program.

Ms. Miller received a B.S. in Electrical Engineering from the University of Washington, an M.S. in Electrical Engineering, Electro-Physics, from George Washington University and an M.B.A. from the University of Tennessee. Ms. Miller was selected in 2005 to the Senior Executive Service and is Defense Acquisition Workforce Level III certified in Program Management; Engineering; and Science and Technology Management.

VENUE MAP


Conference Center
M2
Guest Center
L
to Guadalupe St.
to Parking Garage Entrance and UT Tower
W. 20th St.
Parking Garage Elevators
CONFERENCE CENTER
Tejas
Guest Room Elevators
TOWER WING
Parking Garage Elevators
GUEST CENTER
201
Conference Center Entrance
Concierge Desk
Front Desk
Concierge Desk
202
Business Center
Courtyard
203
Whitis Ave.
One Twenty 5
SPIRIT
Guest Room Elevators
CAPITOL WING
204
205
Texas Executive Education Offices
MLK Entrance
W. Martin Luther King Blvd.
N

TABLE TOP DISPLAYERS

DEFENSE SYSTEMS INFORMATION ANALYSIS CENTER (DSIAC)

The Defense Systems Information Analysis Center (DSIAC) is part of the DoD Information Analysis Center (IAC) enterprise, sponsored by the Defense Technical Information Center (DTIC). The purpose of DSIAC is to perform information research and analysis for DoD and federal government users to stimulate innovation, foster collaboration, and eliminate redundancy. DSIAC maintains a community of subject-matter experts, as well as access to the vast repository of DoD Scientific and Technical Information to support synergistic opportunities and reduce redundancy in DoD research and development (R&D) investments.

A wide range of products and services are provided by DSIAC, including:

- Responding to technical inquiries, including literature searches, document requests, answers to technical questions, and expert referrals; each 4-hour inquiry is free of charge to the customer.
- Developing, managing, and deploying products, tools, and training based on the needs of the Defense Systems community.
- Publishing the DSIAC Journal, which is available by print subscription or free electronic download.
- Building and maintaining a network of defense systems subject-matter experts.
- Participating in key technical conferences and forums to engage and network with the Science and Technology (S&T) community.
- Fostering and supporting the DSIAC Communities of Practice.
- Conducting customer-funded Extended Technical Inquiries (ETIs) and Core Analysis Tasks.

DEFENSE TECHNICAL INFORMATION CENTER (DTIC)

The Defense Technical Information Center (DTIC) is the DoD's central authority for collecting, safeguarding, analyzing, and disseminating defense-related scientific and technical information to a broad spectrum of authorized users. Its flagship knowledge management hub, the R&E Gateway (www.dtic.mil), is the DoD's one-stop source for controlled-unclassified (NIPR) collections and workspaces. The R&E Gateway connects military lab scientists, engineers, and researchers to reduce duplication of effort and build on past successes. DTIC's unclassified (public) site (www.dtic.mil) and collections encourage industry innovation, citizen science and technology transfer. Its classified (SIPR) site (https://dtic.smil.mil) and collections support the requirements of the Combatant Commands (CCMDs) to deliver innovative technologies for our warfighters. New to DTIC is the Journal of DoD Research and Engineering, which offers DoD researchers an avenue to publish controlled unclassified and classified research in a peer-reviewed publication.

GSA FEDSIM & GSA EXPRESS

FEDSIM and Express are programs within GSA which provide solutions for government-wide assisted acquisitions for DoD and Civilian agencies. GSA FEDSIM is the only full service, government-wide assisted acquisition organization that provides hands-on strategic direction and development through all phases of the acquisition process. GSA Express provides streamline assisted acquisition services including contracting and financial management. Leveraging acquisition expertise, tools, templates, and an online automated system to increase efficiency, reduce cost and support acquisition innovations. GSA's FEDSIM, Express, Acquisition and Category teams are committed to helping you discover the fastest, most effective way to fulfill your requirements and get the results you need to deliver your mission.

RECONASENSE

ReconaSense empowers companies to make better decisions, faster.

It elevates Security from a post-event approach to a real-time, proactive posture. This unique sensor-fusion platform lets you choose from native modules such as next-generation Access Control, Video Management/Analytics, or request integration with virtually any other sensor or system. Its familiar touchscreen tile interface lets you customize and simplify the security officer's awareness. Unlike other "Unified Platforms", only ReconaSense automates the detection of events that concern you, then automatically triggers the responses you desire. This automation helps eliminate human oversight or error, helping security officers "make sense of it all".

SMALL BUSINESS ADMINISTRATION

The Small Business Administration provides guidance to agencies that implement the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs.

The Small Business Innovation Research (SBIR) program is a highly competitive program that encourages domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialization. Through a competitive awards-based program, SBIR enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. By including qualified small businesses in the nation's R&D arena, high-tech innovation is stimulated and the United States gains entrepreneurial spirit as it meets its specific research and development needs.

The mission of the SBIR program is to support scientific excellence and technological innovation through the investment of Federal research funds in critical American priorities to build a strong national economy.

The program's goals are four-fold: stimulate technological innovation; meet Federal research and development needs; foster and encourage participation in innovation and entrepreneurship by women and socially or economically disadvantaged persons; increase private-sector commercialization of innovations derived from Federal research and development funding.

Another program that expands funding opportunities in the federal innovation research and development (R&D) arena is the Small Business Technology Transfer (STTR) program.

SEMI-FLEXTECH

SEMI-FlexTech is focused on the growth and success of the manufacturing and R&D ecosystem for flexible hybrid electronics (FHE) - the building blocks for flexible, lightweight, low power, integrated sensor and communication products. We bring together teams of industry, academicians and government representatives to define and manage R&D programs for military and commercial dual-use applications.

SEMI-FlexTech has a successful track record of contract and technical R&D management to maximize innovation through public-private pooled resources. Our consortia model demonstrates the exponential value of collaboration. Talk to us about meeting your next-generation development needs for mobile/wearable solutions, communication, augmentation, sensors, and other requirements you have for the electronics industry.

SEMI® connects over 2,000 member companies and 1.3 million professionals worldwide to advance the technology and business of the electronics industry. SEMI members are responsible for the innovations in materials, design, equipment, software, devices, and services that enable smarter, faster, more powerful, and more affordable electronic products. FlexTech, the Fab Owners Alliance (FOA) and the MEMS & Sensors Industry Group (MSIG) are SEMI Strategic Association Partners, focused on flexible electronics, semiconductor fabrication, and transducers/sensors industries, respectively.

THE UNIVERSITY OF TEXAS SYSTEM

Educating students, providing care for patients, conducting groundbreaking basic, applied and clinical research, and serving the needs of Texans and the nation for more than 130 years, The University of Texas System is one of the largest public university systems in the United States. With 14 institutions and a projected enrollment of more than 234,000 students, the UT System confers more than one-third of the state's undergraduate degrees, educates approximately two-thirds of the state's health care professionals annually and accounts for almost 70 percent of all research funds awarded to public institutions in Texas. The UT System's operating budget for FY 2018 is $18.3 billion, funded in part by $3.6 billion in sponsored programs from federal, state, local and private sources. With more than 20,000 faculty – including Nobel laureates and members of the National Academies – and nearly 80,000 health care professionals, researchers, student advisors and support staff, the UT System is one of the largest employers in the state.

Energy & Power Community of Interest
March 21, 2018

Dr. Dave Drazen – OUSD(R&E) Staff Specialist

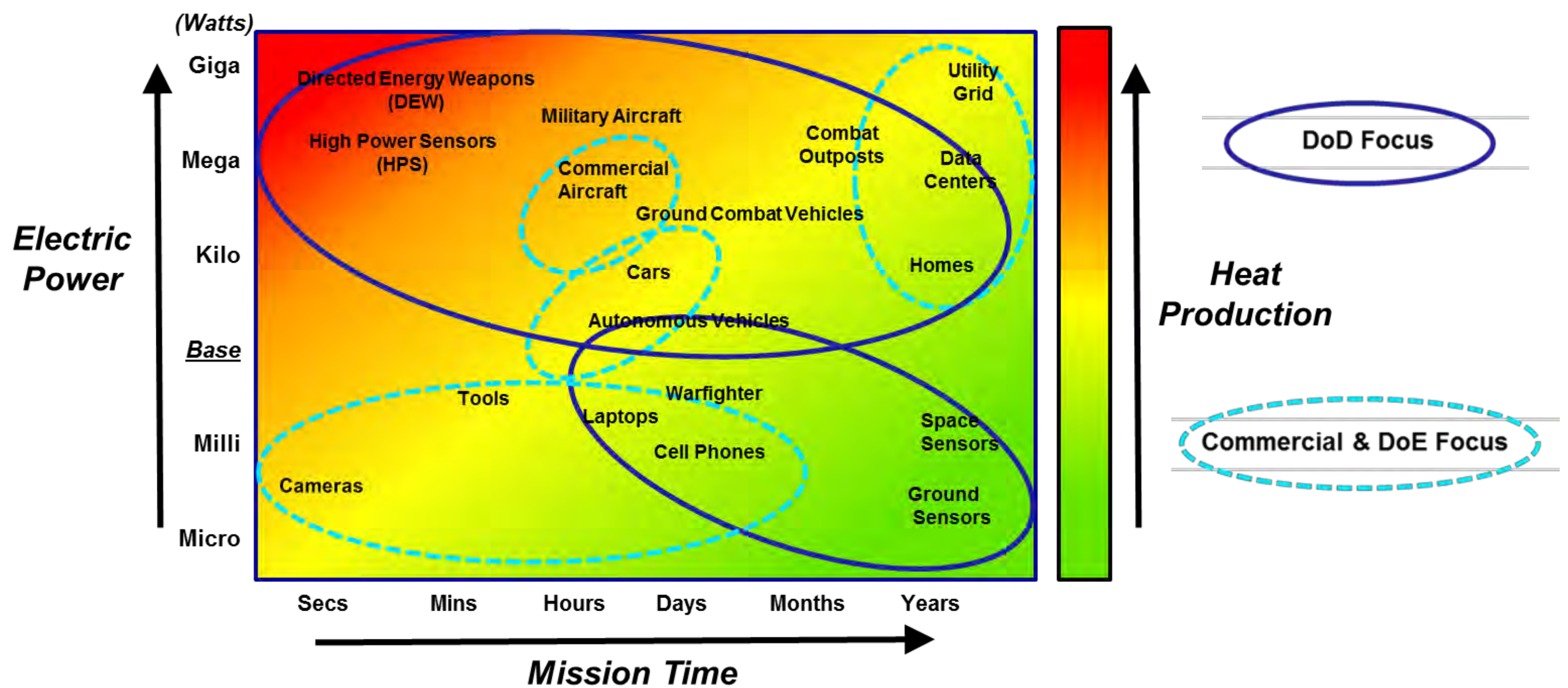
Energy & Power S&T Enables DoD Capabilities

Technical Taxonomy

Power Generation/Energy Conversion
Energy Storage
Power Control and Distribution
Thermal Transport and Control
Electromechanical Conversion

Warfighter Opportunity Areas (WOA)

Energy Optimized Platforms
Electric Weapons and High Power Sensors
Adaptive Power Networks
Autonomous Systems Power
Tactical Unit Energy Independence



Energy & Power Col
Warfighter Opportunity Areas (WOA)

Energy Optimized Platforms: ***Optimizing platforms for a more lethal joint force.***

- Novel Metal-Ion and Aqueous Battery Chemistries
- Electric Ship Research and Development Consortium (ESRDC)
- MegaWatt Tactical Aircraft (MWTA) Program

Electric Weapons and High Power Sensors: ***Enable asymmetric capabilities.***

- Ultra High Density Hybrid Energy Storage Module (UHD HESM)
- Open System for Controls of Integrated Propulsion, Power, and Thermal (OSCIPPT)
- Thermally Enabling Architecture for Pulse-Power Systems (TEAPPS)

Autonomous Systems Power: ***Enable long-duration, autonomous operation in unique and challenging environments.***

- Compact Military Power (UGV)
- Hydrothermal Vent Exploitation for Undersea Energy (HTVE-UE)
- Quiet Propulsion (Great Horned Owl, GHO) & Eyes Below the Weather (Tactical Off-Board Sensing, TOBS)
- Multi-Day Endurance of Group 2 Unmanned Aerial System (Hybrid Tiger)

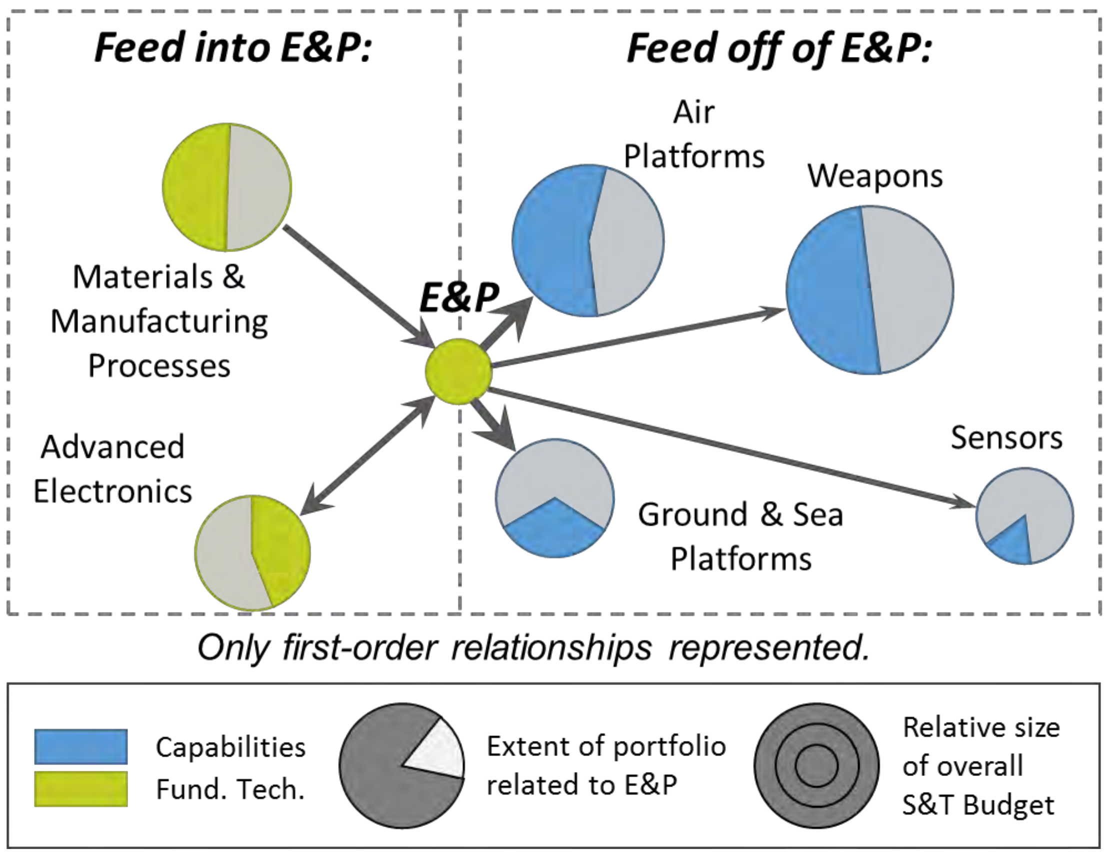
Tactical Unit Energy Independence: ***Extending the reach of energy and power systems to untether Warfighters.***

- Advanced Integrated Solider Power (AISP) Science & Technology Objective (STO)
- Self-Sustaining Soldier Power (S3P) STO
- Multifunctional, Structurally Integrated Flexible Energy Storage

Adaptive Power Networks: ***Automating energy management for optimized mission performance.***

- Energy Informed Operations (EIO)
- Intelligent Power Components & Integration
- Tactical Microgrid Standards Consortium (TMSC)

Energy & Power CoI
S&T Portfolio Interdependency



The remaining CoIs have a second-order relationship (e.g., C4I through Sensors & Processing)

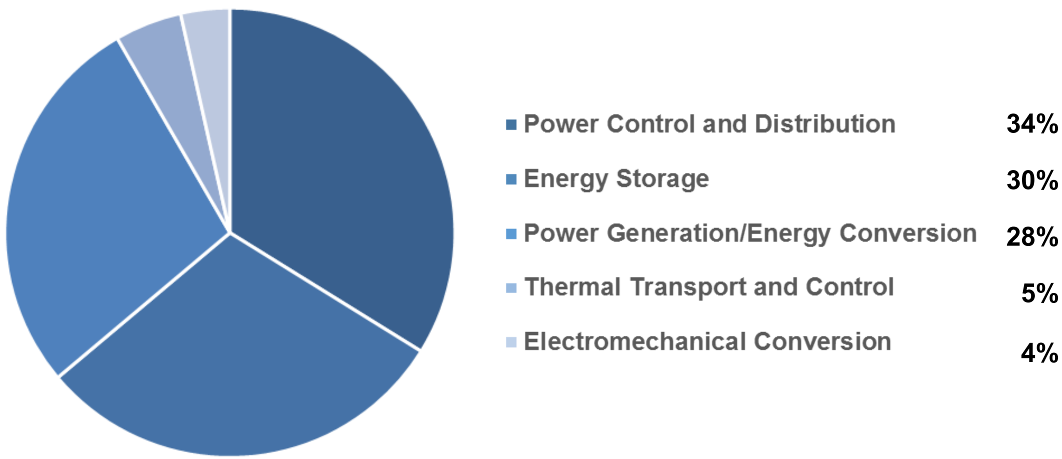
E&P develops fundamental technologies, which

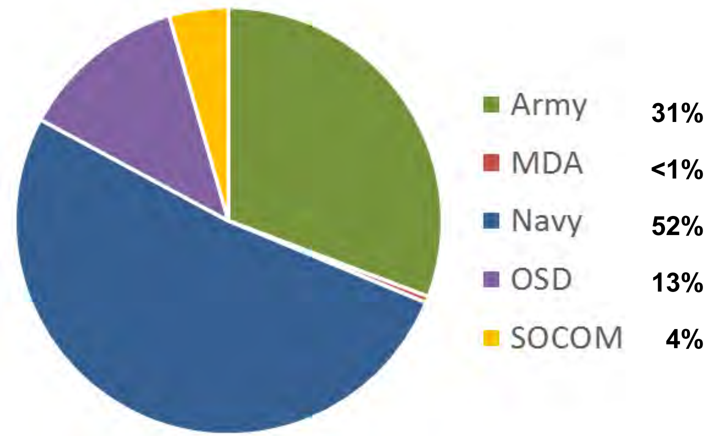
- directly feed into the capabilities developed in the non-Space platforms, Weapons and Sensors CoIs
- and rely on improvements in materials, manufacturing, and electronics.

New advancements will result additional direct relationships:

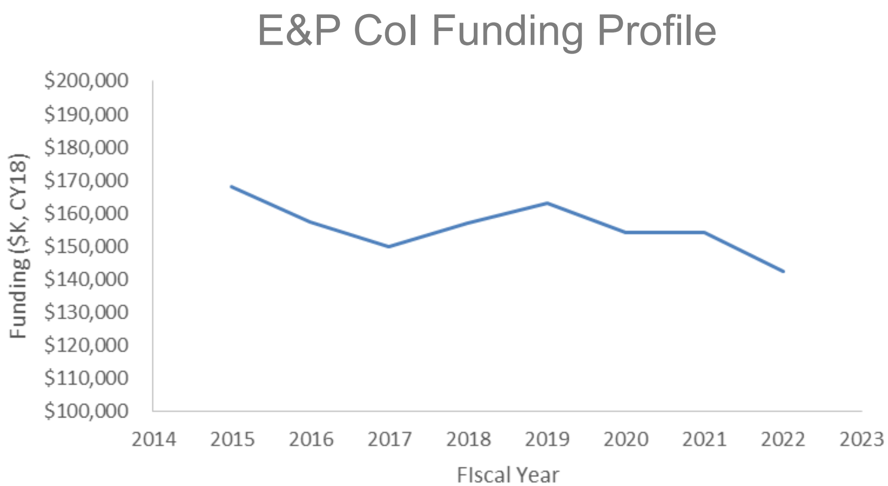
- Cyber CoI on the cyber resiliency of intelligent power and energy systems
- Autonomy CoI on advanced energy behaviors for Autonomous systems

Energy & Power CoI FY18 Funding





Air Force $$ binned under Air Platforms CoI



Investment profile:

- PB18 $156.8M, 54% BA 2 & 46% BA 3
- Significant USAF Thermal Transport and Control funding aligned with Air Platform CoI.

Energy & Power CoI Recent Impact

- **Ongoing collaborative projects between the Services and ODASD(OE) to address identified high risk S&T challenges through OECIF**
  - **Open Syst. for Ctrls. of Integrated Propulsion, Power, and Thermal (OSCIPPT)**
    Provide common baseline controls interface for future platforms.
  - **Ultra High Density Hybrid Energy Storage Module (UHD HESM)**
    Examine HESM-enabled Laser Weapon Syst. & EW operation in power hardware-in-the-loop demonstrations with Army and USAF, plus transition to Navy Multifunctional Energy Systems FNC
  - **Thermally Enabling Architectures for Pulse Power Systems (TEAPPS)**
    Deliver advanced thermal management system architectures and components for transition to 100+ kW HEL efforts: HELIOS, SHiELD, HELMTT.
- **Collaborating with Other Government Agencies**
  - **AFRL/NASA: manned/unmanned aircraft hybrid-electric propulsion**
  - **Joint/DOE/NASA/NIST/NSF: High-voltage GaN semiconductors road-mapping**
  - **Army/JPL/NASA: Lithium Sulfur and Ultracapacitor power sources for Soldiers**
  - **Army/DOE: Advanced Vehicle Power Technology Alliance - leveraging automotive advances for combat vehicles**

Energy & Power CoI
Current S&T Priorities

- **Improve power density and thermal management for air and ground platforms with significant size and weight constraints to enable high power capabilities**
  - **Army Hybrid Energy Storage System**
    Navy Multi-function High Density Shipboard Energy Storage FNC
    USAF MegaWatt Tactical Aircraft
    OSD Operational Energy Capability Improvement Fund
  - **Outreach to platform CoIs for application and transition opportunities**

- **Secure interfaces (including cyber-physical) to mission capabilities for intelligent power and thermal control**
  - **"Assessment of Operational Energy Systems Cybersecurity Vulnerabilities"**
    Study executed using USD(R&E) CoI discretionary funds.
  - **Investigating opportunities to collaborate within DoD and DOE National Labs**

- **On-station energy harvesting/scavenging for autonomous systems**
  - **Working with Autonomy and platform CoIs to determine near-term responsibilities and long-term direction**

DoD Energy & Power S&T Risks

- **Risk: New capability development without sufficient focus on power and thermal infrastructure requirements to support and sustain**
  - **Mitigation Action: Cross-CoI "Enabling DEW & HPS" TEM validated and raised awareness of S&T challenges**
  - **Mitigation Action: E&P CoI planning a Cross-CoI TEM on Autonomous Systems Power with Autonomy and platform CoIs**
- **Risk: Limited resources for platform E&P systems integration and testing**
  - **Recommendation: Continued investment in improved M&S tools to affordably enable platform capabilities**
  - **Recommendation: Leverage prototyping and experimentation resources for integrated system testing to buy-down risk**
- **Risk: Unknown vulnerability of global supply chain**
  - **Mitigation Action: "Critical Energy & Power Technologies Domestic Marketplace Survey" and accompanying analysis tool**
    Study executed with USD(R&E) CoI discretionary funds
  - **Recommendation: M&MP CoI examine and validate findings from E&P CoI Survey**

Energy & Power CoI Summary

E&P CoI Priorities:

- Improve power density and thermal management for air and ground platforms with significant size & weight constraints
- Secure interfaces (including cyber-physical) to mission capabilities for tactical microgrids and surface ship power & energy networks
- On-station, autonomous energy harvesting/scavenging

Potential Future Research Areas:

- Power and thermal requirements of collaborative electric weapon effects
- Energy recharge of autonomous systems
- Enabling increased platform design flexibility and scalability through more capable power and thermal systems
- Multifunctional energy structures
- Flexible, conformal, and robust power for the augmented Warfighter

Engagement Opportunities:

- Army Research Laboratory Open Campus effort
- Defense Innovation Marketplace
- NDIA Annual Science and Technology Conference
- ARPA-E Annual Energy Innovation Summit

Link to download 2017 S&T Roadmap: http://www.defenseinnovationmarketplace.mil/coi_energypower.html

Backup

Tier 1 Taxonomy Brief Descriptions

Power Generation/Energy Conversion:
Develop tactical, deployable power systems using available fuel and renewable/ambient sources to generate electrical energy.

Energy Storage:
Improve electrical and electrochemical energy storage devices to decrease device size, weight, and cost as well as increase their capabilities in extreme temperatures and operating conditions.

Power Control and Distribution:
Enable smart energy networks for platforms, forward operating bases, and facilities through new, greater capability and efficiency components as well as modeling & simulation tools.

Thermal Transport and Control:
Efficiently manage heat and enable higher power density systems through advanced thermal science and technology: advanced components, system modeling, and adaptive or hybrid-cycle technologies.

Electromechanical Conversion:
Increase the power density, efficiency, and robustness of motors, generators, and actuators while also reducing their life cycle costs.

United States Africa Command Posture and Requirements and IPL Overview

Mr. Peter E. Teil

US Africa Command, J803

Command Science Advisor

The overall classification of this briefing is **UNCLASSIFIED**

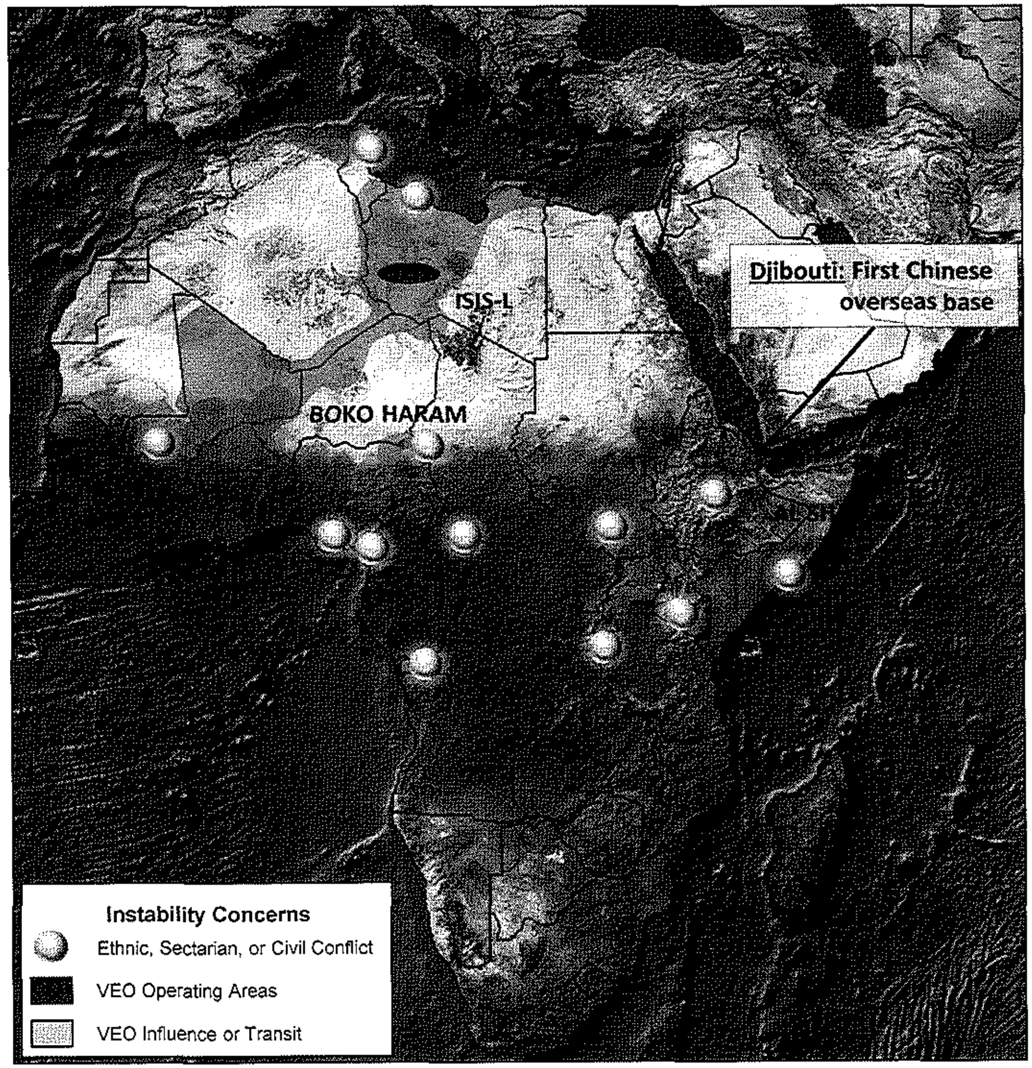
Distribution A: Approved For Public Release

Topics

1. Strategic Context
2. Strategic Posture
3. Current Operations
4. Security Cooperation Activities
5. ISR and Intelligence Operations
6. Integrated Priority List (IPL)

Strategic Context

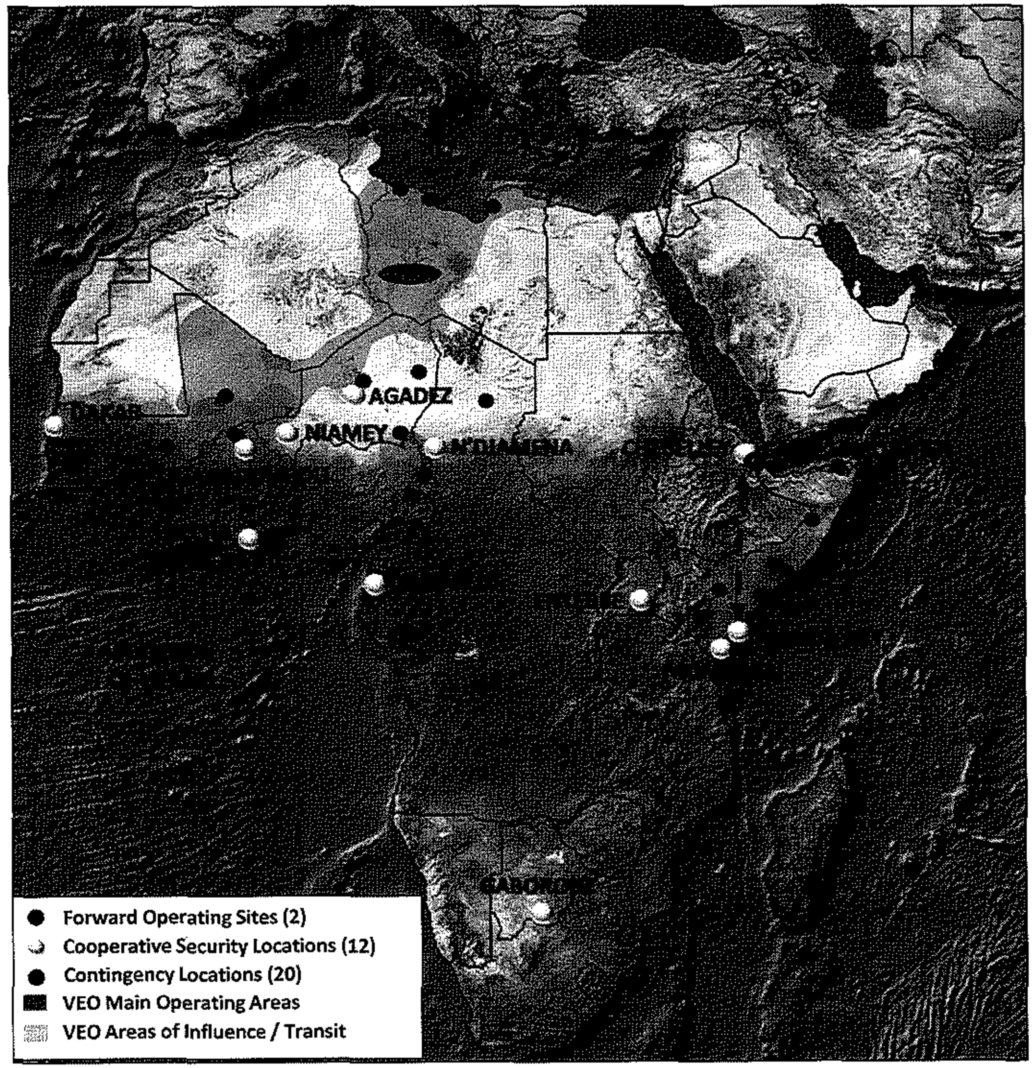
- **Changing threats & conditions**
- **Drivers of Instability**
  - Weak democratic institutions
  - Crime, corruption, informal economy & weak institutions
  - Population growth, youth bulge & urbanization
  - Multipolarity; Great Power Competition
  - Violent extremism
- **Trends in Africa**
  - By 2050, 25% of the global population will live in Africa, mostly in urban areas
  - Competition over resources
  - Violent extremism will continue to threaten U.S. interests



"10 Years of Partnership: Going Further Together"

Strategic Posture

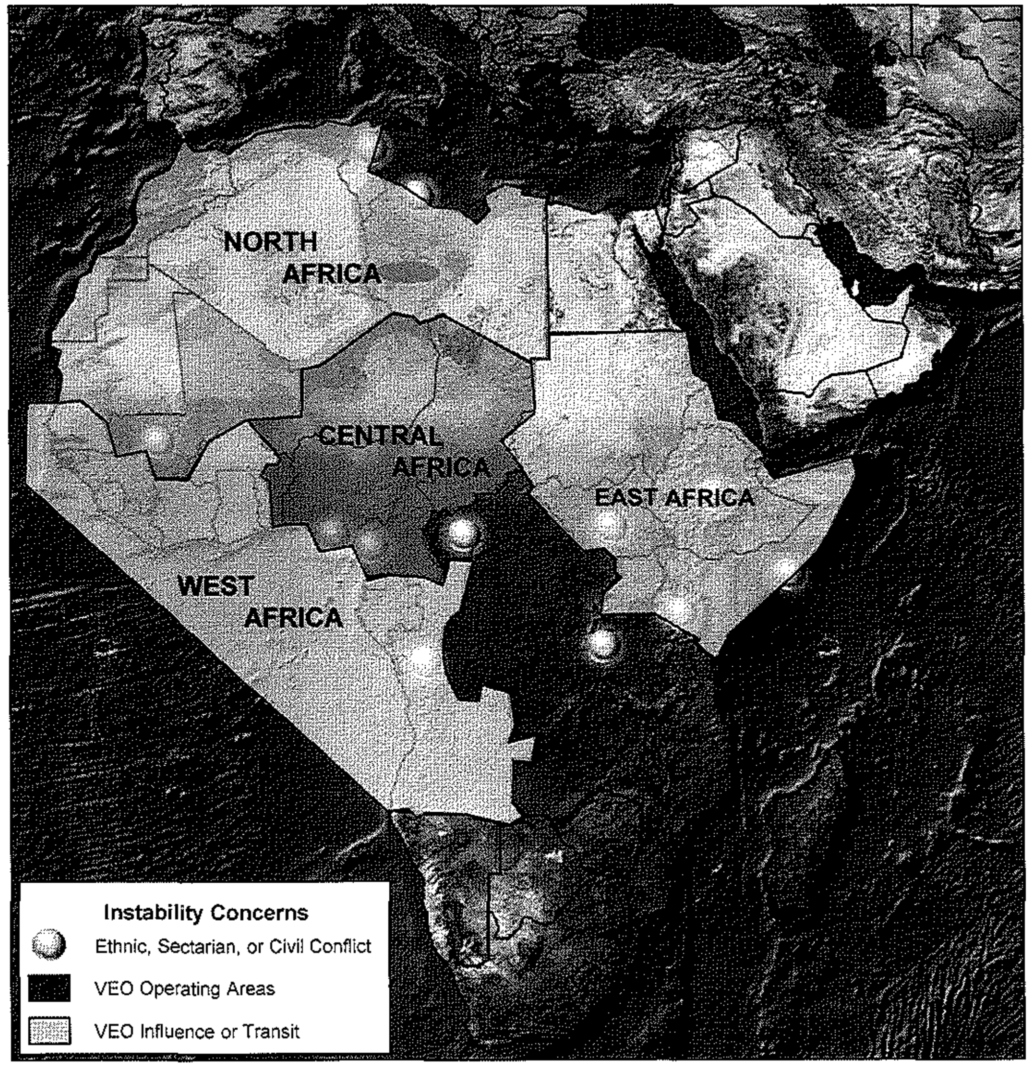
- **Africa: Vast, Remote & Austere**
  - Chebelley to Manda Bay equals Portland, OR to Los Angeles, CA
  - Inadequate local infrastructure
  - Partners lack medical capability
- **Light US Footprint**
  - Small Special Operations Forces teams operating with partners far from logistics & medical support
  - Key component for USAFRICOM's shaping and decisive efforts
- **Camp Lemmonier, Djibouti: only Forward Operating Site in Africa**
  - HQ for CJTF-Horn of Africa
  - Main platform for crisis response and New Normal support



"10 Years of Partnership: Going Further Together"

Current Operations

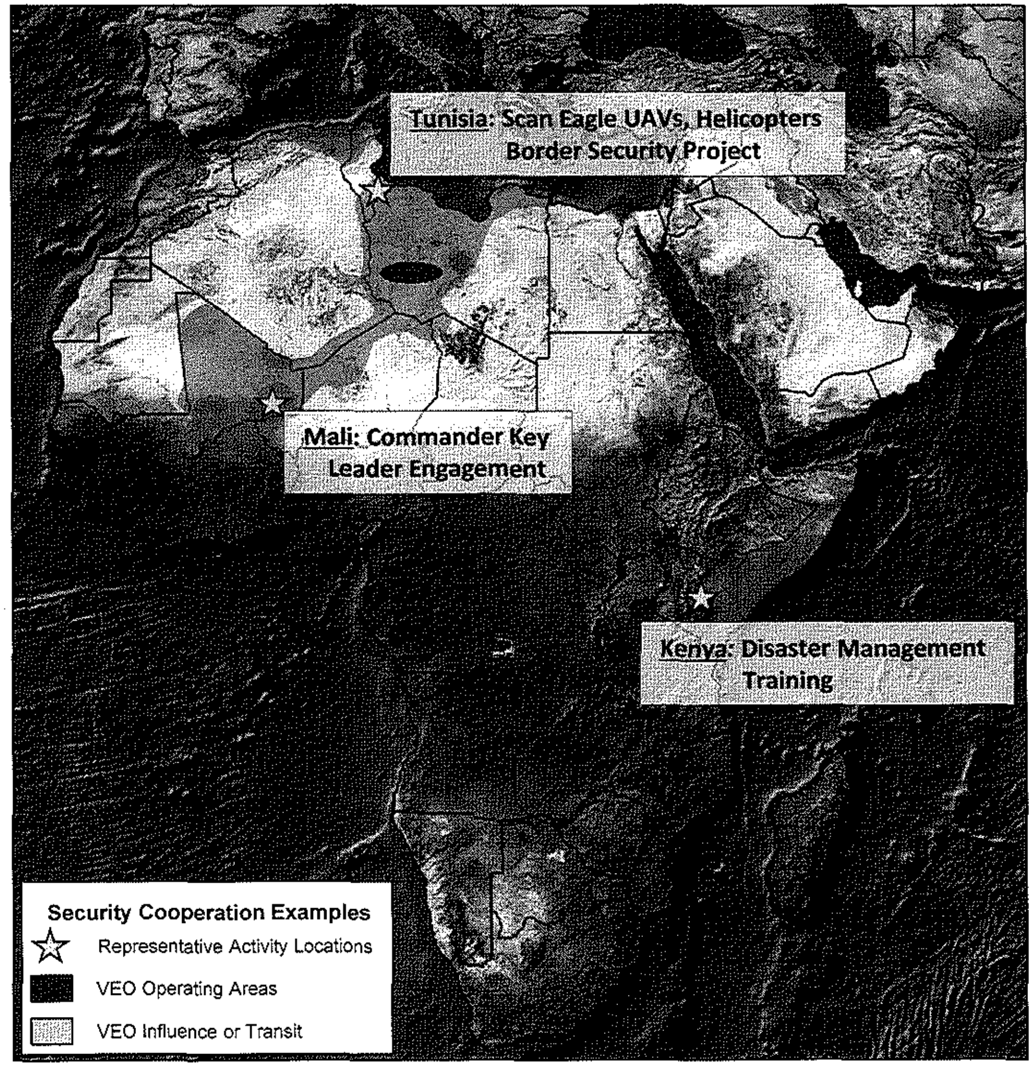
- **East Africa: 6 operations**
  - Neutralize Al-Shabaab, strengthen partnerships through AMISOM
  - Disrupt maritime piracy
- **North/West Africa: 8 operations**
  - Counter ISIL, enable partners
  - Support French CT operations
  - Contain and degrade Boko Haram, build partner capacity
- **Central Africa: 1 operation**
  - Support French forces and strengthen partnerships through UNMISCA
- **Theater-wide: 2 operations**
  - Counter propaganda
  - Conduct crisis response and protect USG personnel & facilities



"10 Years of Partnership: Going Further Together"

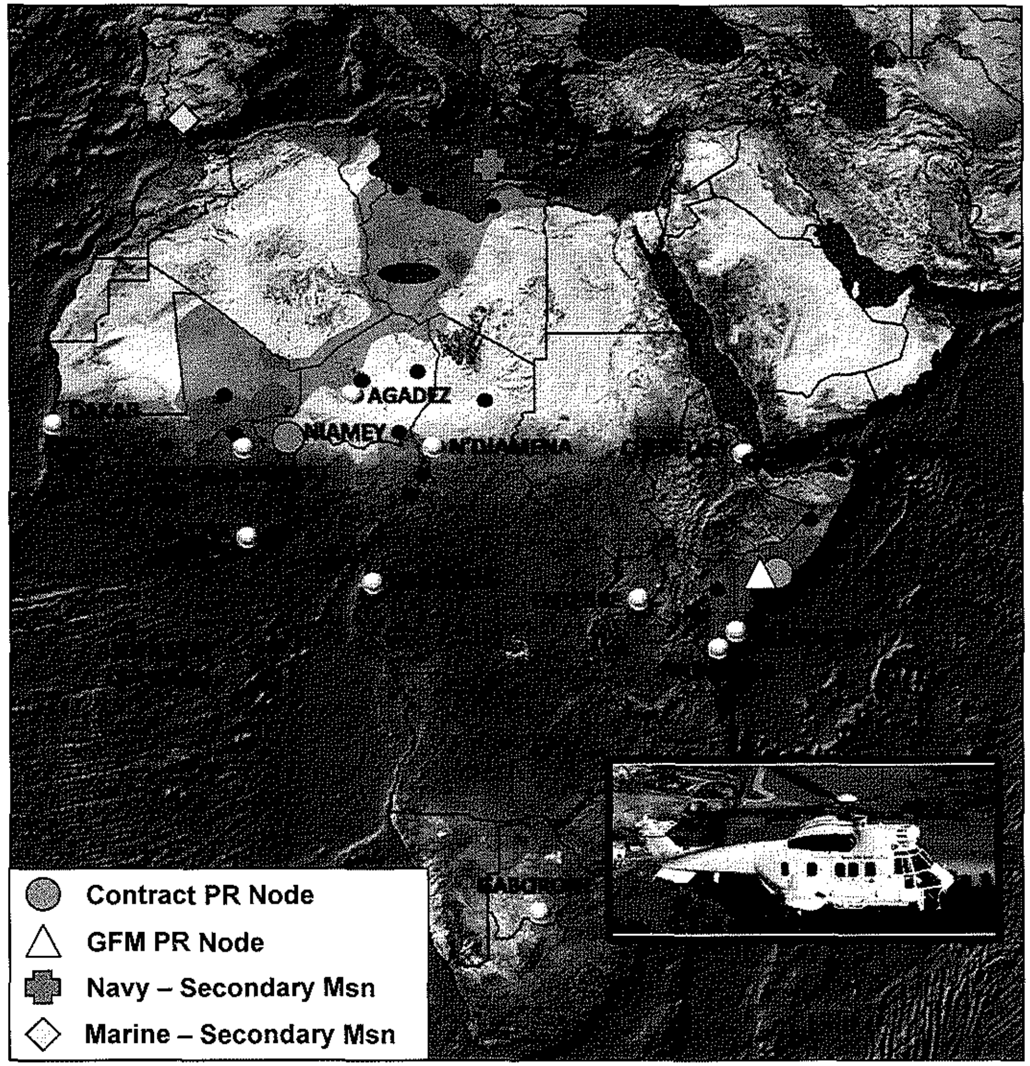
Security Cooperation Activities

- ***Work By, With, & Through***
  - U.S. objectives will be achieved through enduring relationships with capable African partners and US Government agencies
- **Dozens of capacity building activities; adequately funded**
  - Key Leader Engagements
  - Foreign Military Sales
  - Material Assistance
  - Training and Exercises
  - Humanitarian Assistance
- **New U.S. Code Sec 333 (former Counter-Terrorism Partnership Fund) has been essential**
  - Enables African partners in their fight against extremism



Personnel Recovery/ Casualty Evacuation

- **Commander's #1 Priority**
- **Insufficient capacity available through Global Force Management**
  - Only 1 of 3 requests is sourced
  - Marines/Navy – limited coverage outside of primary mission
- **Partner African nations lack capability & capacity**
- **Contract PR narrows the gap**
  - West Africa – Niger
  - East Africa – Somalia
- **PR Strategy is heavily dependent on supplemental funding**
  - FY19 Contract PR/CASEVAC fully funded in Army OCO ($49M)



AFRICOM FY 20-24 IPL

Joint Capability Areas

Protection
Battlespace Awareness
Force Application
C4/Cyber
Logistics
Force Support

#	Title
1	(U) Personnel Recovery
2	(U) Persistent Long-Range ISR
3	(U) Persistent Sea-based ISR and Strike
4	(U) AFRICOM Logistics Distribution Network
5	(U) Integrated Mission Partner Network
6	(U) Airborne ISR Transport Network
7	(U) Identity Activities and Identity Intelligence
8	(U) Environmental Monitoring
9	(U) Protected & Resilient Mission Command
10	(U) Airborne Signals Intelligence
11	(U) Low Density Language Translation
12	(U) Intelligence Operations Support
13	(U) Institutional Capacity Building

"10 Years of Partnership: Going Further Together"

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DoD Research and Engineering Enterprise

19th Annual National Defense Industrial Association Science & Emerging Technology Conference

March 20, 2018

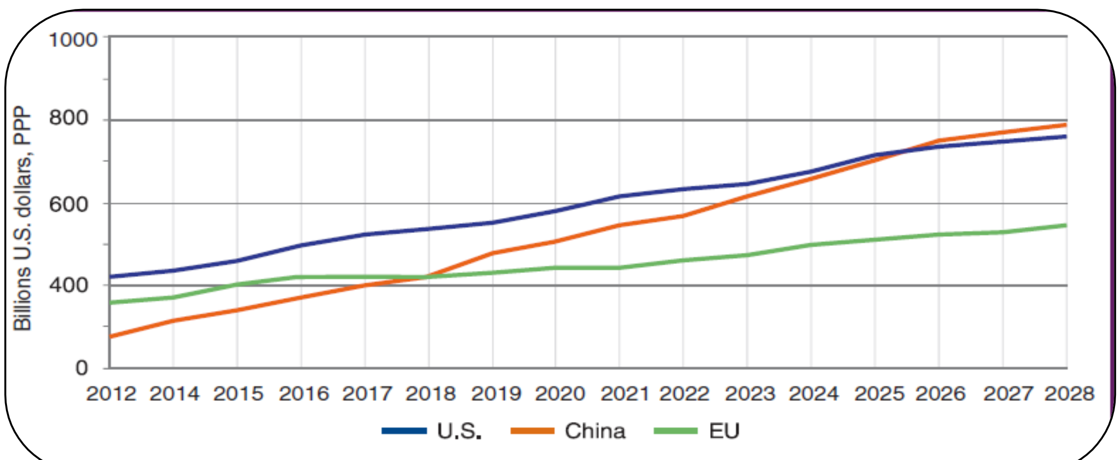
Mary J. Miller

Performing the Duties of Assistant Secretary of Defense
for Research and Engineering

What Drives Us…

Threats Exist Across All Domains

- **Adversaries are moving to next generation capabilities across all domains: Air, Land, Maritime, Space, & Cyber**
- **Advanced materials, ranges, speed, and lethality seen across Russian and Chinese platforms – approaching/at parity**
- **Increased power projection**
  - We are <u>now</u> on-par or outranged by Russian and Chinese rocket and artillery capabilities
  - Russia and China continue to develop and modernize their extensive nuclear forces and long range precision-guided conventional weapons systems
- **China and Russia can hold <u>U.S. and allied positions at risk</u>**
  - Amplifying capabilities to detect, track, and target threats in varying conditions, larger volumes, and at greater distances, extend China's integrated air defense systems



"China's 2017 (R&D) growth is basically twice the percentage change and twice the dollar amount of change as the growth forecast for the U.S.'s 2017 R&D spending"

- 2017 GLOBAL R&D FUNDING FORECAST WINTER 2017
Industrial Research Institute, R&D Magazine

What we are doing about it…

Secretary of Defense Focus Areas

- Strengthen military readiness by increasing ***lethality*** of the force

- Strengthen our ***alliances*** and collaborate with allies whenever and wherever possible

- ***Reform*** the Department of Defense through budget discipline and increased accountability

> *"When it comes to security, no one goes their own way in this world alone. Security is always best when provided by a team."*
> – Secretary Mattis, Munich Security Conference, February 2017

National Defense Strategy

- Sec Mattis unveiled the first National Defense Strategy in 10 years
- First comprehensive review in a decade and first major policy document of the Trump administration
- Sec Mattis' intent is "to pursue urgent change on a significant scale"
- US military is refocusing on fighting other nations rather than terrorist groups
  - Means buying new equipment and embracing innovations so they reach the battlefield faster
  - Erosion of US Military advantage vis-à-vis China and Russia, if unaddressed, could ultimately undermine our ability to deter aggression

"America must be the world's dominant technological powerhouse of the 21st century."
– President Trump, speech on National Security, Sept. 7, 2016

Need to Modernize

- The U.S. is now challenged to strike any adversary at will
- Equal access to emerging technologies, such as autonomy, artificial intelligence and synthetic biology, will disrupt future conflicts
- The U.S. still possesses the best military, however our adversaries' deliberate actions mandate change in what we buy and how we operate
- We must develop new lethal capabilities and accelerate the pace in which we get that capability to the warfighter

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To Modernize, We Must Regularize Mission-Focus Thinking

Modernization seeks to **win the enduring competition** of military superiority

BUILD ON THREE STRENGTHS

investing in our differentiators:

JOINTNESS

Fighting together towards a common goal

incentivize investment for interoperability

EMPOWER AT THE EDGE

Warfighter autonomy and mission command

decentralized execution across workforce and in garrison, supported by systems.

ALLIES AND PARTNERS

Leverage geography, assets, and capabilities of allies and partners to fight stronger together

A forethought across DOTMLPF

&

EXECUTE THREE PIVOTS

shifts in emphasis:

DOMINANCE TO LETHALITY

From all-domain supremacy to fighting through adversity and ability to target and prosecute red before they act

resilient kill chains over invulnerable systems

PREDICTABILITY TO SURPRISE

From polishing proven practices to expanding & continuously refreshing playbook of employment concepts & technologies

heterogeneity over uniformity

DELIBERATE INERTIA TO CONTINUOUS SPEED

From a steady pace seeking major advances to rapid block upgrades & capability enhancements

agility & adaptability over performance

driving towards a **mission-focused department**

Path to Modernization

- Establish a unifying goal within the Department – Networked Adaptive Multi-Domain Joint Battle
- Establish a deliberate set of resources for concepts that will be competitively selected to help achieve this goal
- Move to a mission-focused, portfolio managed schema, vice individual platform approach
- Focus on both new capabilities and operational constructs

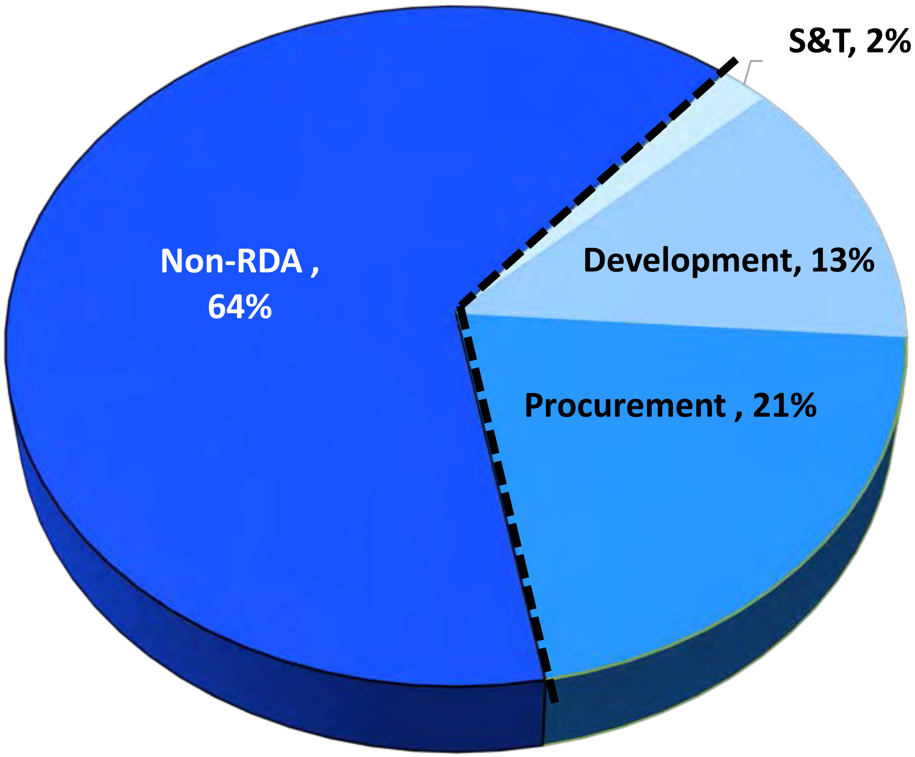
Networked Multi-Domain Joint Battle

Accelerate getting capability to the Warfighter

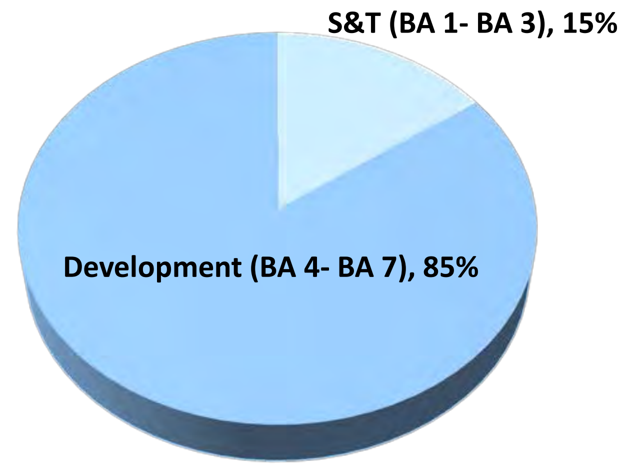
DoD Budget Status

PBR 2019 DoD S&T Funding In Perspective

DoD TOA (Base Only) = $617B



RDT&E (S&T + Development + T&E)



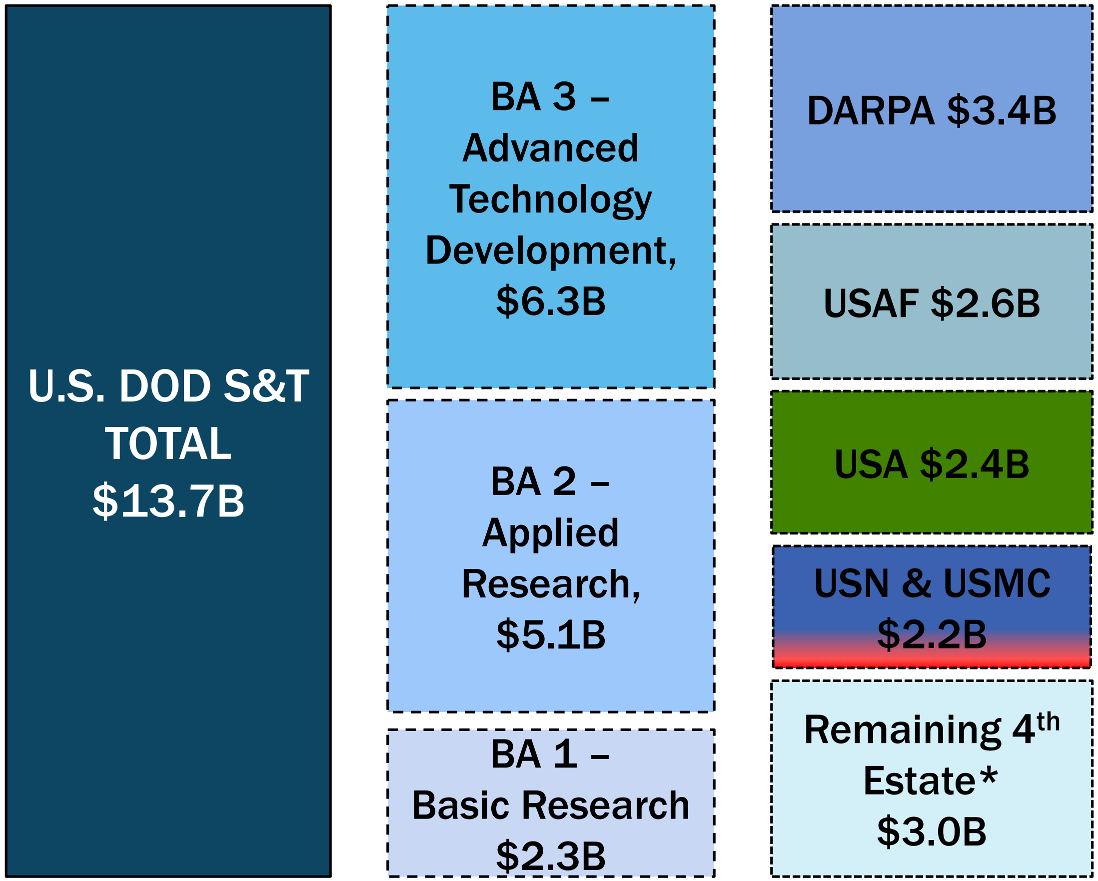
PBR19	FY19 ($B)
Non-RDA	394.4
RDA	222.6
Procurement	131.6
RDT&E	91.0
S&T (BA1-BA3)	*12.7*
Development BA4-BA7)	*77.4*

Note:

- ***Dollars reflect Base Only, no OCO***
- ***Non-RDA = Force Structure and Operational Readiness***
- ***BA = Budget Activity***
- ***S&T = Science and Technology***

U.S. DoD PB 2019 S&T Request

Technology Development Budget

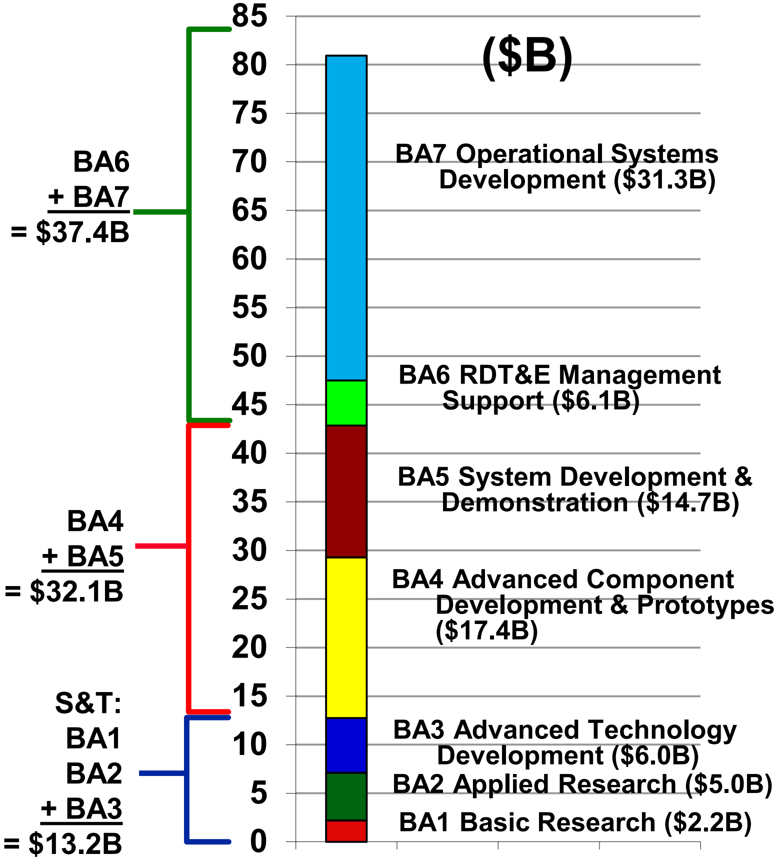


*NOTES:

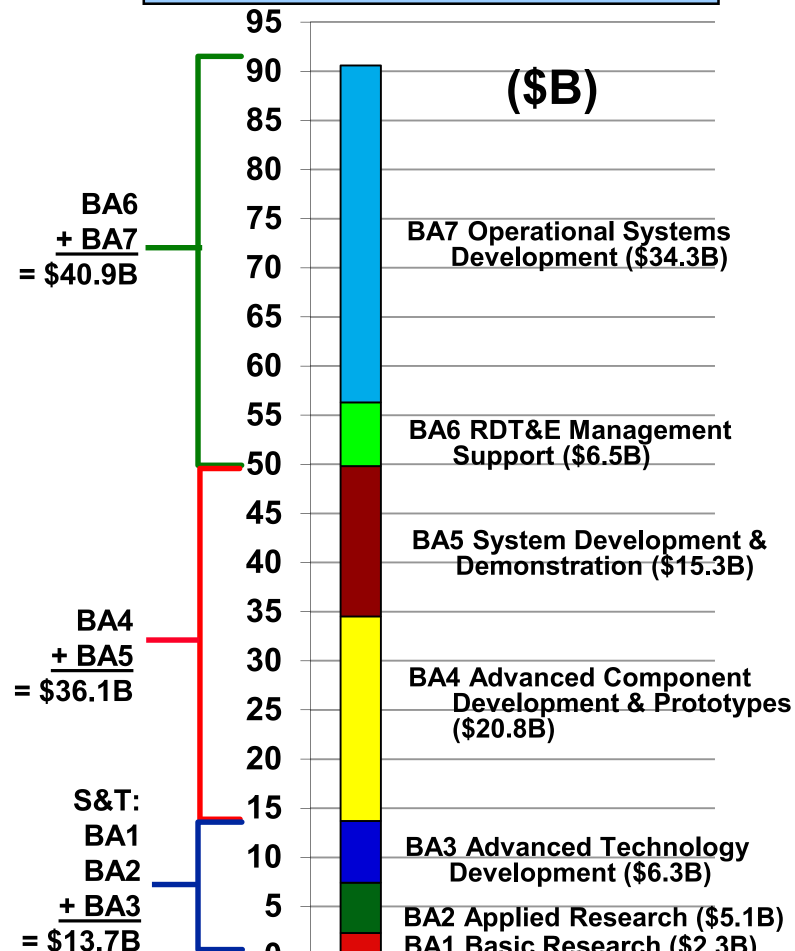
4th Estate includes Chem Bio, DTRA, OSD, USSOCOM, and other DA.

DoD PBR18 & PBR19 RDT&E – Budget Request Comparison

PBR18 FY18 RDT&E = $ 82.7B
(Budget Activities 1-7)



PBR19 FY19 RDT&E = $ 90.6B
(Budget Activities 1-7)



Technology Base (BA1 + BA2) = $7.1B

S&T is 15.9% of RDT&E;
RDT&E is 14.4% of DOD Topline (Base only)

- in Then Year Dollars -

Technology Base (BA1 + BA2) = $7.4B

S&T is 15.1% of RDT&E;
RDT&E is 15.1% of DOD Topline (Base only)

Who are the players???

Leveraging the Entire R&E Ecosystem

Engaging with all partners to ensure technological superiority…

Win today's fight

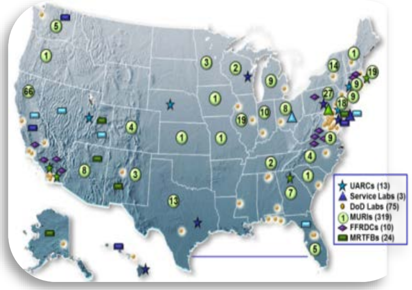
Design and acquire for the next fight

Global Partners

Academia & Industry Partners

Federally Funded R&D Centers (FFRDCs) & University Affiliated Research Centers (UARCs)

DoD Labs, Engineering & Warfare Centers



Force acceleration of science and engineering – driving ideas to capability

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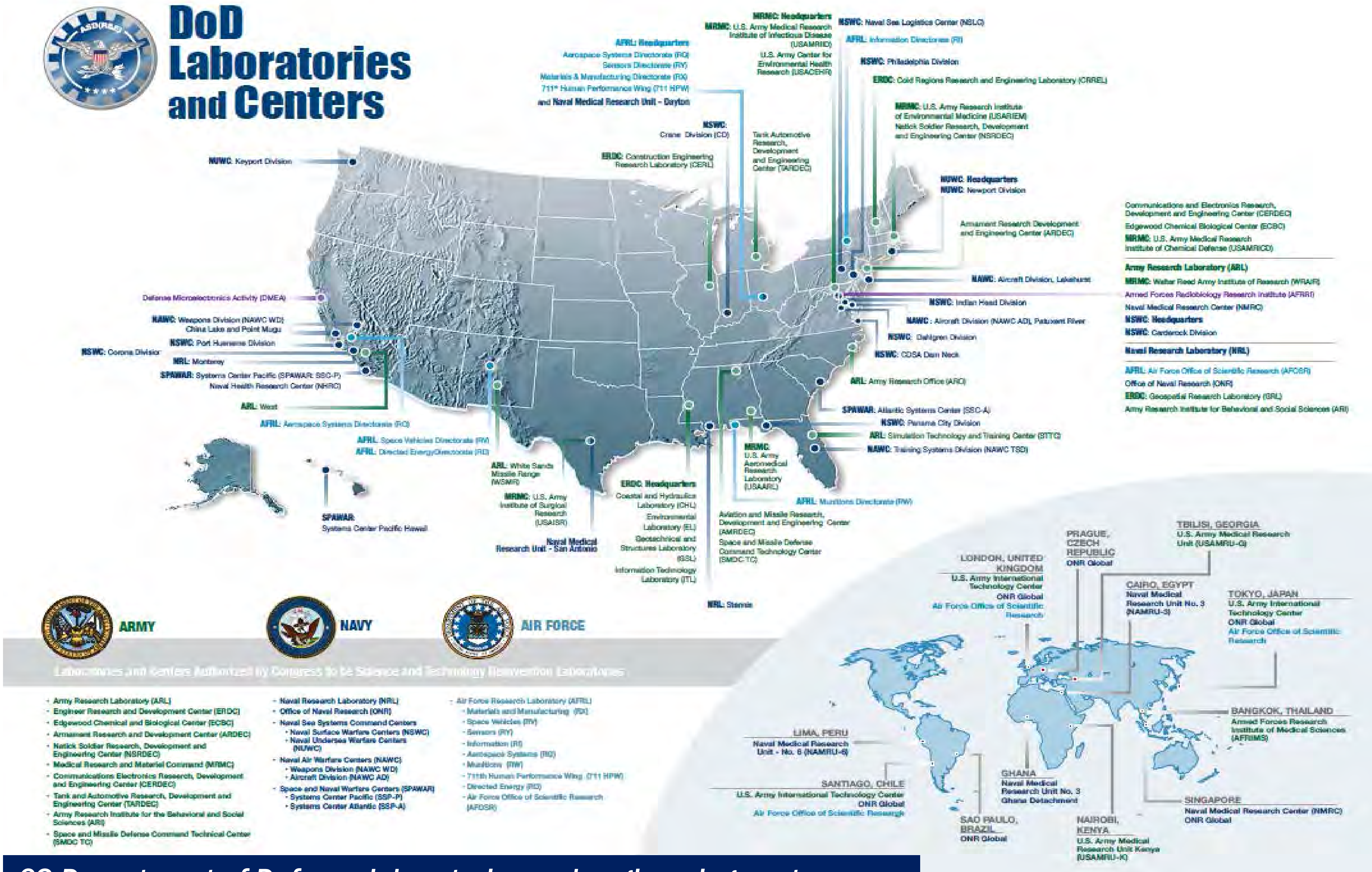


63 Department of Defense laboratories and engineering centers provide expertise and insight to enhance our warfighter's capability .

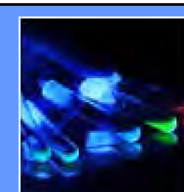
U.S. Communities of Interest

CoIs lead the innovation and the acceleration of advanced concepts and prototypes across three main focus areas:

Mission Focus
Capabilities enabled by advanced technologies & systems

Counter-Improvised Explosive Devices (IED)

Counter-Weapons of Mass Destruction (WMD)



Biomedical (ASBREM*)

Systems / Capability Focus
Multiple technologies are integrated into complex systems to achieve mission impact

Human Systems

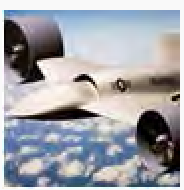
Sensors

Space

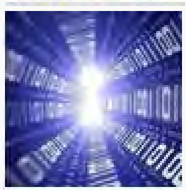
Ground and Sea Platforms

Electronic Warfare

Weapon Technologies

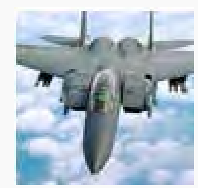


Autonomy



Cyber

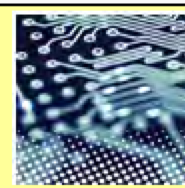
Command, Control, Communication, Computers and Intelligence (C4I)



Air Platforms

Technology Focus
Technology goals with multiple applications

Energy and Power Technologies



Advanced Electronics

Materials and Manufacturing Processes

Alumni CoIs: Engineered Resilient Systems

***ASBREM: Armed Services Biomedical Research Evaluation and Management**

DoD S&T Enterprise Strategy

Continuously Refine our Strategic Thinking and Planning

Mission

"Where we are and who we are now"

"Where we are going and who we will be"

Vision

Strategic Plan

"How we get there"

- Refine our Mission, Strategic Plan, and Vision for Technical and Enterprise Priorities

- Continuous look at the Technology, Focus Areas, CoIs, and Partnering Are we addressing the right problems?

DoD S&T Enterprise Strategic Vision: One Enterprise

- Mitigate challenges by **strengthening the DoD S&T Enterprise's focus, policies and processes** to unleash the full potential and ingenuity of our S&T workforce
- Anticipate the future S&T environment and **transform the S&T Enterprise toward efficient cross functional practices** that will boost innovation, lower barriers to technology transition, and accelerate response to warfighters
- The new *DoD S&T Enterprise Strategy* **provides strategic directions** and initiatives to support the One Enterprise vision
- The focus is in three areas:
  - Addressing new S&T priorities
  - People and culture
  - Supporting business practices and operations

The DoD S&T Enterprise will operate as One Enterprise to deliver responsive, relevant, lethal and affordable technical solutions to deter or defeat known and emerging threats to U.S. national security

Capability Gaps

Opportunities for Collaboration

INPUT FACTORS

- **Threats**
- **Planning**
  - LRRDPP
- **Hard Problems**
  - A2/AD
- **Tech Trends**
  - Globalization
- **Affordability**

Speed

Situational Awareness

Survivability/ Protection

Training Fidelity

Range

Weight/ Mobility

Lethality

Ability to Communicate

LRRDPP – Long-Range Research & Development Planning Program
A2/AD – Anti-Access/Area Denial

Research and Development
— On-going Activities—

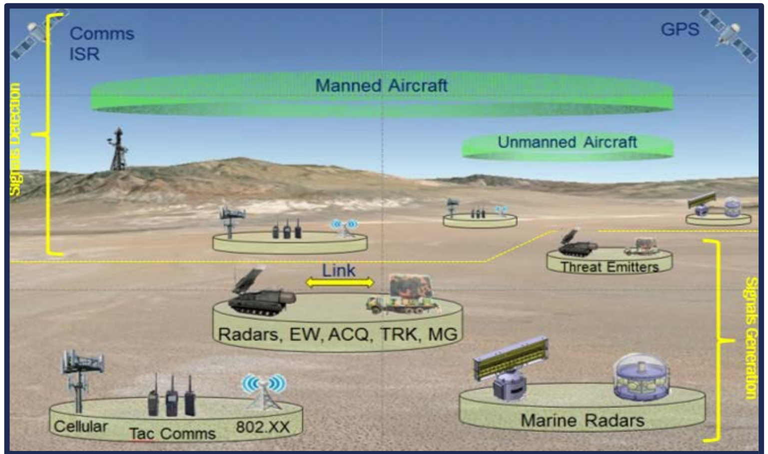
- Autonomy & Robotics
- **Artificial Intelligence** / Man-Machine Interface
- Micro-electronics
- **Hypersonics**
- Directed Energy
- Manufacturing
- Electronic Warfare
- Cyber
- **Advanced Computing**
- Novel Engineered Materials
- Precision Sensing: Time, Space, Gravity, Electromagnetism
- **Emerging Biosciences**
  - Synthetic Biology
- Understanding Human and Social Behavior
- Human Performance

Rapid technological change includes developments in advanced computing, big data analytics, artificial intelligence, autonomy…directed energy, and hypersonics – the very technologies that ensure we will be able to fight and win the wars of the future.“

– Secretary of Defense Mattis, HASC Posture Hearing, June 12, 2017

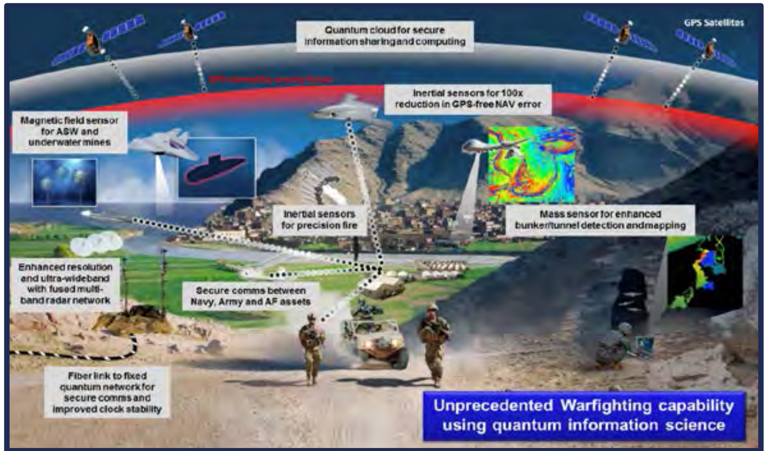
Enhancing Capabilities

Prototyping



Experimentation

New Approaches; Problems, Environments



Cross-Service Research

People and Culture

- **Retain** and continue to **build** our talented R&E workforce
- **Attract** the **best** and **brightest** to **national security service and eliminate barriers** to service
- Bolster programs such as the *S*cience, *M*athematics, *A*nd *R*esearch for *T*ransformation **(SMART)** Scholarship for Service Program
- **Increase recognition** of unique and relevant technical work and **innovative thinking**
- **Leverage all** sources of **talent – internal, industry, academia**

USD(R&E) Organization…

1 Aug 2018
Congressional Report

USD(R&E) Proposed Organization

- Sets and advances technology /innovation agenda for DOD to dominate battlespace

Under Secretary of Defense (Research and Engineering)

Defense Science Board

MDA

Strategic Intel Analysis Cell

- Kill Chain Analysis (US and threat)
- Red-Teaming and Vulnerability Analysis (Technology/Concepts)
- Global Technology Tracking
- Technology Forecasting

Assistant Secretary of Defense (Research & Technology)

- DASD (Research &Technology Investment)
- DASD (Laboratories and Personnel)
- DARPA

Responsibilities:

- Strategic Technology Objectives and Investment Strategy
- Foundational Research and Innovative Approaches for Warfighting Challenges
- Affordable & Assured Technology Development
- Global Technology Outreach and Leverage (academic/commercial/ government/international)
- Laboratory Infrastructure and Workforce Policy

Assistant Secretary of Defense (Advanced Capabilities)

- DASD (Mission Engineering & Integration)
- DASD (Prototyping & Experimentation)
- Strategic Capabilities Office (SCO)
- DIUx

Responsibilities:

- Developmental Prototyping
- Experimentation / Concept Development
- Joint Enduring Operational Needs (JEON) & CCMD Support
- Developmental Planning and Mission Engineering Analysis (assured integration of capability)
- Acquisition Program Support
- Open Architecture / Cyber Security Policy & Standards
- Non-traditional Rapid Acquisition Pathways

USD(R&E) Tenets

What has changed as we stand up the USD(R&E)?

- USD(R&E) will **operate with a Mission Focus**
  - Move from Service oversight focus to CCMD enabling focus
  - Assess capability gaps/needs by mission, vice system or Service
  - Resource integrated prototyping/experimentation activities (leveraging Service efforts) with outcomes focused on mission effectiveness
  - Engage CCMDs/operators in mission analysis/experimentation to develop new CONOPs
- USD(R&E) will **set the Technical Direction for the Department**, not just recommend
- USD(R&E) **will utilize intelligence products, technology forecasting and analysis to inform decisions** on investment, prototyping, experimentation and emerging capabilities and concepts of operation
- USD will **focus on driving effectiveness and affordability** by addressing drivers in acquisition, testing and sustainment into the system design phase – setting and adhering to open architectures and interface standards while implementing good systems engineering/cyber resiliency practices
- USD(R&E) will pilot new acquisition pathways to speed capability to the Warfighter

USD(R&E) will establish and embrace a collaborative culture focused on providing effective and affordable capability to the Warfighter

Opportunities

Industry Support

There are opportunities for industry to provide valuable support to an array of technical and operational challenges across the Department.

- **Improve** communication, coordination, and **research and development** in **artificial intelligence, hypersonics, advanced computing, synthetic biology,** and other emerging technologies**.**
- **Establish** known degree of assurance that **devices, networks, and cyber-dependent functions** perform as expected, **despite attack** or error
- **Reduce size, weight, and power** across all sensor modalities while **preserving sensor capability** and sensitivity
- Provide **delivery, maneuvering, and recovery of payloads to and from space**
- **Deliver** materials, processing, and fabrication **techniques** that significantly change the **manufacturing cost curve**

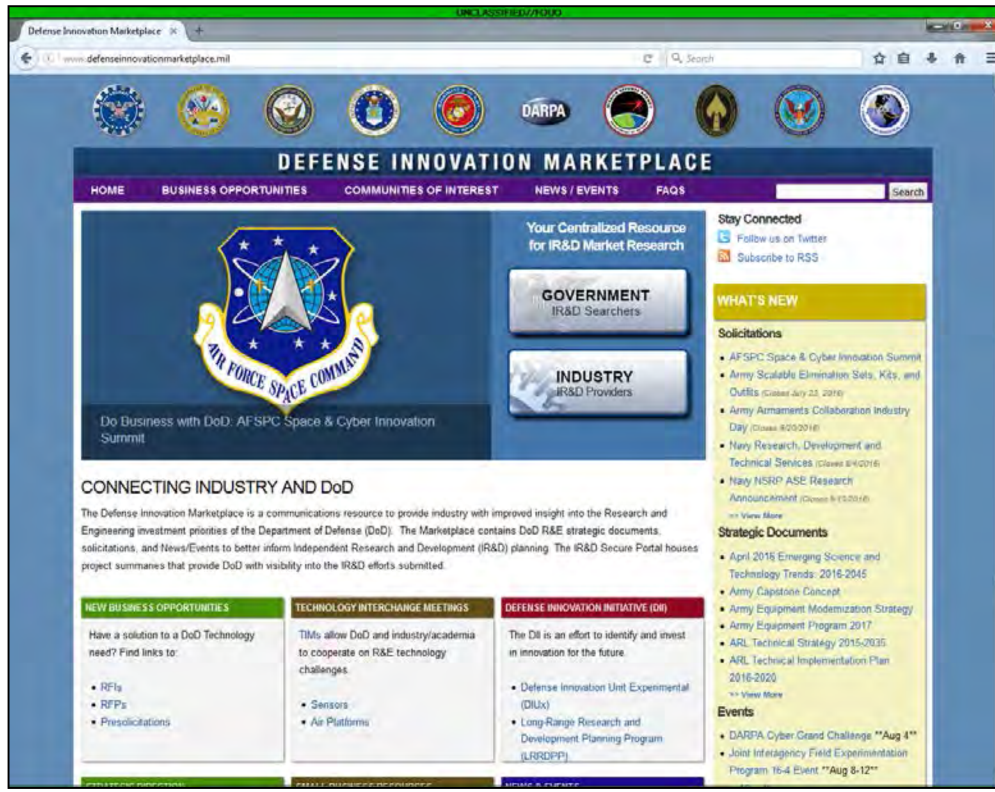
The opportunities mentioned above are not an exhaustive list, but a representative sample of some areas where industry can play a key role.

DoD Innovation Marketplace

The Marketplace addresses the Department's need for increased collaboration with industrial base partners and small businesses.

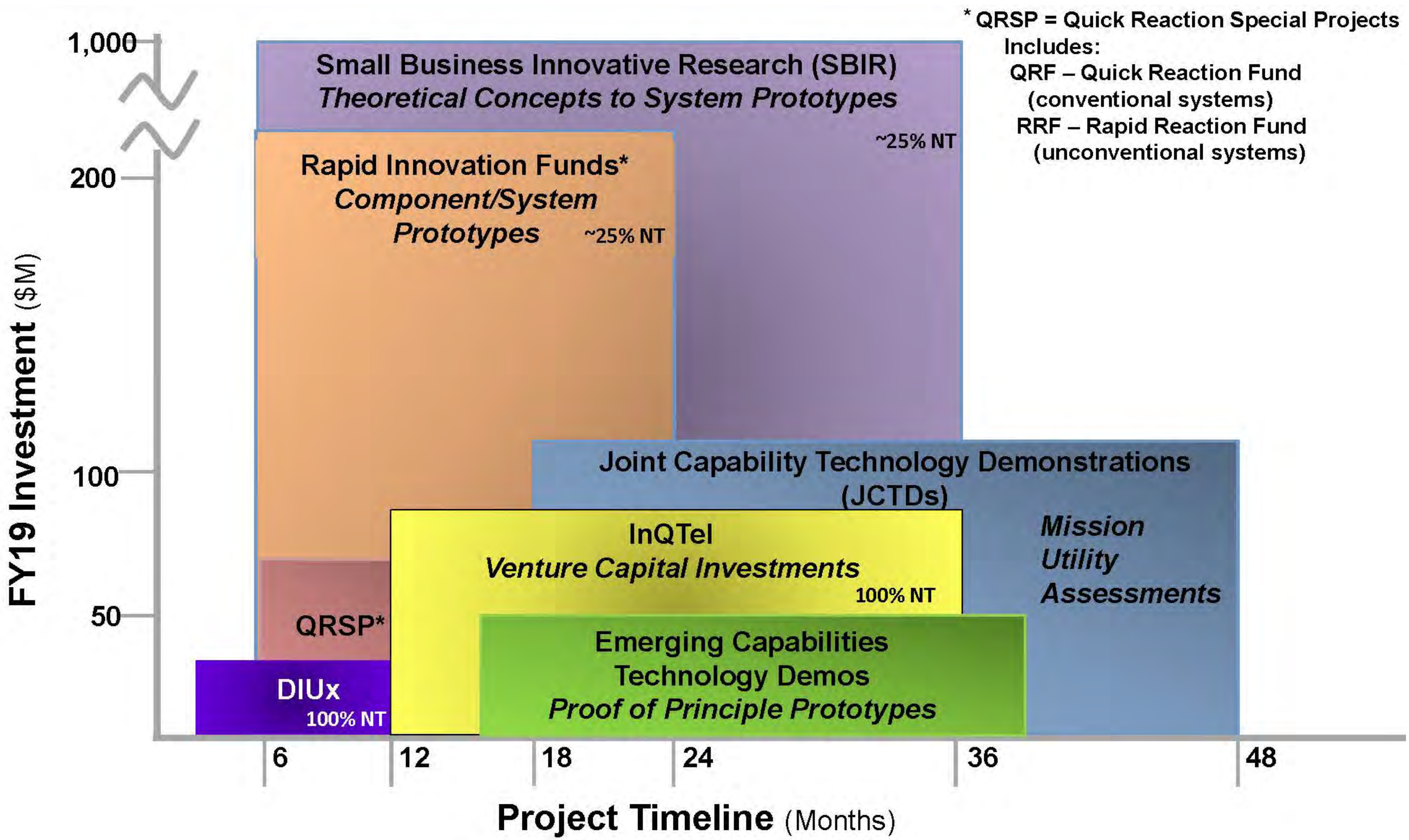
What can be found at the site?

- **New Business Opportunities**
  - Request for Information/Proposals Presolicitations
  - Broad Agency Announcements
  - Rapid Innovation Fund
- **Small Business Resources**
  - Small Business Innovation Research (SBIR)
  - Mentor-Protégé
- **Acquisition Instruments**
  - Other Transaction Authority (OTA)
  - Consortiums (e.g., STEM R&D)
- **Technology Interchange Meetings**
  - Sensors, Air Platforms, etc.



Defense Innovation Marketplace, the one-stop-shop for connecting Industry to DoD.

Non-Traditional Prototyping Outreach



NT = Non-traditional

Maintaining Technology Superiority

- The U.S. military has long relied on ***high quality people, technological superiority, innovative operational*** and ***organizational constructs***, and our ***unmatched ability to fight*** as a ***Joint Force***
- We are addressing the erosion of technological superiority by identifying and investing in ***innovative technologies and processes***
- We are pushing the envelope with ***innovative*** and ***cutting edge research***
- Beyond technical innovation, we are pursuing ***new practices*** and ***organizational structures*** to ensure future U.S. technical dominance
- From ***basic research*** to ***advanced capabilities***, the DoD R&E enterprise provides the ***technological foundations*** that ensures our military of the future remains the ***most capable in the world***

DoD R&E Enterprise: Solving Problems Today – Designing Solutions for Tomorrow

DoD R&E Enterprise
Solving Problems Today – Designing Solutions for Tomorrow










DoD Research and Engineering Enterprise
https://www.acq.osd.mil/chieftechnologist/

Defense Innovation Marketplace
http://www.defenseinnovationmarketplace.mil

Twitter
@DoDInnovation

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Mar 13, 2018 5

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

Prototyping - *A Path to Agility, Innovation, and Affordability*

Dr. Chuck Perkins
Principal Deputy
Emerging Capability & Prototyping
(EC&P)

18-S-1049

Defense Strategy

Secretary of Defense detailed three lines of effort for the Department:

- Restore military readiness as we build a more lethal force
- Strengthen alliances and attract new partners
- Bring business reforms to the Department of Defense

*"More than any other nation, America can expand the competitive space…. A more lethal force, strong alliances and partnerships, American **technological innovation**, and a culture of performance will generate decisive and sustained U.S. military advantages."*

2018 National Defense Strategy

A culture of innovation delivered at the speed of war

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Why greater emphasis on prototyping?

- **Constrained Budgets - we cannot afford to procure unique or exquisite systems for every potential threat**
- **Complex Threat Environment**

Russia, China	North Korea, Iran	Non-State Actors

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

Prototyping accelerates the cycle of innovation

Imperatives & Activities

- **Research and Engineering Imperatives**
  - Mitigate current and anticipated threat capabilities
  - Affordably enable new capabilities in existing military systems
  - Create technology surprise through science and engineering
- **Prototyping Activities**
  - Conceptual Prototypes
    - Demonstrate feasibility of an integrated capability
    - Overcome technical risk
    - Enable cost vs. capability trades
  - Developmental Prototypes
    - Demonstrate military utility of integrated solution
    - Demonstrate robust manufacturing processes
    - Define form, fit and function
  - Operational Prototypes
    - Suitable for a targeted purpose in a specific environment
    - Demonstrate form, fit, and function

"Prototyping and experimentation should be utilized prior to defining requirements, and commercial-off-the-shelf systems should be leveraged more often" (Source: 2018 National Defense Strategy)

Source documents & inputs for identifying needs

- **National Defense Strategy**
- **Chairman's Capability Gap Assessment**
- **CCMD Integrated Priority Lists (IPLs), Joint Urgent Operational Needs (JUONs), and Joint Emerging Operational Needs (JEONs)**
- **USD(R&E) and Military Services' Science and Technology (S&T) Strategies**
- **End-user and/or Warfighter involvement**

EC&P's Mission & Objectives

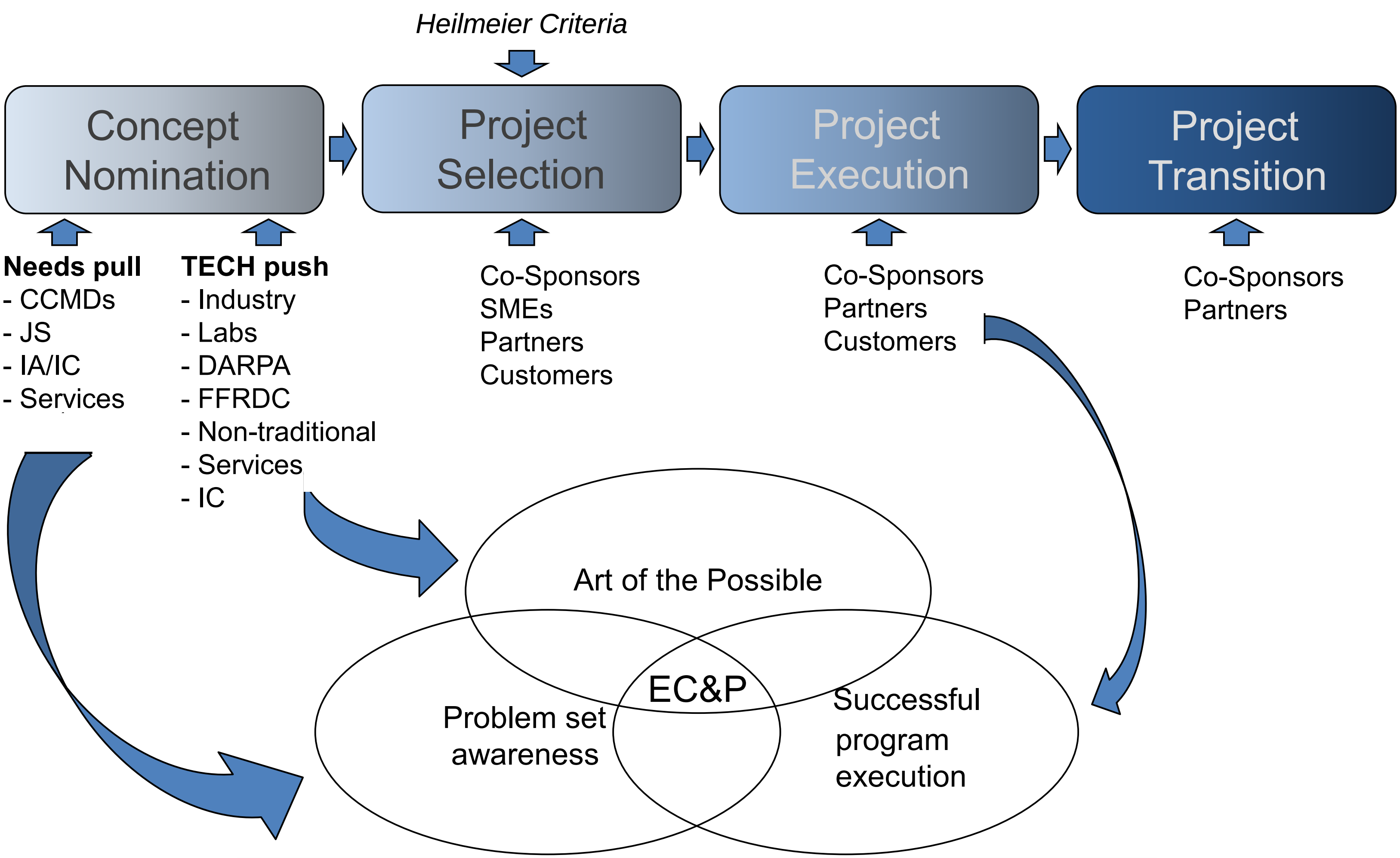
Identify, develop, and demonstrate technical concepts to address defined national security challenges faced by the DoD, Joint Force, and Combatant Commands (CCMDs)

- **Operationalize leading edge technologies and leverage the entire R&E enterprise for sources of innovation**
- **Partner with Joint, interagency and international players**
- **Foster innovation using prototyping and experimentation**
- **Broaden the supplier base to include non-traditional, domestic, & international performers**

Accomplished through:
- **Experimentation**
- **Prototyping**
- **Test & Evaluation**
- **Demonstration**

Transition → **DoD & interagency programs of record and/or sustained capabilities**

EC&P's Methodology & Critical Network of Partners



EC&P links the capabilities of three critical partner networks

Characteristics of EC&P Projects

- Span all Joint Capability Areas
- Emphasize Joint and interagency problem sets
- Inform requirements development
- Most have co-sponsors (partnerships are critical to success)
- Emphasize user involvement with technology demonstration and experimentation
- Include transition planning from the start
- Most provide residual capabilities

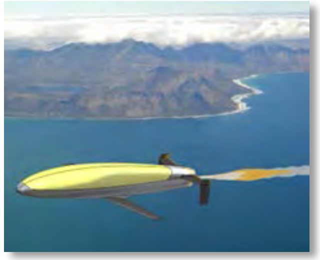
"Seams, cracks and fissures"

EC&P Programs

EC&P's objectivity, freedom to cross boundaries, and freedom to take risks enables us to provide game-changing capabilities to the Joint Warfighter through seven programs.

- **Joint Capability Technology Demonstration (JCTD)**
- **Emerging Capabilities Technology Development (ECTD)**
- **Quick Reaction Special Projects (QRSP)**
- **Rapid Prototyping Program (RPP)**
- **Foreign Comparative Test (FCT)**
- **Spectrum Access Research & Development Program (SAR&DP)**
- **Rapid Innovation Fund (RIF)**

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Emerging Capability & Prototyping

Emerging Capability & Prototyping
TBD
PD – Dr. Chuck Perkins

-  **Deputy Director Prototyping & Experimentation**
  Mr. Glenn Fogg
  - **Rapid Reaction Technology Office**
    Mr. Jon Lazar
    - ECTD
    - QRSP
    - RPP
  - **Program Integration Office**
    Mr. Tom Moore
  - **Joint Capability Technology Demonstrations**
    Mr. Elmer Roman
    - JCTD
-  **Deputy Director Emerging Capability**
  Dr. Chuck Perkins
  - **Comparative Technology Office**
    Col Sean Bradley
    - FCT
  - **Program Resources & Integration Office**
    Mr. Jim Smithers
  - **Initiatives & Analysis**
    Ms. Ellen Purdy
    - SAR&DP
    - RIF

Political appointee (blue)
Career SES/GS-15/Mil 0-6 (green)

Joint Capability Technology Demonstration (JCTD)

Execute prototypes and experiments to address DoD strategic needs, fill operational gaps and reduce technical risk

Anti-jam Precision Guided Munition (AJPGM)

Autonomous Mobility Applique System (AMAS)

Joint Multi-platform Advanced Combat ID (JMAC)

Joint Capability Technology Demonstration (JCTD)

- Foster innovation and contribute to accelerated acquisition and weapon system affordability while providing the Joint Force with a decisive technical advantage
- Developmental/Operational Prototypes & Demonstrations; < 48 months, < $100M

JCTD Program Overview

The JCTD Office is the conduit between the Military Services, CCMDs, and industry.

- Execute DoD-wide prototyping and demonstration of high-payoff capabilities in operationally relevant environments
- Each project is sponsored by a CCMD and is managed and executed by a DoD or Military Service activity which fields needed technical capabilities within 2 to 4 years
- Inform requirements generation process (projects produce Initial Capabilities Document)
- FY18 on-going efforts include developing capabilities in four focus areas:
  - Asymmetric Force Application
  - Intelligence Surveillance & Reconnaissance (ISR)/Counter-ISR
  - Electromagnetic Spectrum Agility Maneuver
  - Information Operations & Analytics

JCTDs seek Industry collaboration in technology development to ensure innovative capabilities are fielded to build military strength and establish competitive advantages

Emerging Capabilities Technology Development (ECTD)

Explore art of the possible

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

Long Range Engagement Weapon (LREW)

Remote Weapon System Auto Prioritization, Targeting, and Operator Cueing (RAPTOR)

Emerging Capabilities Technology Development (ECTD)

- Pursue risk-reducing technology prototypes and demonstrations of cutting-edge land, sea, air, and space systems for the Joint Warfighter
- Proof-of-Principle prototypes; < 36 months, < $6M

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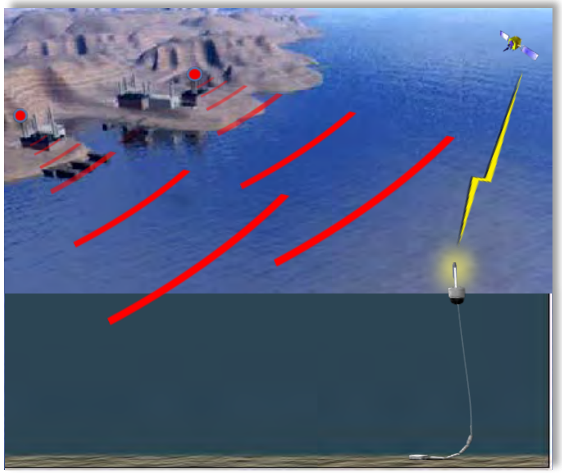
ECTD Program Overview

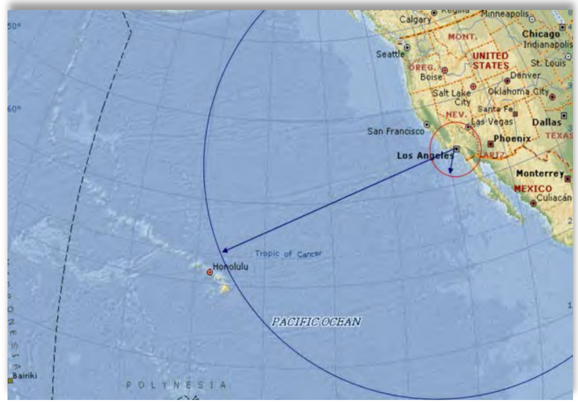
- Produce risk-reducing, proof-of-principle prototypes that inform streamlined, rapid, and iterative development of new emerging capabilities for the Joint Force
- Mitigates new and emerging threats through rapid prototyping in support of near- and mid-term operational engagements and stability operations
- Partners with the Military Services and interagency to support demonstrations and experimentation with the goal of accelerating prototyping and rapid fielding
- Rapid prototyping areas include:
  - Advanced computing
  - Multi-domain artificial intelligence
  - Unmanned autonomous systems
  - Directed energy
  - Dismounted soldier systems

Quick Reaction Special Projects (QRSP)

Offer rapid response to emerging capability shortfalls

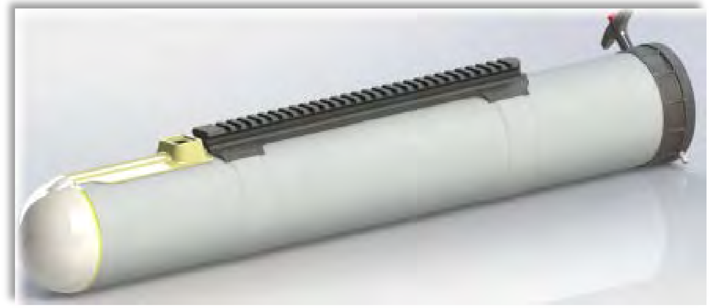
Bloom





Aluminum-Seawater Fuel Cell Start System

UAV Payload Dispenser



Quick Reaction Special Projects (QRSP)

- Mature emerging technologies for operational use by the Joint Warfighter
- QRF – Conventional warfare needs focusing on A2/AD; < 12 months, < $3M
- RRF – Irregular warfare needs with global focus; < 18 months, < $1M

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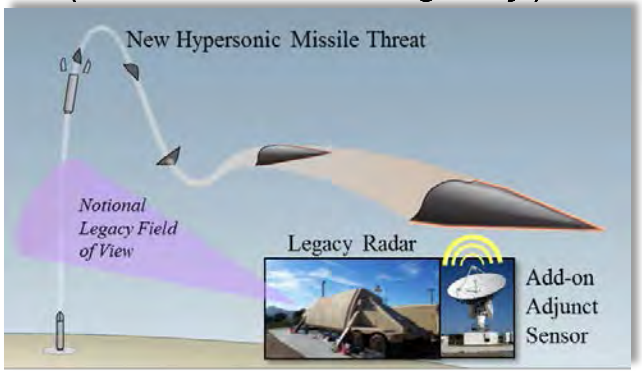
QRSP Program Overview

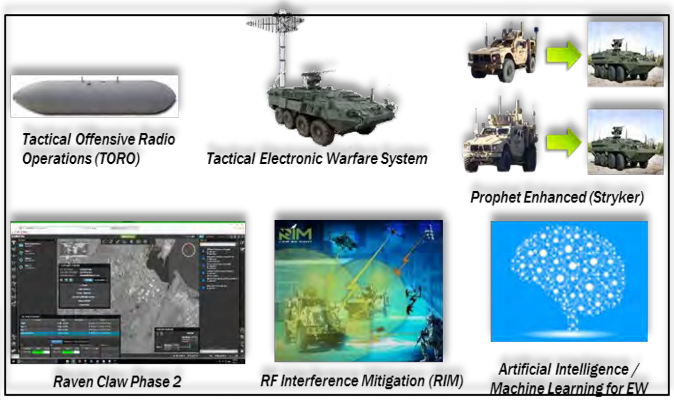
- Mature potentially game-changing capabilities for increased lethality and Joint Force effectiveness through rapid prototyping and novel business practices
- Rapidly develops leap-ahead technology solutions to meet the most pressing Joint capability needs of the CCMDs and warfighter
- Partners with CCMDs, Military Services, government labs, the Interagency, academia, and industry
- Program specifically targets small businesses and non-traditional sources, as well as traditional innovators using a streamlined entry process that increases the rate of innovation, affordability, and responsiveness to the changing nature of warfare
  - Supports modernization of key capabilities & provides a hedge against technology surprise
  - Develops modular capabilities to improve lethality in existing systems
  - Addresses strategic competition & counters non-traditional, non-kinetic threats
- **Low barrier of entry**; quad charts/white papers provide details for funding decisions
  - Technical review through network of government developers and users
  - Small Group Review of technical and operational experts to de-conflict and provide recommendations
- Proposal vetting and project selection made throughout the year of execution

Rapid Prototyping Program (RPP)

Accelerates prototyping capabilities of the Military Services and defense agencies

Transportable Radar Surveillance and Control Model 2 (TPY 2) Adjunct Sensor Prototype for Hypersonic Glide Defense
(*Missile Defense Agency*)





Rapid Prototyping of Multiple Electronic Warfare (EW) capabilities
(*U.S. Army RCO*)

High Power Microwave (HPM) for Airbase Defense
(*U.S. Air Force*)

Rapid Prototyping Program (RPP)

- Reduce technical and integration risk and accelerate transition of new capabilities to programs of record
- Developmental and operational prototypes

RPP Program Overview

- RPP program facilitates and accelerates prototyping efforts for the Military Services and Defense Agencies
- Develops prototypes that reduce technical and integration risk; obtain warfighter feedback that result in affordable and realistic requirements; and, support development of prototypes that can be demonstrated in an operational environment in timelines supportive of warfighter requirements
- 6.4 funding facilitates maturation of prototypes and development of CONOPS/TTPs
- Proposals are accepted on an annual basis

RPP enables Military Services and defense agencies to rapidly prototype, evaluate, and transition new capabilities to programs of record

Foreign Comparative Test (FCT)

Authorized to leverage international allies’ and partners’ R&D investments

Pilot Physiological Monitoring and Warning System (Israel)

Pilot Oxygen/Blood Flow Sensors

Soldier-Sniper Weapon Observation Reconnaissance Device (Canada)

Secondary Propulsion Thrusters (Germany)

New Pump Jet Technology

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

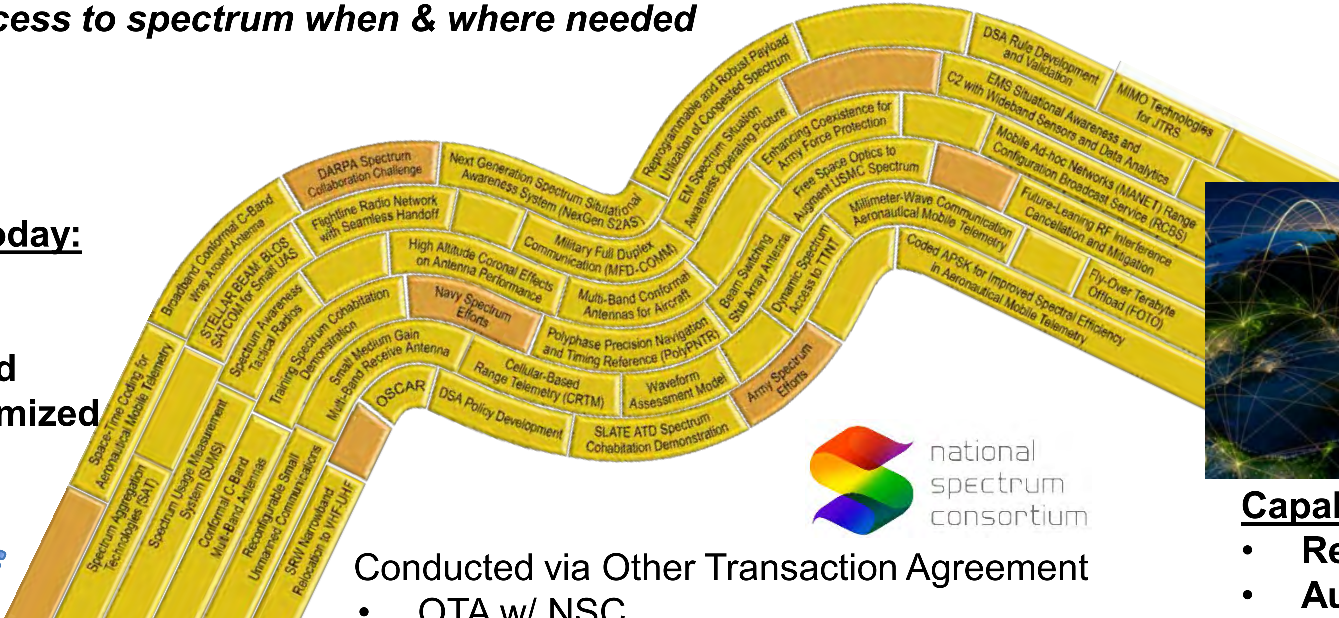
FCT Program Overview

- Implement Title 10 provision to conduct “side-by-side” evaluation of friendly, foreign technologies to meet DoD requirements
- Evaluate foreign prototype technology to adapt / transition for DoD use
- Facilitate the use of foreign developed technologies to solve OSD priorities and cross-domain challenges (e.g., interoperable open systems and affordable capabilities)
- Buys foreign test articles and oversees testing of 10-12 new projects each year with focus on:
  - Asymmetric Force Application
  - Autonomous Systems
  - Information Operations and Analytics
  - Electromagnetic Spectrum Agility
  - Other National Priorities

The FCT Program leverages global technology investments and innovation, promotes competition to reduce DoD costs, and strengthens key alliances and partnerships

Spectrum Access Research & Development Program (SAR&DP)

SAR&DP: access to spectrum when & where needed



Capability Today:
- **Static**
- **Manual**
- **Regulated**
- **Sub-Optimized**

Today…

Tomorrow…

Capability Tomorrow:
- **Resilient**
- **Autonomous**
- **Agile**
- **Cognitive**

national spectrum consortium

Conducted via Other Transaction Agreement
- OTA w/ NSC
- Exempt from Fed Acq Regs
- Consortium members can team
- DoD can dialog in details w/NSC prior to project awards for better understanding between DoD & developers

Spectrum Access Research & Development Program (SAR&DP)
- Mitigate risks associated with AWS-3 repurposing of DoD spectrum to commercial use
- Fieldable/transitionable projects; 24-36 months, < $1M - $30M

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SAR&DP Overview

- Projects mitigate risks associated with the third Advanced Wireless Services (AWS-3) repurposing of DoD spectrum to commercial use and associated transition
- Maintain operational capability resilience in the EMS environment
- Initiated via partnership between the Under Secretary of Defense for Research & Engineering, DoD Chief Information Office, and Joint Staff J6
- First $500M increment funded via the Spectrum Relocation Fund (non-appropriated funds). Newly established as an EC&P Program Element in FY18Q1.

Rapid Innovation Fund (RIF) Overview

- Stimulates innovative technologies and reduces acquisition or lifecycle costs
- Addresses technical risks and improves timeliness and thoroughness of test and evaluation outcomes
- Focuses on short-duration innovative technology development predominantly from small businesses as means of sustaining technology refresh in defense industry and technology dominance for U.S. forces
  - Key program to bridge "valley of death" between advanced technology and programs of record, and sustain small business growth
- Rapidly inserts products directly in support of primarily major defense acquisition programs, but also other defense acquisition programs that meet critical national security needs
- Partners with Office of Small Business Programs (OSBP), Military Services, defense agencies, CCMDs, and industry

How to work with us

JCTD

- Submit proposals in quad chart format to JCTDHelpDesk@osd.mil, Military Services, CCMD, or defense agency technology development offices
- POC: Mr. Elmer Roman, elmer.l.roman.civ@mail.mil

ECTD & QRSP

- Submit proposals in "quad chart" or "white paper" format to us directly at: osd.pentagon.ousd-atl.list.rrto-poc@mail.mil
- POC: Mr. Jon Lazar, jon.e.lazar.civ@mail.mil, (703) 697-4084

RPP

- Submit proposals to Military Service and/or defense agency POCs in response to solicitations on FedBizOps and other open source business announcement/advertisement venues, or, contact us directly at osd.pentagon.ousd-atl.list.rrto-poc@mail.mil
- POC: Mr. Jon Lazar, jon.e.lazar.civ@mail.mil, (703) 697-4084

RIF

- Find more information about RIF on the Defense Innovation Marketplace RIF Portal at: http://www.defenseinnovationmarketplace.mil/rif.html
- Contact us directly at osd.pentagon.ousd-atl.mbx.ia-poc@mail.mil
- POC: Ms. Ellen Purdy, ellen.m.purdy.civ@mail.mil, (571) 372-7545

How to work with us *cont:*

FCT

- Contact the Security Cooperation Office and/or the Defense Attachés in the U.S. Embassy in your country, or, the Defense Attaché and/or trade or science and technology reps in your Embassy in Washington D.C.
- Contact CTO directly at osd.fct@mail.mil, or visit our website at: https://cto.acqcenter.com
- POC: Col Sean "Stu" Bradley, sean.a.bradley.mil@mail.mil, (571) 372-6825

SAR&DP

- Submit proposals to Military Service and/or defense agency POCs in response to solicitations through the National Spectrum Consortium at: https://www.nationalspectrumconsortium.org, or, contact us directly at: osd.pentagon.ousd-atl.mbx.ia-poc@mail.mil
- POC: Ms. Ellen Purdy, ellen.m.purdy.civ@mail.mil. (571) 372-7545

Visit our website at: https://www.acq.osd.mil/ecp

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For Additional Information

Dr. Chuck Perkins
Principal Deputy
Emerging Capability & Prototyping
(703) 697-3802
charles.w.perkins.civ@mail.mil

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Defense Advanced Research Projects Agency

Dick Urban
Special Assistant to the Director

19th Annual NDIA S&ET Conference

March 2018

DARPA's Mission

Breakthrough Technologies and Capabilities for National Security

Precision Guidance & Navigation

Communications/Networking

IR Night Vision

Stealth

Radar Arrays

UAVs

1960s	1970s	1980s	1990s	2000s	2010s	2020s

Microelectronics: VLSI, CAD, manufacturing, IR, RF, MEMS

ARPAnet/Internet

Information Technology: timesharing, client/server, graphics, GUI, RISC, speech recognition

Materials Science: semiconductors, superalloys, carbon fibers, composites, thermoelectrics, ceramics

DARPA's role: Pivotal early investments that change what's possible

Major Factors Shaping DARPA Investments Today

Wide range of threats to the nation:

Enemy states, non-state actors, shifting networks, WMT

Peer competitions on land (Europe), at sea (Asia), and in the EM and space domains

Continuous and persistent counter-terrorism and counter-insurgency operations world-wide

Powerful, globally available technologies set a fast pace

DARPA's Portfolio

Multi-varied threats to the nation

Defend the homeland

Cyber deterrence
Bio threat detection and mitigation
Defense against WMT
Countering hypersonic weapons

Peer competitor confrontations in Europe and Asia

Deter and prevail against high-end adversary

Adaptive lethality for air, land & sea
Control of the EM spectrum
Long range effects
Robust space

Continuous counter-terrorism and counter-insurgency operations

Effectively prosecute stabilization efforts

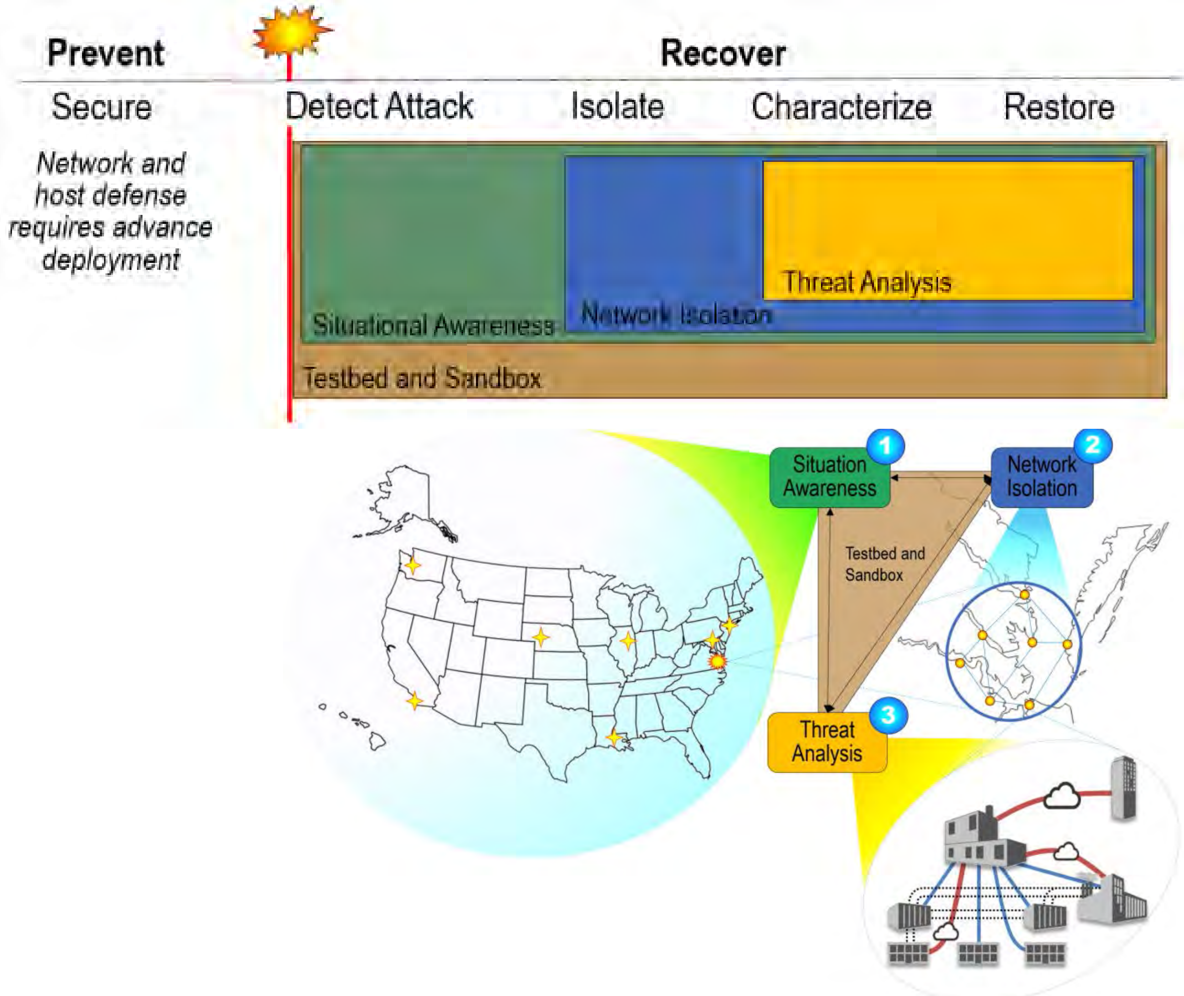
Gray warfare experimentation
Behavior modeling & influence
3D city-scale operations
Warrior performance

Foundations

Understanding complexity, composable systems, advanced materials and electronics, trusted hardware and software, human-machine symbiosis, 3rd wave artificial intelligence, data and social science, new computing, and engineered biology

Increasing the pace of developing technologies and capabilities for the U.S. and allied warfighter

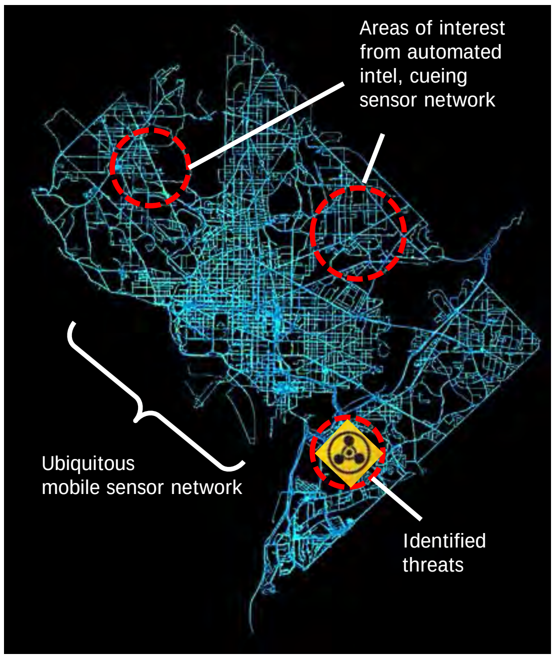
Cyber Deterrence

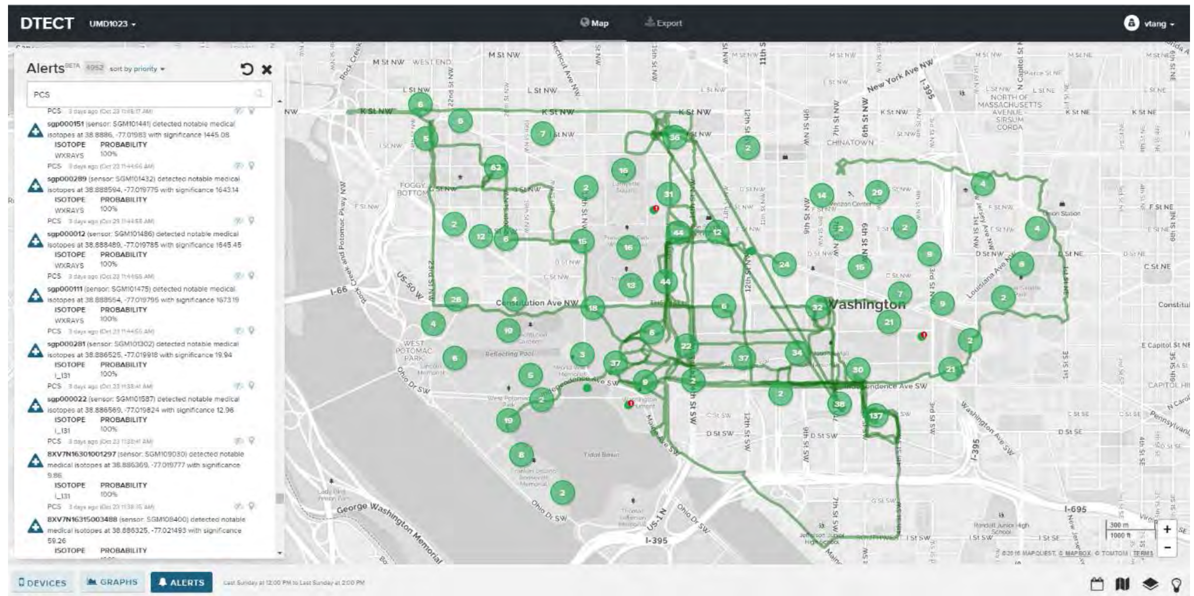


Rapid Attack Detection Isolation & Characterization System (RADICS)

Enable black start recovery of the U.S. power grid within 7 days after a cyber attack

Countering WMT





Command and control and analytics at scale

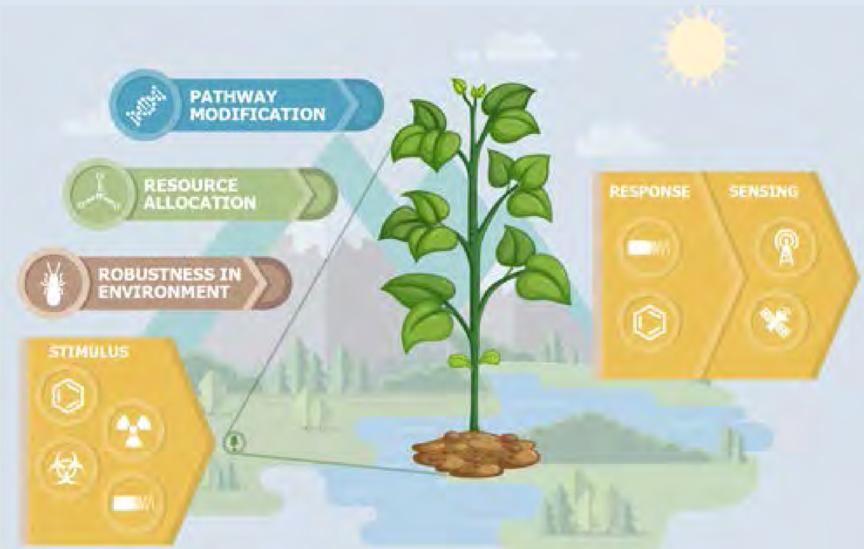
SIGMA+

Persistent, early detection system for the spectrum of CBRNE WMD/WMT threats at city-to-region scales

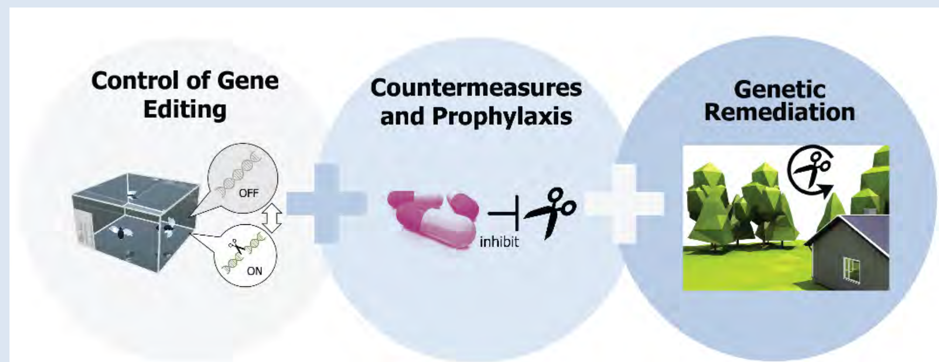
CBRNE: Chemical, biological, radiological, nuclear, and explosives

Bio Threat Detection & Mitigation

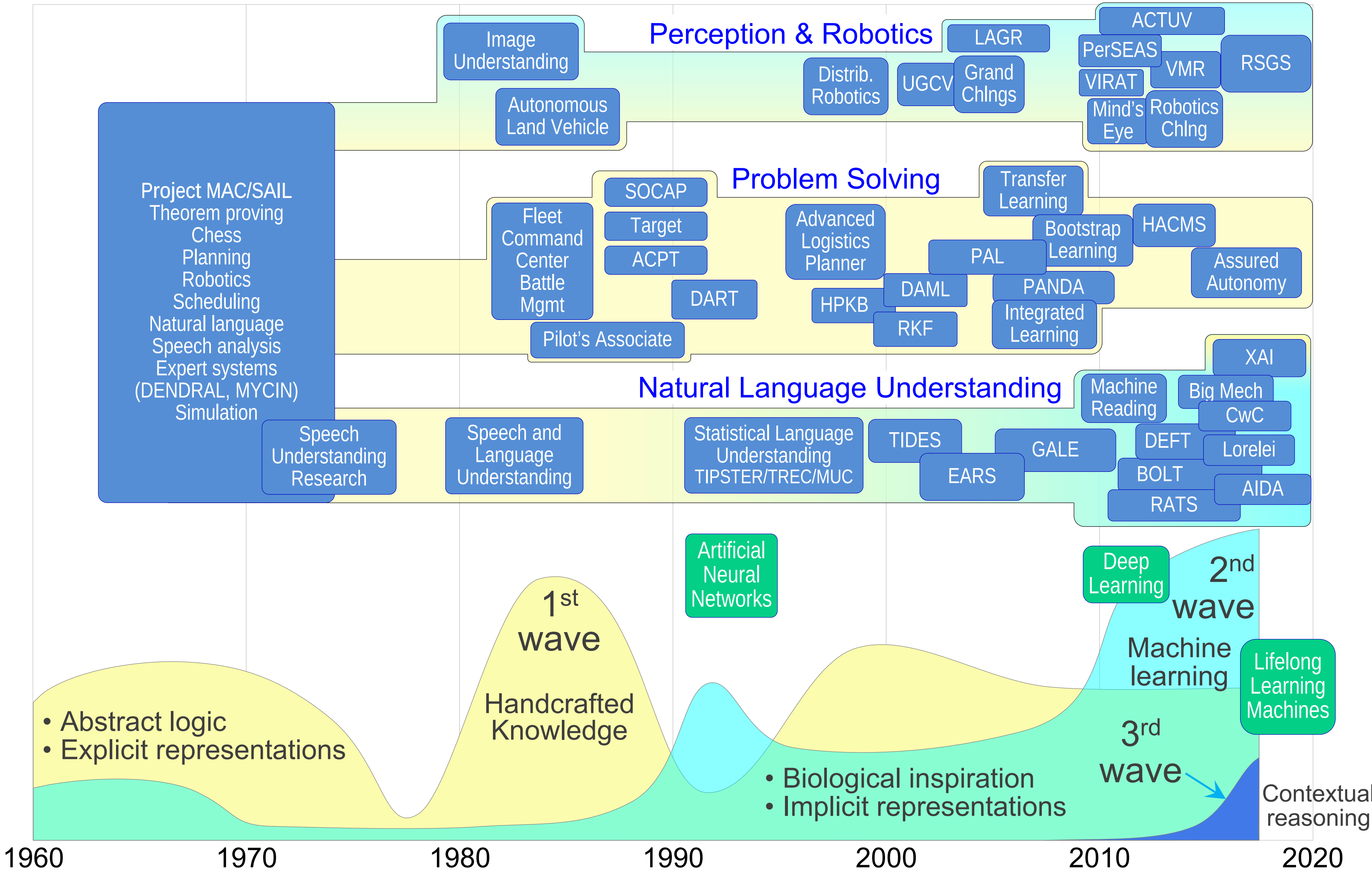
Advanced Plant Technologies



Safe Genes



DARPA Has Funded the Foundations of AI



Select Small UAS Programs

Aerial Dragnet

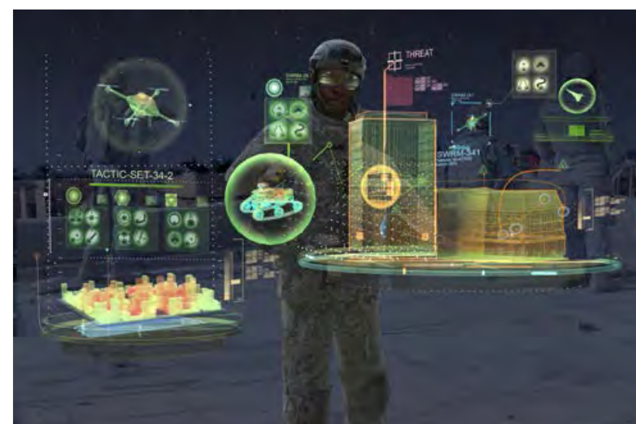
Persistent wide-area surveillance of multiple small UASs in complex terrain

- Early I&W of UAS threats in urban environments before in line of sight
- Signal processing algorithms for NLOS detect, track, classify

Offensive Swarm-Enabled Tactics (OFFSET)

Develop a swarm system architecture to advance swarm tactics

- Generate / assess 100+ swarm & counter-swarm tactics in game-based settings
- Demonstrate real-time interactions with swarm sizes w/over the air tactics <1 min



Select Autonomy Programs

Aircrew Labor In-Cockpit Automation System (ALIAS)

Drop-in system to automate aircraft operation

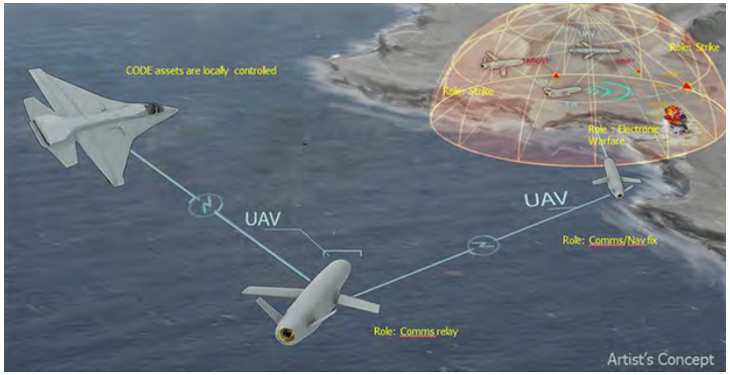
Removable kit that would promote the addition of high levels of automation into existing aircraft, enabling operation with reduced onboard crew

- Support execution of an entire mission from takeoff to landing even in the face of contingency events
- A platform for integrating additional automation or autonomy capabilities

Collaborative Operations in Denied Environment (CODE)

Cooperative autonomy algorithms

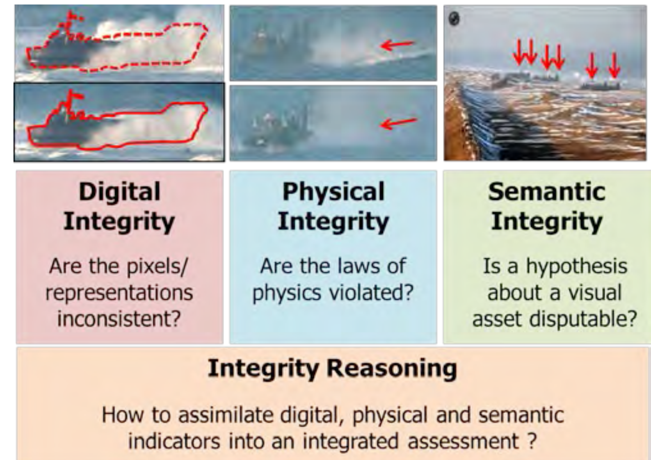
- Navigate, find, track, ID, & engage targets under established rules of engagement
- Recruit other CODE-equipped UASs from nearby friendly forces to augment their own capabilities
- Adapt to dynamic situations such as attrition of friendly forces or the emergence of unanticipated threats



Select Information Programs

Media Forensics (MediFor)

Enhance and scale indicators of digital, physical or semantic manipulation in images and video to enable automatic assessment of their integrity



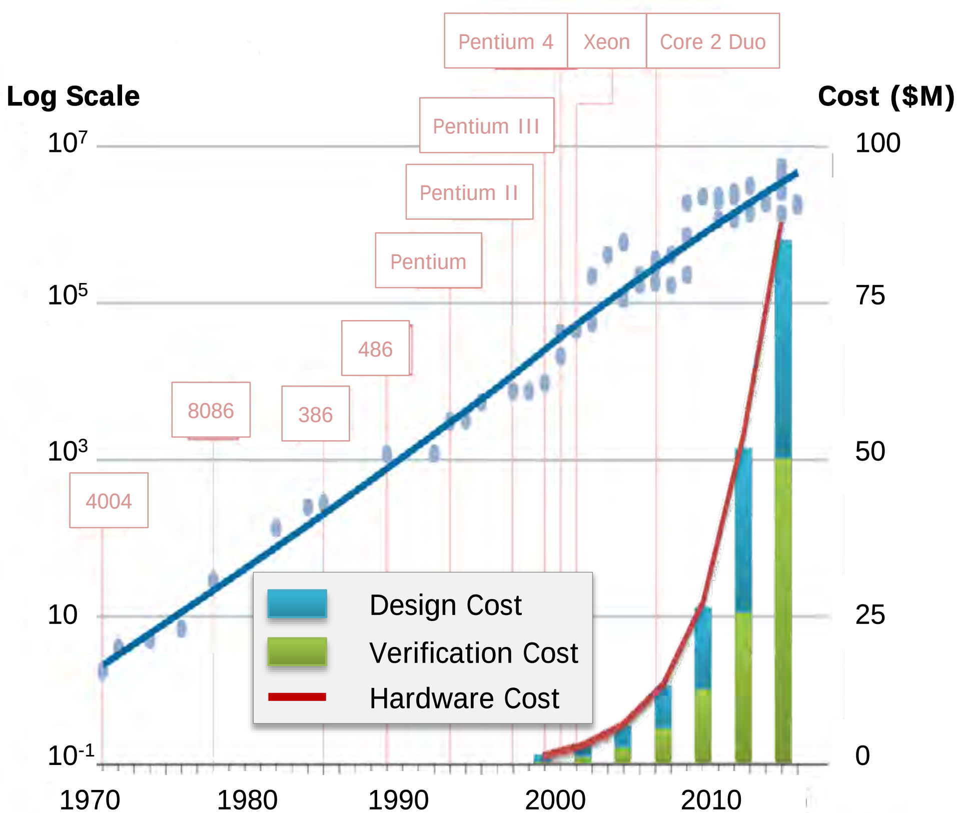
Robust Automatic Transcription of Speech (RATS)

Finding Intel Streams in noisy/distorted Channels across the Spectrum

- Improving DoD capability to find and make use of intercept data in Arabic, Farsi, Dari, Pashto and Urdu
- Funded by Rapid Reaction Technology Office for operations in theater

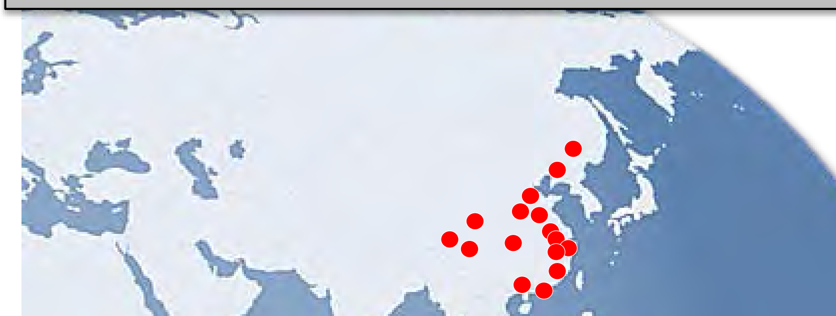
Advanced Electronics

Moore's Law faces an inflection point, where transistor cost stops going down and electronics stop improving as quickly (ISAT)



Sources: Intel; press reports; Bob Colwell; Linley Group; IB Consulting; *The Economist*

Slower innovation benefits China's plan to supplant U.S. leadership (PCAST)



China has:

- Announced $150 billion in semiconductor investments, in 2015
- Begun constructing 26 new 300mm semiconductor foundries
- Launched 1,300 fabless startups
- Formed joint ventures with AMD, ARM, IBM, Intel, GlobalFoundries, and Qualcomm that require IP sharing

ISAT – Information Science and Technology study group
PCAST – President's Council of Advisors for Science and Technology

Advanced Electronics

The Electronics Resurgence Initiative (ERI)

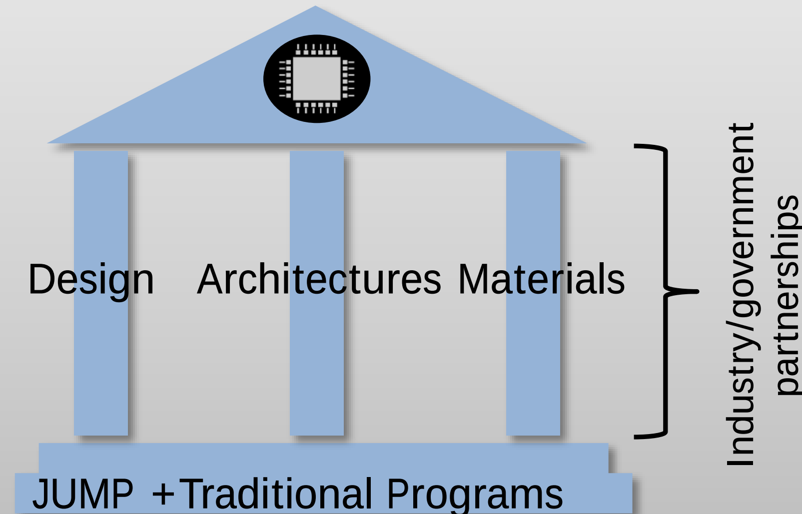
Strategy

Specialize
- Reduce the complexity in leveraging specialized hardware

Decentralize
- Make foreign investments an expensive albatross for manufacturing low-end commodities

Align
- Provide a pipeline of commercially-leveraged electronics for the DoD

2025 – 2030:
National Electronics Capability



JUMP – Joint University Microelectronics Program

Currently in source selection. Kickoff meeting scheduled for July 2018.

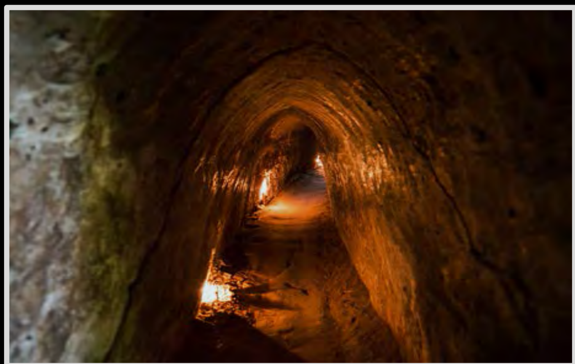
The Spectrum Collaboration Challenge

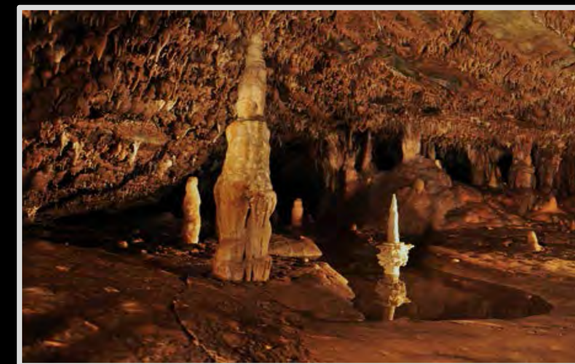
spectrumcollaborationchallenge.com

The DARPA Spectrum Collaboration Challenge (SC2) is the first-of-its-kind collaborative machine-learning competition to overcome scarcity in the radio frequency (RF) spectrum. Today, spectrum is managed by dividing it into rigid, exclusively licensed bands. This human-driven process is not adaptive to the dynamics of supply and demand, and thus cannot exploit the full potential capacity of the spectrum. In SC2, competitors will reimagine a new, more efficient wireless paradigm in which radio networks autonomously collaborate to dynamically determine how the spectrum should be used moment to moment.

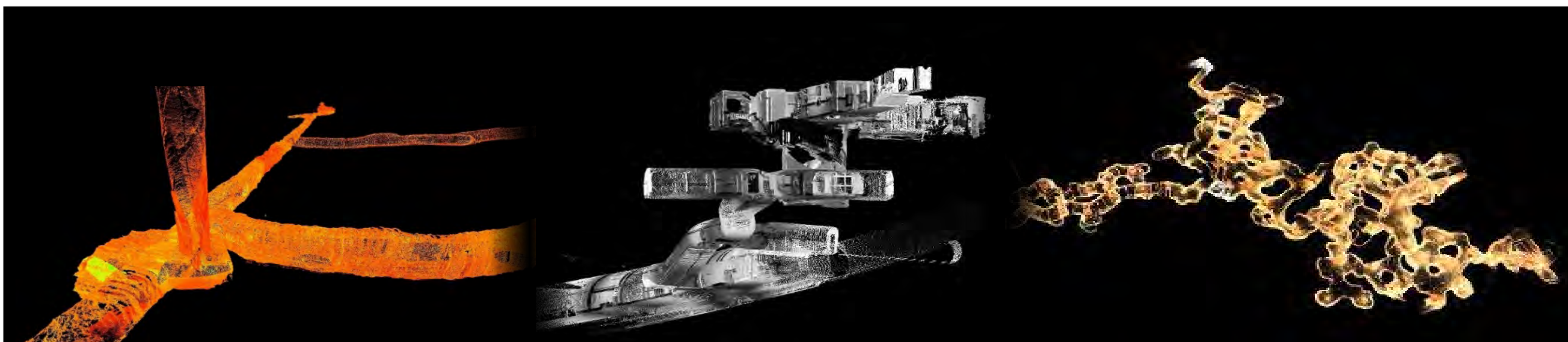
SC2 Championship Event September 2019.

3D City-Scale Operations





Border Tunnels | **Urban Underground** | **Cave Networks**

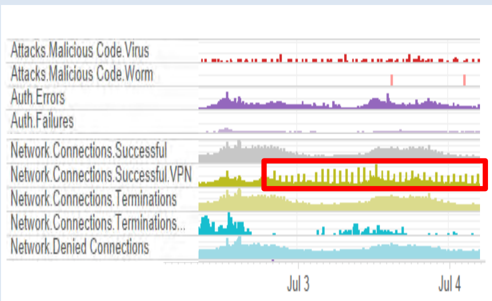


DARPA Subterranean (SubT) Challenge

Discover innovative solutions to map, navigate, and search the diverse subterranean operating environment without and better than humans

Transitions

Net Defense



Detects network infiltration via scalable mathematics to ID anomalous behavior

- Transition of tools and techniques to CYBERCOM and Army Cyber Protection Teams. MOA in place with CYBERCOM

Long-Range Anti-Ship Missile (LRASM)

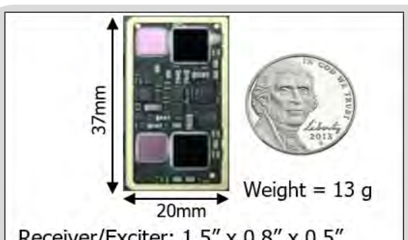
LRASM Deployment Office (LDO) formed in Feb 2014 to address urgent need for Offensive Antisurface Warfare (OASuW) capability in the Pacific Theater

- Early operational capability (EOC) in 2018

Revolutionizing Prosthetics

Recent transition of the “LUKE Arm”, a replacement arm for veteran amputees, with near-natural control and capability

- Received FDA clearance (May 2014)
- Transfer Agreement with Walter Reed National Military Medical Center (Dec 2016)
- First two LUKE arms prescribed by VA (Jun 2017)



Arrays at Commercial Timescales (ACT)

Digitally-interconnected building blocks for large, complex antenna arrays; enables rapid development and upgrades for communications, signals intelligence, radar, and electronic warfare systems

- MOAs in place for transition to Navy, Air Force, and Army programs

D60 Symposium

February 7, 1958 - February 7, 2018

Breakthrough Technology

Past | Present | Future

Date: 5-7 Sep, 2018

Location: Gaylord National Harbor, Oxon Hill, MD

Goals:
Strengthen and expand DARPA's innovation
Inform key stakeholders about DARPA's vision
Learn from DARPA's achievements past and present

PLENARY SESSIONS

- BioNext
- Deter Cyber Attack
- Electronics Resurgence
- Enterprise Disruption
- Mosaic Warfare
- Preventing Weapons of Mass Terror (WMT)

BREAKOUT SESSIONS

- Alternative Computing
- Autonomy & Robotics
- Power Behind the AI Surge
- The Future of Space
- Trajectory of Neurotech
- Understanding the Evolving Urban Threat
- DARPA & Academia
- DARPA at the Tactical Edge
- DARPA Grand Challenges
- Why it Matters: New Spin on Spintronics
- X-Planes: Past, Present and Future

SPEAKERS INCLUDING

- Vint Cerf
- Vijay Kumar
- Manuela Veloso
- Pradeep Khosla
- Steve Wax
- Jim Hendler
- Tony Tether
- Brian Nosek
- Yolanda Gil
- Albert Fert

EXHIBITS AND DEMOS

- Microsystems Technology Office
- Tactical Technology Office
- Information Innovation Office
- Strategic Technology Office
- Defense Sciences Office
- Biological Technologies Office
- DARPA Historical Exhibit

Registration Opens April 16, 2018
www.darpa.mil

DARPA

www.darpa.mil

DTRA Research and Development

Rhys M. Williams, Ph.D.

March 20, 2018

Distribution Statement A .
Approved for public release;
distribution is unlimited.

Agency Mission

The Defense Threat Reduction Agency enables DoD and the U.S. Government to prepare for and combat weapons of mass destruction and improvised threats and to ensure nuclear deterrence

Agency Evolution

2016
Joint Improvised-Threat Defeat Organization Integrated

1998
DTRA Established

- *Sustain nuclear deterrent*
- *Growing nonproliferation and counterproliferation mission*
- *Increased Arms Control Implem/Verif*
- *Rapid capability delivery*

WMD Terrorism, Counter Improvised Threats

1996-1998
Defense Special Weapons Agency

- *Post-Cold War environment*
- *Joint Science Programs, munitions effects, hard targets*
- *Nuclear Stockpile Stewardship*

Non-nuclear development, WMD Nonproliferation

1971-1996
Defense Nuclear Agency

- *Operational Safety*
- *Cooperative Threat Reduction Initiated*
- *End of Nuclear Testing*

Counter-proliferation, Arms Control Implementation/Verification

1959-1971
Defense Atomic Support Agency

- *Nuclear effects research and testing*
- *Force modernization*
- *Limited Test Ban Treaty*

Research, Modeling

1947-1959
Armed Forces Special Weapons Project

- *Weapon custody*
- *Operational Storage*
- *Weapons Effects Testing*

Deterrence, Survivability

1941-1947
Manhattan Engineering District

- *Initial atomic weapons program*

Weapons Development

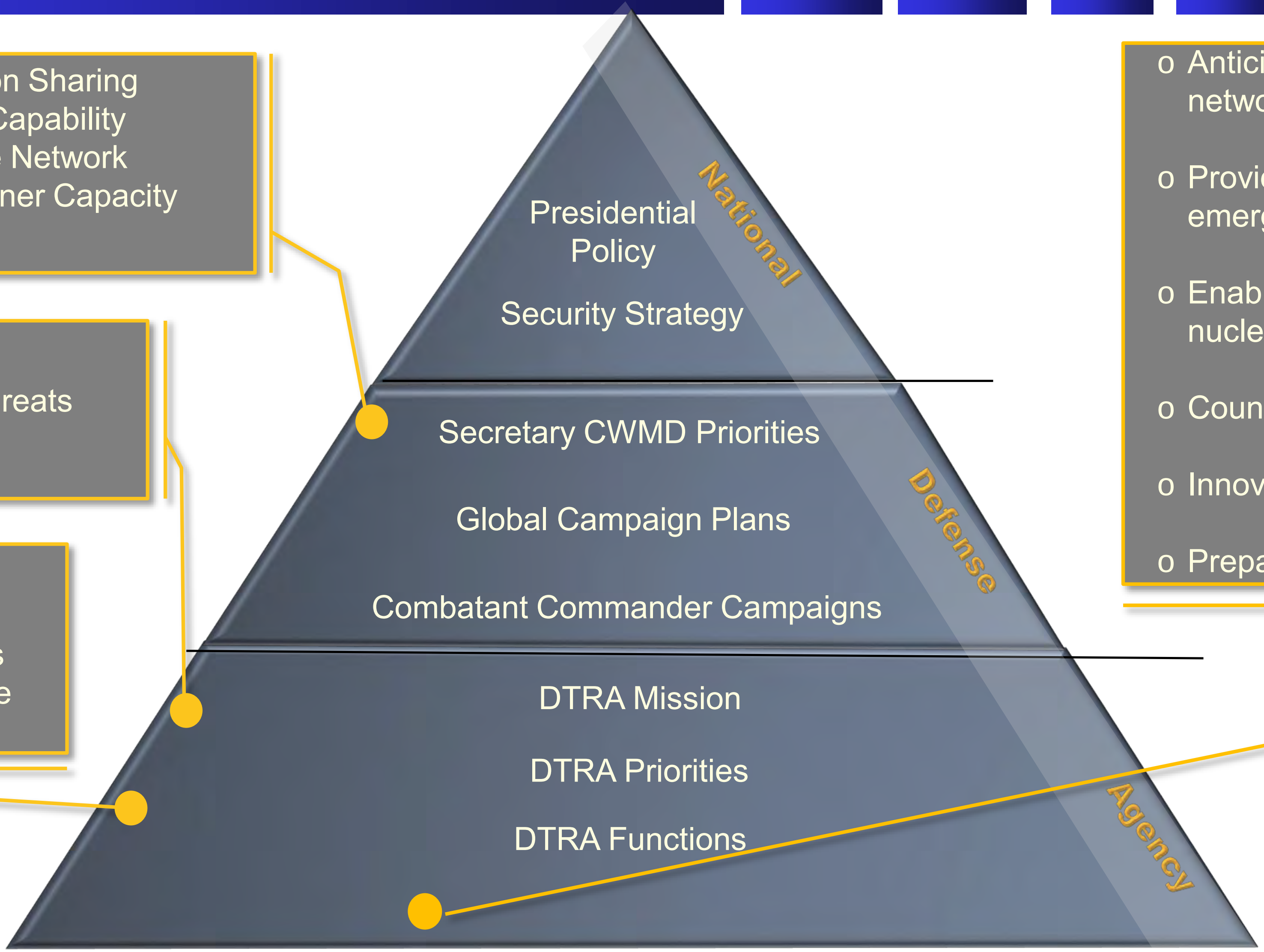
The Agency evolved over 76 years to incorporate additional missions and complexity that directly impact U.S. national security and combat support to the warfighter

Agency Strategic Approach

- o Information Sharing
- o Develop Capability
- o Attack the Network
- o Build Partner Capacity

- o Counter-WMD
- o Counter-Improvised Threats
- o Nuclear Deterrence

- o Engage with partners
- o Innovate capability
- o Respond to warfighters
- o Empower the workforce



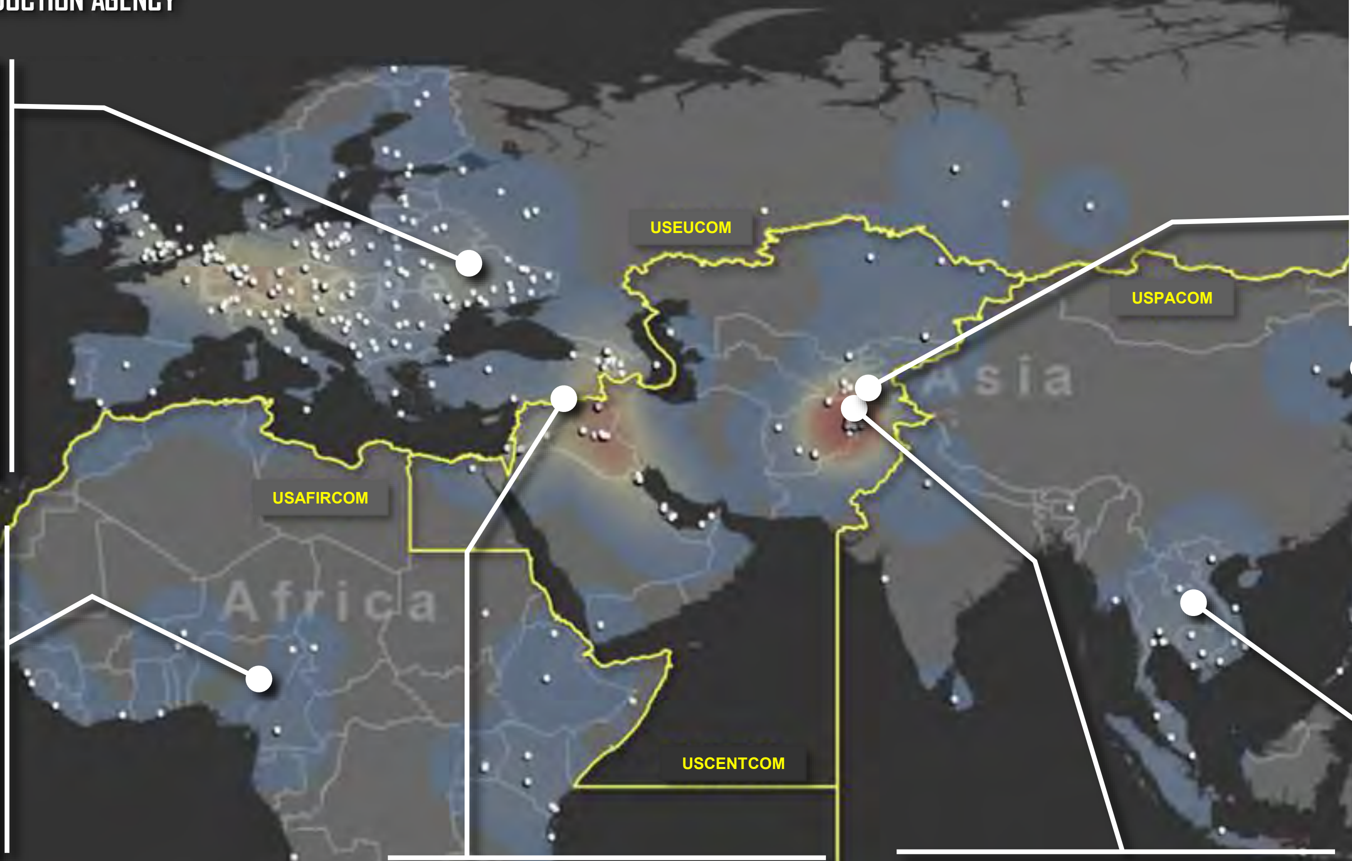
- o Anticipate & understand future threat networks
- o Provide understanding of current & emerging threats & defeat options
- o Enable a safe, secure, & effective nuclear deterrent
- o Counter proliferation & facilitation
- o Innovate capability solutions
- o Prepare for & respond to crisis

DTRA GLOBAL REACH

DEFENSE THREAT REDUCTION AGENCY

Over 2,500 Global Engagements in the Past Year

2943 Site Locations | 2637 Missions | 110 Countries | 48 US States



(U) Dismantling FSU WMD infrastructure, preventing WMD smuggling, and building WMD response capacity

(U) Reducing biological threats in sub-Saharan Africa

(U) Development in technology, tools and equipment advances DTRA in the IED fight

(U) Targeting and technical reach-back for OIR/RSM, and border security cooperation in Jordan

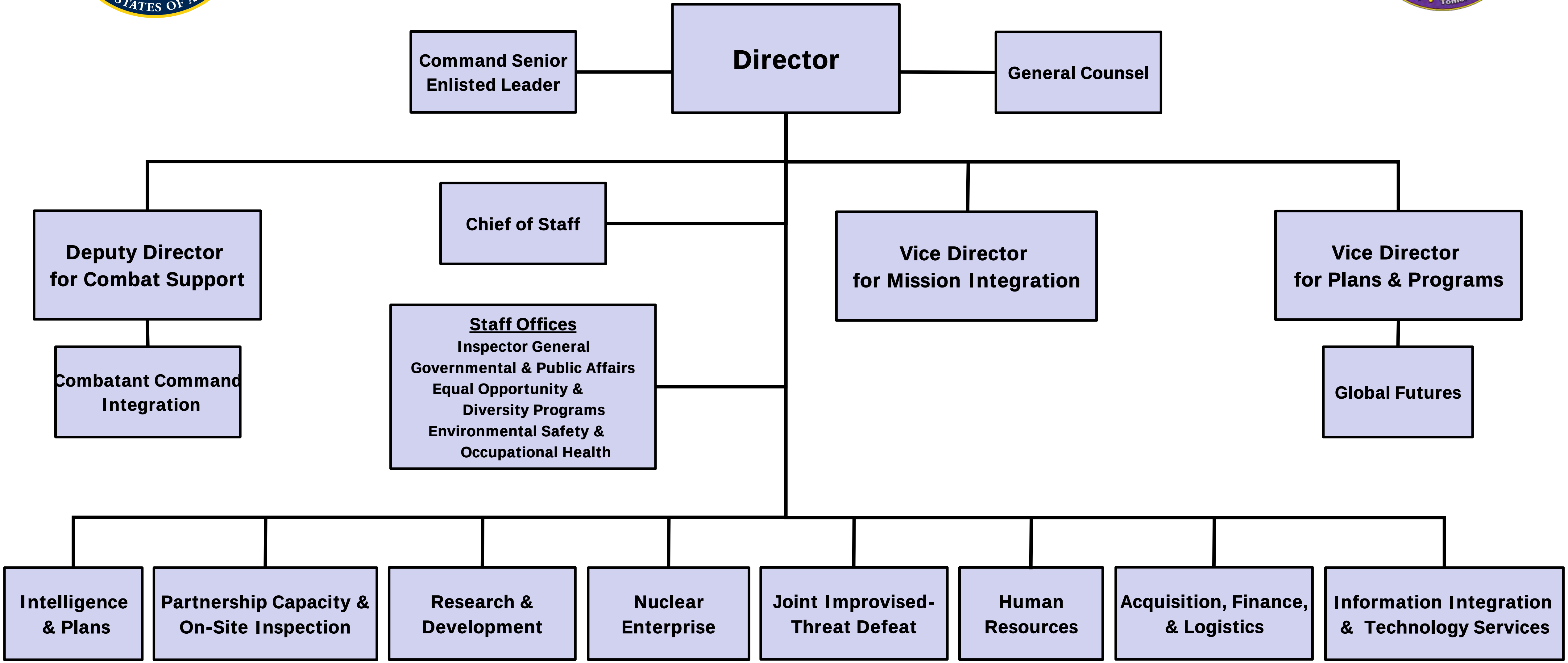
(U) Counter-Improvised Threat rapid acquisition and embedded "Counter Threat Networks" support

(U) Seeking additional Senior Leader engagements in Afghanistan to build on OIR/RSM lessons learned

(U) USFK/CFC WMD OPS Exercise Support

(U) Building CBRN defense and response capacity in Southeast Asia

DTRA Organization Chart



Mission and Vision

Our R&D Mission

Provide research, development, test and evaluation (RDT&E) investments that focus on maintaining the U.S. military's CWMD technological superiority, supporting current readiness, and mitigating the risks of technical surprise for the CWMD mission.

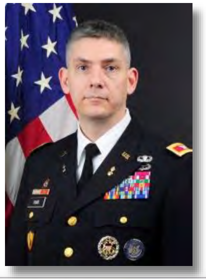
Our R&D Vision

Be the recognized leader for CWMD technical innovation – responding to urgent warfighter needs while investing in R&D to shape the Nation's CWMD capabilities.

Research and Development Organization

Dr. Rhys Williams

Director, RD



COL William Viar
Deputy Director,
RD

Dr. Ronald Hann
Chemical Biological
Technologies (RD-CB)

Mr. Stephen Dowling
Counter WMD
Technologies (RD-CX)

Dr. Michael Kuliasha
Nuclear Technologies
(RD-NT)

CAPT Victor Lake
Data Integration and
Analysis (RD-IA)

Dr. Gary Hood
Test Science and
Technology (RD-TS)

COL Matthew Sandelier
Chief Scientist and
Innovation (RD-ST)

DTRA S&T Portfolio Aligns with DTRA Missions, DoD CWMD Strategy, and SecDef LOEs

Understand the Environment, Threats, and Vulnerabilities

Control, Defeat, Disable and/or Dispose WMD Threats

Safeguard the Force and Manage Consequences

Nuclear Detection

Nuclear Survivability

Nuclear Effects

Nuclear Forensics

Nuclear Survivability

Nuclear Effects

Special Programs

Target Assessment Technologies

WMD Counterforce Technologies

CWMD Weapons and Capabilities

Counter-Terrorism Technologies

Chem-Bio Defense Program
Sense / Shape

Chem-Bio Defense Program
Sense / Shape
Shield / Sustain

24/7 Reach Back • CWMD Testing Capabilities • Advanced Analytics • Basic Research • Interagency & International Leverage

LOE 1 – Build a More Lethal Force

LOE 2 – Strengthen Alliances and Attract New Partners

LOE 3 – Reform the Department

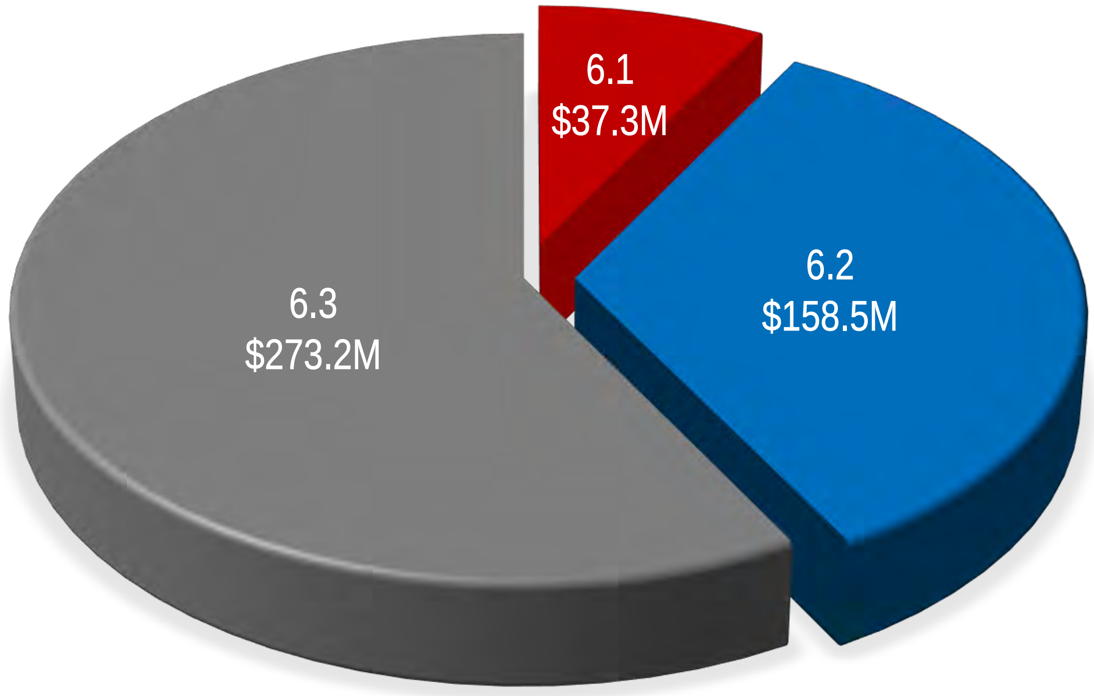
DTRA S&T Project Category

- *Contributes to Enhancing the Strategic Deterrent*
- *Focused on Countering WMD*
- *Chem-Bio Defense Program*
- *Enabling Technology*

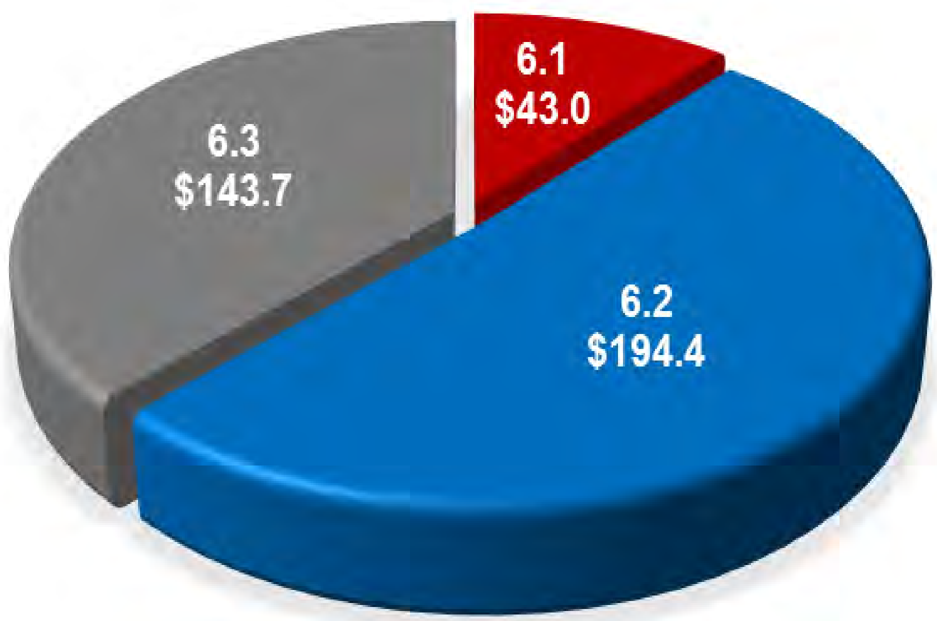
FY 2019 DTRA S&T Funding

Total S&T Portfolio: $850.2M

DTRA S&T PORTFOLIO: $469.0M



CBDP S&T PORTFOLIO: $381.2M



Capability Development in Support of Warfighter Requirements

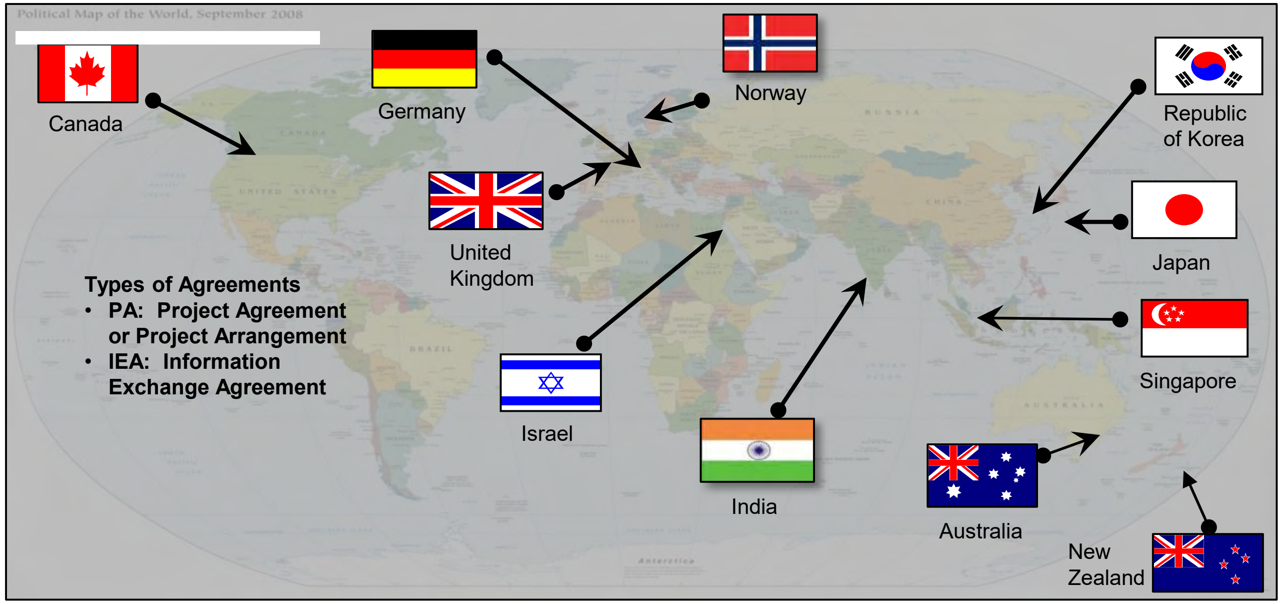
- Enhance the nuclear enterprise and maintain nuclear competencies
- Global Situational Awareness and Surveillance
  - Dissemination of timely sensor warning and reporting with automated, networked monitoring and near real-time integration of surveillance information
  - Radiological and biological detection and medical diagnostic capabilities for expeditionary missions, detect-to-warn, and rapid field identification of hazards
  - Rapidly deployable, enhanced low-visibility ISR capabilities that exploit alternative signals and compress attribution, warning, and response timelines
- Holding WMD programs, facilities, and materials at risk in all environments
  - Delay, disrupt and defeat adversaries' acquisition paths for materials or expertise, via kinetic or non-kinetic means
  - Ability to locate, characterize, secure, and destroy (or render safe) all weapons on a large scale and in complex operational environments
- Application of emerging technologies and data analytics to WMD
  - Technology forecasting capabilities to anticipate mid-term, emergent threats and relevant technologies
- Medical and physical (material) protection from CBRN threats, including conventional, non-traditional, and emerging CBRN threats

Interagency and International S&T Partners

Understand the Environment, Threats, and Vulnerabilities*

Control, Defeat, Disable, and Dispose of WMD Threats*

Safeguard the Force and Manage Consequences



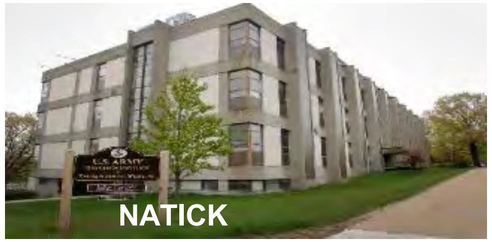
Enhancing Capability and Interoperability through International Partnerships

- Accelerate development of U.S. C-CBRNE capabilities by accessing unique foreign S&T resources and sharing costs
- S&T Areas Include
  - Nuclear Effects and Survivability
  - Enhanced Explosives and Conventional Weapons Effects
  - CBR Detection
  - Protection
  - Medical Countermeasures
  - Modeling and Simulation
  - Decision Support

*Strategic objectives in the DoD Strategy for Countering WMD, June 2014

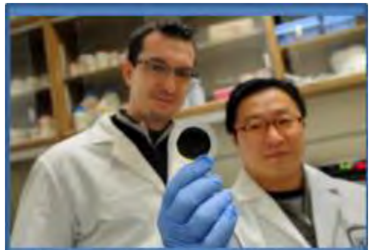
CBDP S&T - Sustains Unique and World-class DoD Capabilities

Sustaining Critical CBDP Laboratory Core Competencies provides unparalleled R&D capabilities *and the Ability to Surge in a Crisis*



CB S&T investments fund hundreds of CBRN scientists and engineers with unique expertise or experience not readily available in the private sector


Chemists at ECBC are studying an unknown chemical sample


Chemical engineers display nanofiber fabric at LLNL


Scientists are conducting BSL-4 training at USAMRIID


Scientist weighs aluminum powder for an energetics project in laboratory at NSWC.

DoD CWMD S&T workforce face many of the same challenges as the broader S&T community.

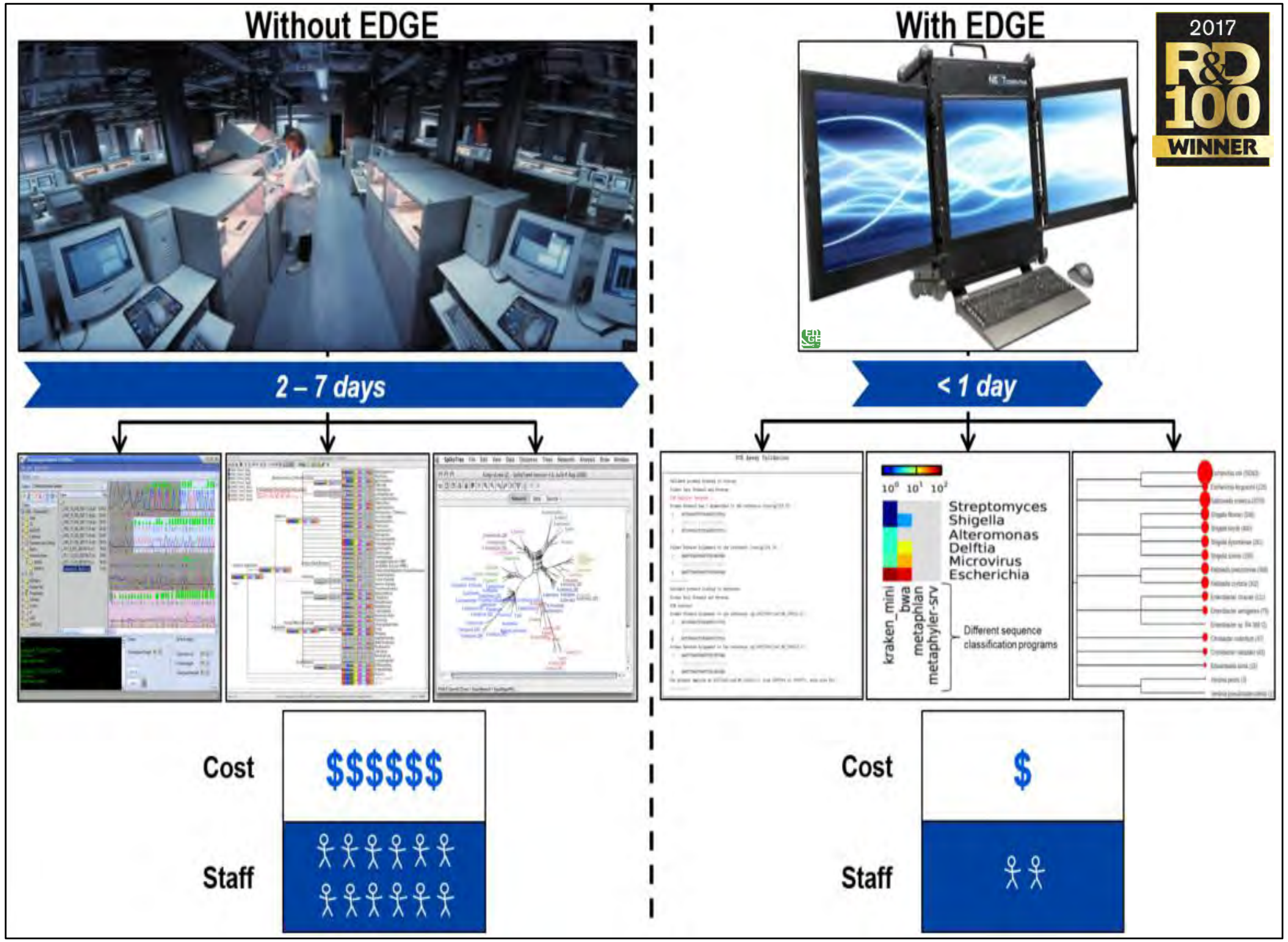

Scientist in Foxhole effort exposes scientists to experiences of the warfighter

<u>Mitigating Surprise</u>: DoD Laboratories, Test Ranges, and Scientific Expertise provide cutting-edge capabilities, flexibility, and agility required to address current and emergent threats.

Empowering the Development of Genomics Expertise (EDGE) Bioinformatics

- Genomics: DNA provides the template for all animate things on Earth and *codes* for various building blocks such as amino acids, proteins, and genes

- EDGE bioinformatics provides a comprehensive, intuitive, and user-friendly genomic analysis solution that addresses complex big data challenge for genomics



JIDO Focus Areas

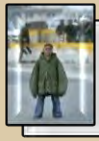

Standoff Detection


Miniaturization & integration of sensors


Vehicle attached IEDs


Situational Understanding in Anti-Access/Area Denial (A2AD) environments


Identifying explosive threats within structures


Person-Borne IEDs (PBIEDs)


Counter VBIED


Electronic countermeasures (ECM) for advanced wireless signals & techniques


Virtual Advise & Assist

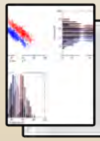

Remote neutralization of HME and precursors


Counter-UAS methods


Anti-armor IED detect & defeat


Subterranean Void Detection & Defeat


Processing, Exploitation and Dissemination (PED) for integrated sensors


Data Analytics


Pre-detonation capabilities


Safeguarding GPS functionality


Mounted detection that enables rate of advance

Future capabilities must be:	Scalable – Affordable – Adaptable – Expeditionary – Domestic Application – Whole-of-Government Approach

Dismount Digital Detector Array (DDA) through Industry-Partnership

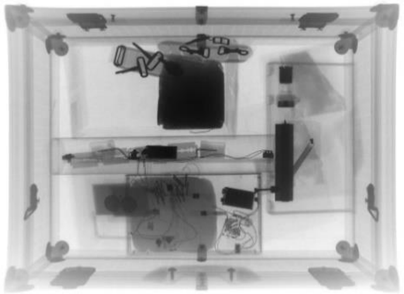
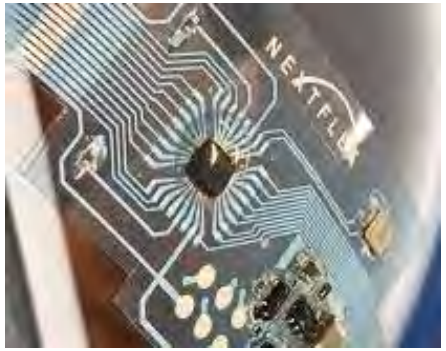
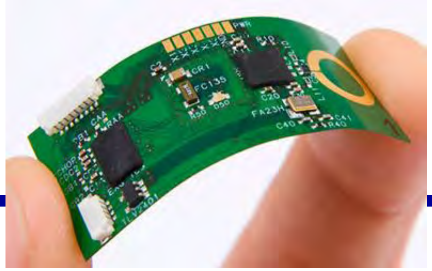


Image from DDA

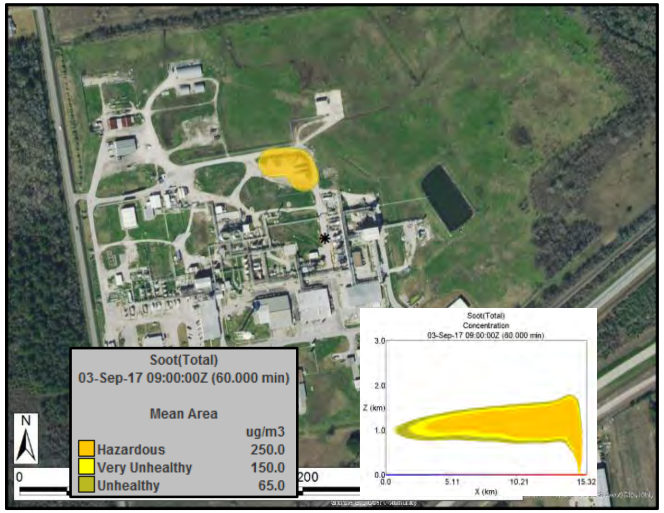
- Military and other federal X-ray portable imagers are large and fail to meet requirements
- Partner with Army & OSD to develop:
  - Man portable light-weight, rugged digital flexible x-ray imaging arrays
  - Enable fully-flexible & novel system form-factors
- Successfully developed very large flexible DDA
  - 10” diag, less than 0.25” edges, less than 3lbs
  - Flexible electronic sensors on plastic substrates





IMAAC Activation (Aug 29-Sep 3, 2017) Arkema Chemical Plant, Crosby, TX

- Assisted TX authorities to respond to a chemical fire caused by flooding from Hurricane Harvey
- DTRA worked with with many intergovernmental parnters to coordinate evacuation areas over the 6 days
- Leveraged multiple modeling software tools to provide twice daily plume updates
- Expertise from multiple agencies ensured best science brought to First Responders!



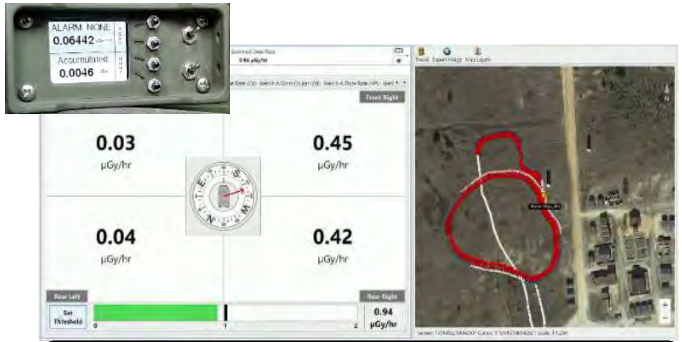
MERLIN/VIPER – Putting the "Nuclear" back in NBC

Designed for armored vehicles to detect on the move

MERLIN-BOSS (CONTROL)

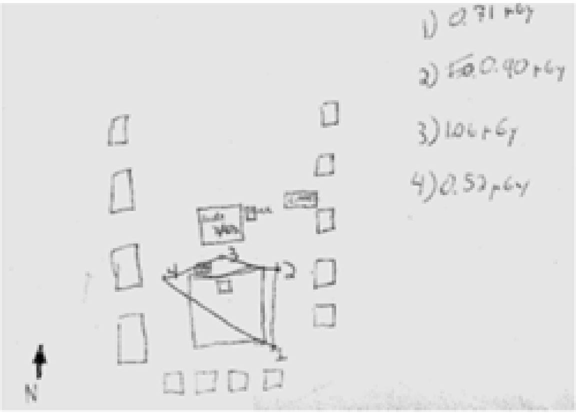
VIPER

Enhanced Crew Dosimeter



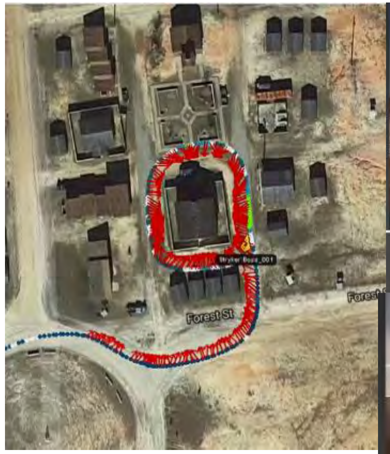
New MFK/TAK interface provides ease of operation by users

Revolutionary ISR products for the users and leaders faster, and more accurate than current methods and equipment to enhance mission command



Using current equipment (VDR-2) 30 minute "Best Guess"

ISR capability after 5 minutes

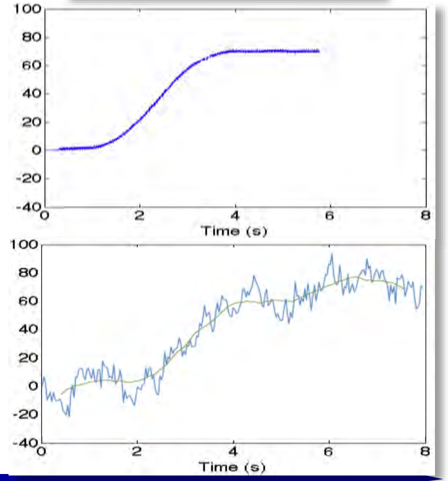


- ***Minimized radiation exposure/hazard avoidance through stand-off detection capability***
- ***Reduced decontamination requirements***
- ***Increase/maintain tactical maneuver***
- ***Increased R/N battlefield awareness***
- ***Maintain formations' capabilities to continue the fight on a R/N battlefield***
- ***New CONOPs, including: Hazard ID, point-source detection, survey, fall-out field navigation, route clearance, etc.***

Limited visibility Operations

Aerial Digital Image Correlation (DIC)

- Drone-based DIC capability
  - o DIC: stereoscopic image analysis to generate 3D measurements of changes
- Capstone event
  - o Three underground explosions, 24-26 Apr 18



Small Business Investment Success

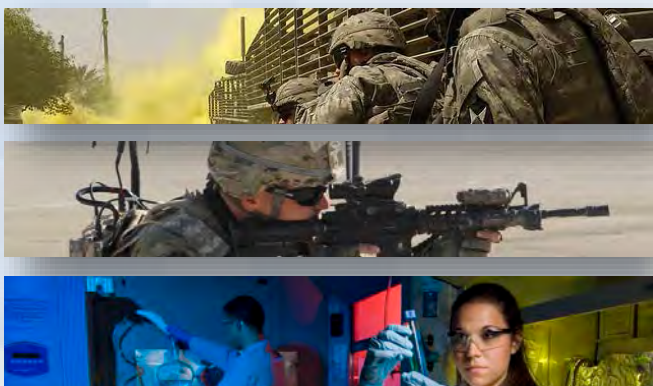
- Two Congressionally-mandated programs funding R&D Small Businesses to create and deliver cost-effective innovation
  - Small Business Innovation Research (est. 1982) FY18 - $9.1M
  - Small Business Technology Transfer (est. 1992) FY18 - $1.1M
- Examples of focus areas being addressed by SBIR/ STTR include:
  - Rapid development of weapons payloads via additive manufacturing
  - Automated approaches to identifying potential dual-use research
  - Mitigation of radiation effects in advanced electronics technology nodes
- Successes in innovation, commercial sales, and demonstrated relevance
  - Multibeam Corporation: From Phase I Proof of Concept to $35M Phase III award to manufacture an advanced E-Beam system for Integrated Circuit production.
  - Radiation Monitoring Devices, Inc. / Proportional Technologies, Inc./ Development of non-HE-3 based neutron/gamma detectors

DTRA RDT&E Summary

- DoD’s R&D organization focused on CWMD
  - Executes the two primary DoD CWMD S&T programs
  - Integration of JIDO’s efforts adds significant value to overall RDT&E portfolio
- Responds to national/DoD CWMD priorities and SecDef’s Lines of Effort (LOE)
  - Supports the strategic deterrent
  - Provides USSOCOM primary support for CWMD capabilities
  - Develops, coordinates, and transitions CBDP S&T medical and physical sciences technologies for validated joint military capability needs
- WMD-related research into over 100 universities
- Preserves core scientific and technology capabilities within the Military Service laboratories
- Comprehensive integrated R&D investment increases agility to respond to new/changing requirements

Army Science & Technology

The Army Science & Technology Program



Jeffrey D. Singleton
Director for Technology
Office of the Deputy Assistant Secretary of the Army
Research and Technology

20 March 2018

Army Modernization Priorities

SECRETARY OF THE ARMY
WASHINGTON

29 SEP 2017

MEMORANDUM FOR THE DEPUTY UNDER SECRETARY OF THE ARMY

SUBJECT: Science and Technology Portfolio Realignment

1. The August 2017 senior leader review of the Fiscal Year 19-23 Program Objective Memorandum determined that the investment portfolio does not fully support the Army's new modernization priorities:

   a. Precision Fires

   b. Next Generation Combat Vehicle (NGCV)

   c. Future Vertical Lift (FVL)

   d. Network/Command, Control, Communications and Intelligence (C3I)

   e. Air and Missile Defense (AMD)

   f. Soldier Lethality

2. To maximize effectiveness for the Warfighter, the Army must immediately review the fiscal year 2018 (FY18) and FY19 investments to ensure the investments align with the new priorities—realigning what can be changed in the investment portfolio for FY18 budget and FY19 program to better support the six modernization priorities.

3. Roadmaps and metrics will be developed for the evaluation of the investment portfolio to allow for reallocating resources when a program does not deliver the needed outcome.

4. I expect the Army Staff and Secretariat, to include the organizations to whom a copy of this memorandum has been furnished, to support this important endeavor.

5. The Deputy Under Secretary of the Army will oversee these efforts and will provide bi-weekly updates to the Under Secretary of the Army and Vice Chief of Staff of the Army.

Ryan D. McCarthy

Ryan D. McCarthy
Acting

DISTRIBUTION:
(see next page)

Army S&T Investments by Priority

PB19 - $13.7B (FY19-23)

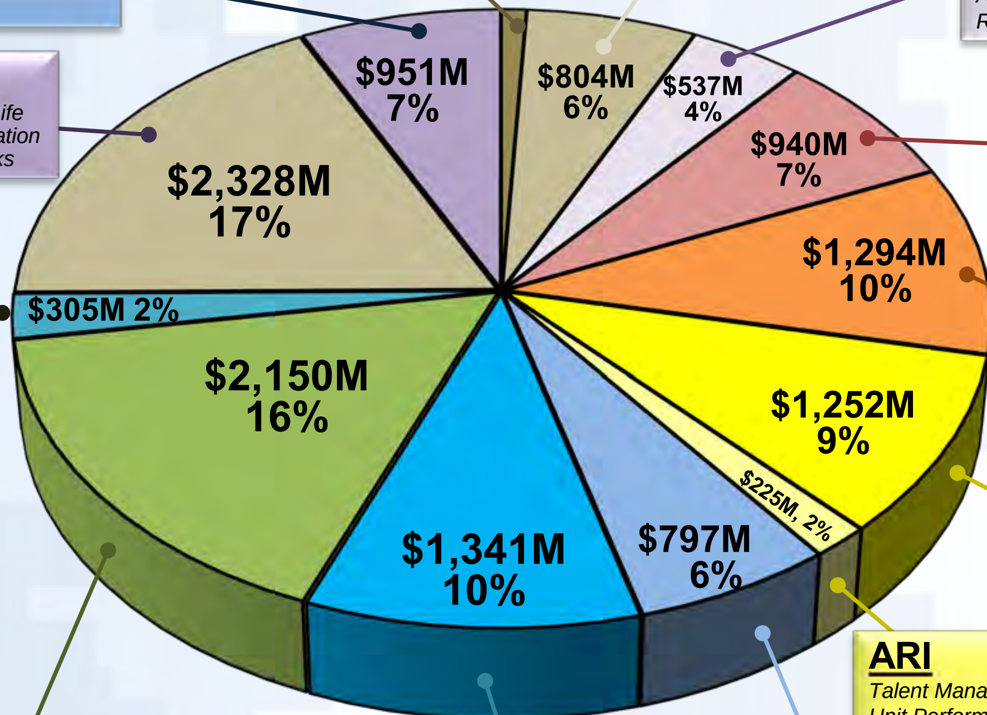
Management Support
Classified; Technical Information Activities
$116M, 1%

Maturation
Technology Maturation Initiatives; Manufacturing Technology

Air and Missile Defense
Smaller & Cheaper Missiles
High Energy Lasers
Gun Based C-Tactical & Small UAS
Advanced Seekers
Advanced Energetics & Propulsion
Radars

HPCMP
High Performance Modernization Program (DoD)

Basic Research
Materials Science; Medical/Life Sciences; Quantum / Information Science; Autonomy; Networks



Long Range Precison Fires
Propulsion for Extended Range Missiles
Extended Range Cannon Artillery
Enhanced Guidance / Navigation for Weapons
Advanced Energetics
Advanced Warheads for Cluster Munitions
Radars

Enabling
Anti-Tamper
Atmospheric Modeling
Logistics Planning R&D
Structural Hardening
Breaching Technologies
Components
Maneuver in Complex Environments

Network/C3I
Tactical Communications
Mission Command
Cyber Electromagnetic Activities
Assured Position, Navigation & Timing
Persistent ISR

Soldier/Lethality
Soldier & Squad Weapons
Training
Soldier Protective Equip
Situational Awareness
Physical/Cognitive Performance
Prolonged Field Medical Care

ARI
Talent Management
Unit Performance and Cohesion
Integrated Assessments

Next Generation Combat Vehicle
Next Gen Combat Vehicles Design
Vehicle Protection Against Advanced Threats
Advanced Power Generation and Distribution
AI, Robotics and Autonomy for Logistics & Combat Ops
Advanced Energetics & Direct Fire Weapons Systems

Future Vertical Lift
Platform Development and Demonstration
Next Generation Unmanned Aircraft System Technologies
Aviation Protection / Aircraft Survivability
Situational Awareness
Integrated Mission Systems
Advanced Power Systems

Medical
Combat Casualty Care, Infectious Disease mitigation, clinical/rehabilitative medicine

Army Investments	FY19-23
BA1	$2,328M
BA2	$4,767M
BA3	$5,290M
BA4	$522M
BA7	$301M

BA6 $155M, Procurement $350M

Version: 26 Jan 2018

Long Range Precision Fires

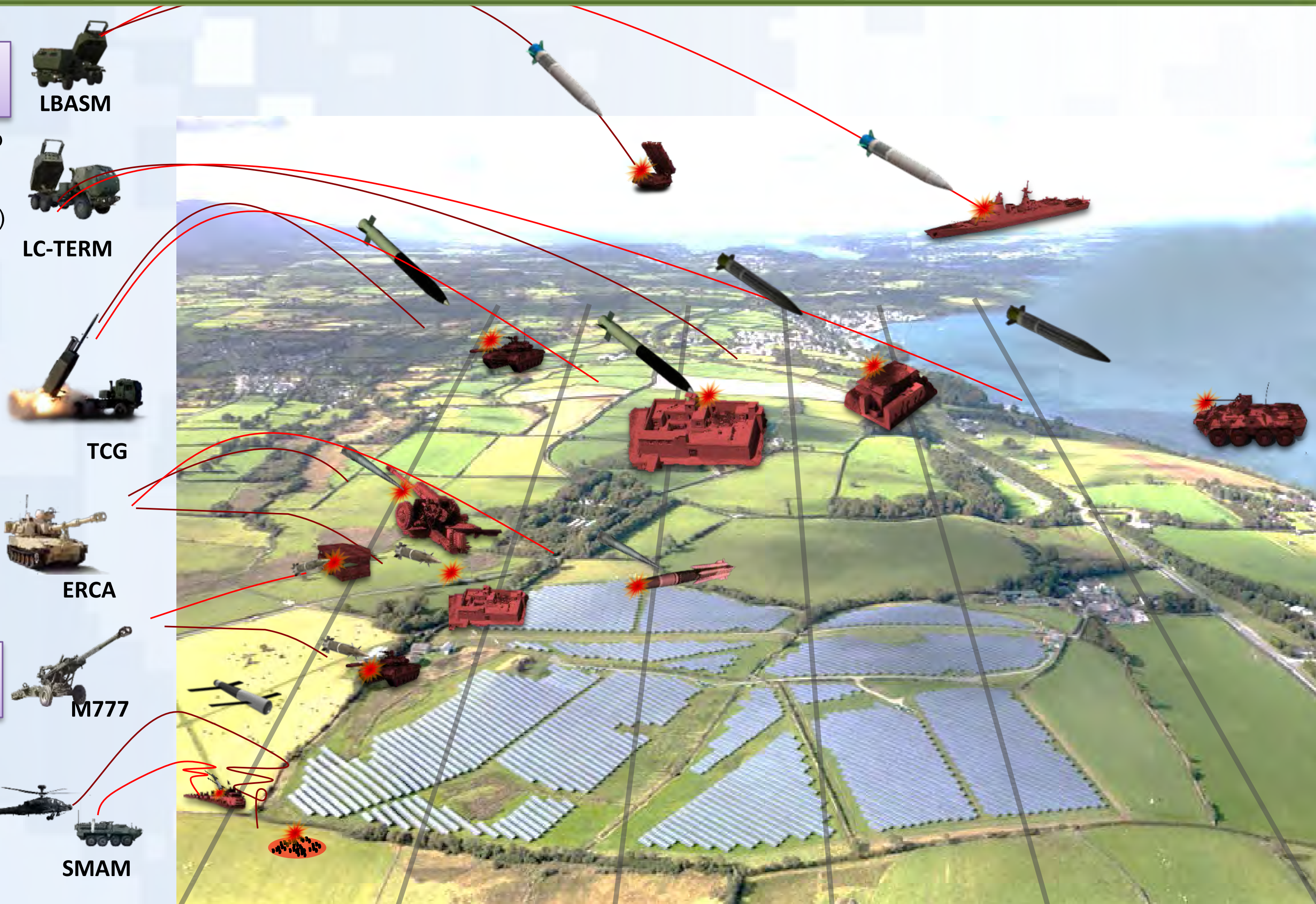
Goal: Provide extended range allowing an increased capability to support maneuver and counter enemy long-range systems.

Technology Demonstrations

- Land-Based Anti- Ship Missile (LBASM)
- Single Multi-mission Attack Missile (SMAM)
- Multiple Simultaneous Engagement Technologies (MSET)
- Extended Range Cannon Artillery (ERCA)
- Low Cost – Tactical Extended Range Missile
- Cluster Munition Replacement Technologies
- Long Range Maneuverable Fires (LRMF)

Critical Technology Areas

- Extend Range
- Expand Coverage
- Enable Cross-domain Maneuver



Land-Based Anti-Ship Missile (LBASM)

Payoff:

- Cross-domain Fires: enables Multi-Domain Battle through the projection of power from land into the maritime domain
- Tier One CNA16 Capability Gap 501343 (High Risk): capability to engage, & defeat surface targets located in littoral waters up to 499km range
- Tier One CNA16 Capability Gap 550083 (Extremely High Risk): capability to destroy enemy air defenses

Purpose:

- Adapt Army and Marine Corps HIMARS and MLRS rocket and artillery systems to provide a Defeat of Enemy Air Defense (DEAD) capability against land- and maritime-based targets

Products:

- Development and demonstration of appropriate sensor, datalink, and payload component technologies for engaging and defeating land- and maritime-based ADA
- Integration of these component technologies into prototype missile hardware and demonstration of this hardware in a relevant flight environment
- Provides evidence for the feasibility of adapting existing Army and Marine Corps GMLRS and HIMARS systems for offensive anti-ship warfare
- Provides a basis for cost-capability trades for an objective system

Next Generation Combat Vehicle

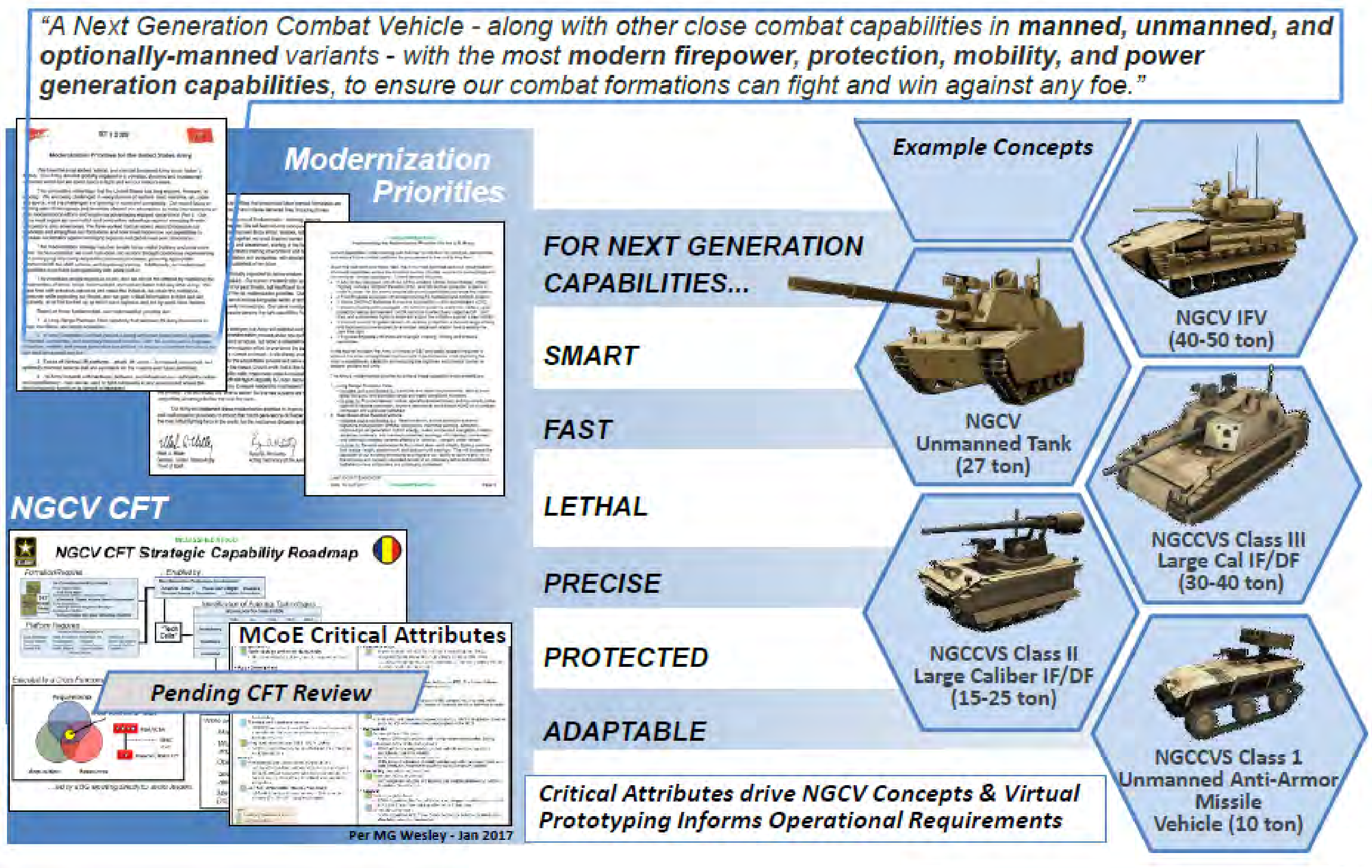
Goal: Provide an experimental Prototype in FY 20 for Soldier evaluation.

Technology Demonstrations

- Combat Vehicle Robotics (CoVeR)
- Robotics for Engineer Operations
- Ground System Active Defense (GSAD)
- Advanced Powertrain Demonstrator
- Advanced Lethality & Accuracy System for Medium Caliber (ALAS-MC)
- Extended Line of Sight (ELoS)

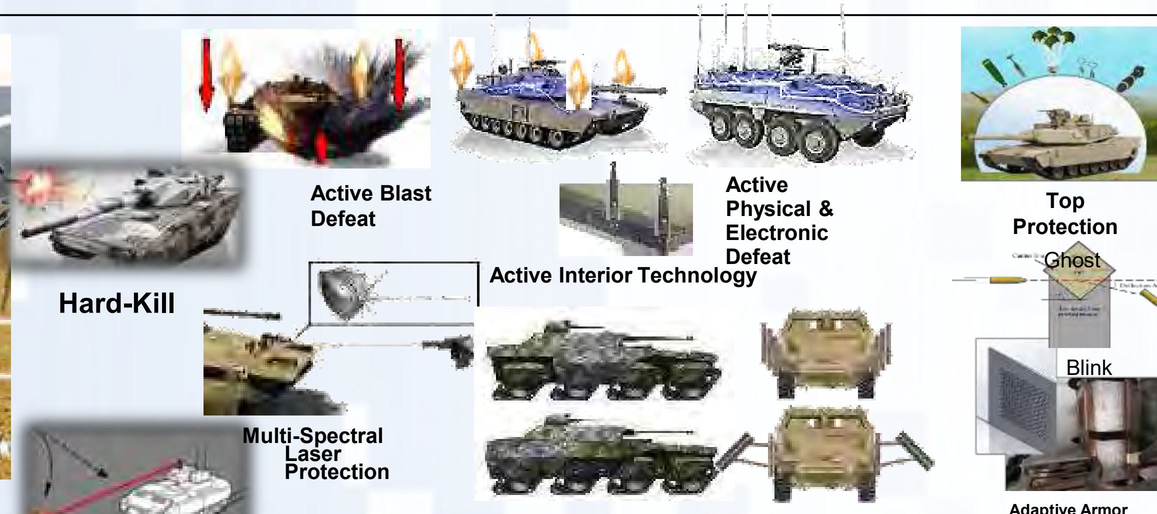
Critical Technology Areas

- Maneuver Robotics and Autonomous Systems
- Directed Energy & Energetics
- Power Generation & Management
- Advanced Armor
- Vehicle Protection Suites



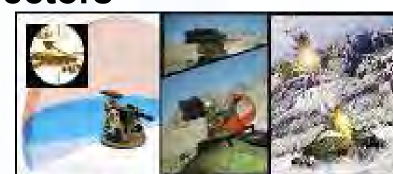
Ground System Active Defense

Multi-Threat Domain and Changing Operational Environment

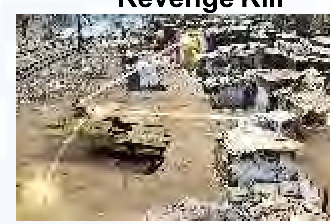


Active Survivability Subsystems and Effectors

Develop active survivability subsystems and effectors which sense, track and respond to neutralize threat prior to terminal effects. System leverages common architecture to provide threat defeat redundancy and layered survivability to optimize protection with reduced weights.



Pre-shot Detection/ Revenge Kill



Active Physical, Electronic Defeat; Mechanical Ctr Measures; Adaptive Interior Protection, Adaptive Armor

Future Vertical Lift

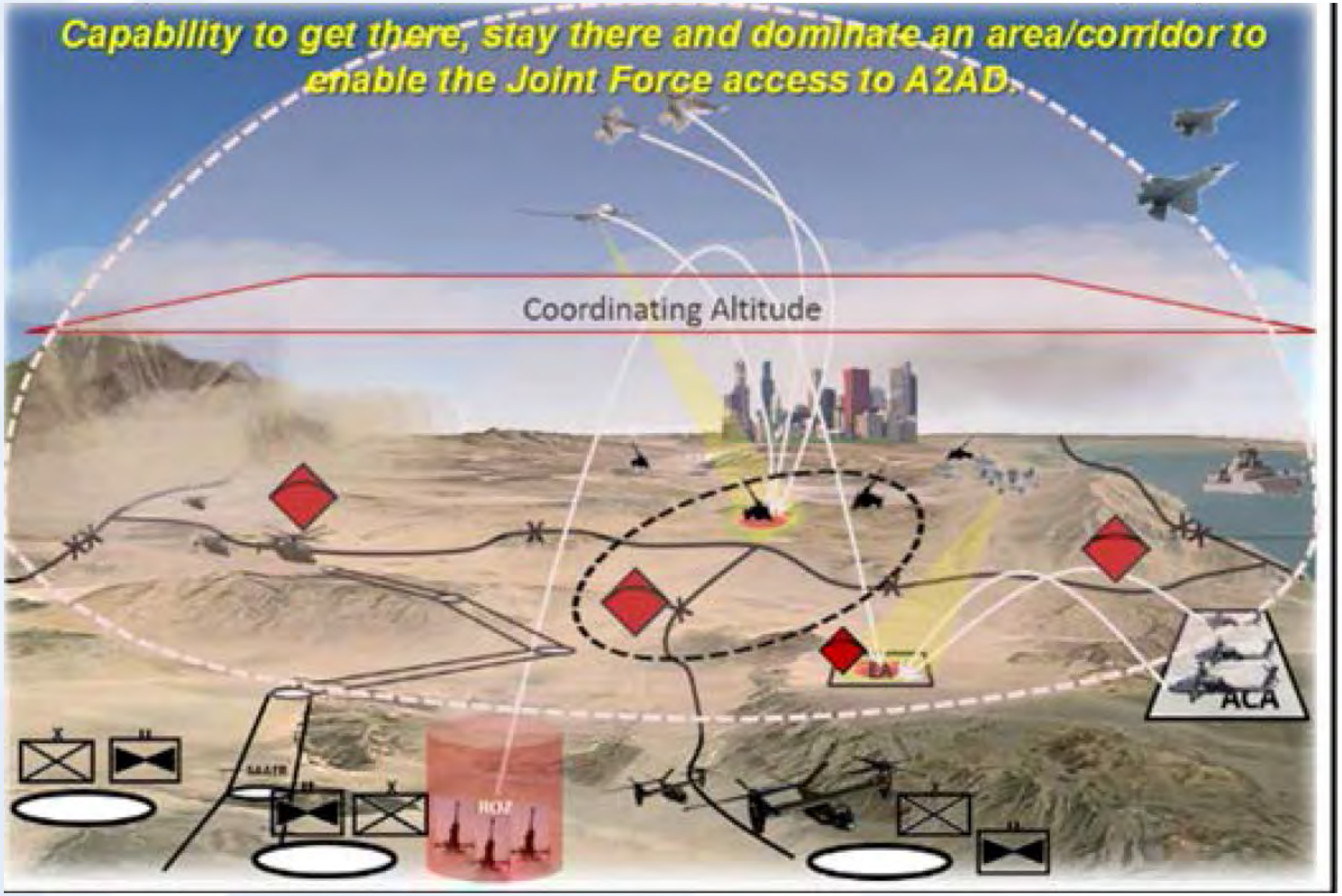
Goal: Close selected Army capability gaps and rapidly deliver 5th Gen rotorcraft to the Army.

Technology Demonstrations

- Joint Multi-Role Technology Demonstrator
- Degraded Visual Environment-Mitigation
- Next Generation Tactical UAS Tech Demonstrator
- Alternative Concept Engine
- Next Gen Rotorcraft Transmission
- Integrated Mission Equipment
- Modular Missile Technology
- Multi-Role Small Guided Missile
- Advanced Rotorcraft Armaments Protection System

Critical Technology Areas

- Expanded Reach & Protection during Movement of Forces
- Increased payload, maneuverability and performance
- Manned-Unmanned Teaming



Next Generation Tactical UAS

Purpose:

- Develop and demonstrate transformational air vehicle technologies that overcome key barriers to enable the Future Tactical UAS performance, survivability, and reliability requirements and operational capabilities

Products:

- Informed Requirements for FTUAS, including new concepts of operations
- Wingman concepts for FVL manned systems
- Enhanced survivability enabling operations in highly contested environments
- System-level SWAP allocation
- Informed Model Performance Specifications (MPS) used as basis for solicitation of FTUAS aircraft; provides quantifiable metrics for technical evaluation of proposals

Payoff:

- A refined set of technologically feasible and affordable capabilities that enable Future UAS requirements in POR EMD phase
- Operational parity with manned fleet enabling advanced manned unmanned teaming (MUM-T)
- Government-owned decision support tools and data readily available to support future acquisitions and product upgrades

Network/C3I

Goal: Provide Soldier with assured communications in contested environments through situationally-aware, intelligent network, and autonomously routing of information over resilient communications link.

Technology Demonstrations

- Modular RF
- Non-Traditional Waveforms
- Protected SATCOM
- WGS Interference Cancellation
- Spectrum Obfuscation
- Next Gen HF
- Every Receiver a Sensor
- Robust Grey C3I
- Integrated Demos with NGCV, Soldier Lethality, FVL, AMD, and LRPF

Critical Technology Areas

- Tactical Network/Comms
- CEMA/EW/Cyber
- Mission Command/Command Posts
- A-PNT
- Persistent ISR

Modular RF Communications

Purpose:

- Enable connectivity in contested and congested environments by applying modular radio frequency (RF) and networking techniques, to adapt and continue operation under interference signals

Products:

- A system architecture for modular RF networks to be integrated with a single user device
- Autonomous networking to provide agile detection and switching amongst available network connections to maintain network resiliency in congested and contested environments
- Soldier Radio Waveform (SRW) on a modular module to integrate within an automated network
- Distributed, dismounted beamforming for communications through RF interference
- Low Probability of Interception and Detection (LPI/LPD) techniques that support communications in contested and congested environments

Payoff:

- The ability to operate in congested, and contested environments, and automatically adapt and respond to dynamically changing situations without user input
- Elimination of single point of failure when operating as a mobile protected network with assured and resilient communications at the tactical edge
- Common user interface with seamless incorporation of new and additional network capabilities through open architecture design

Air and Missile Defense

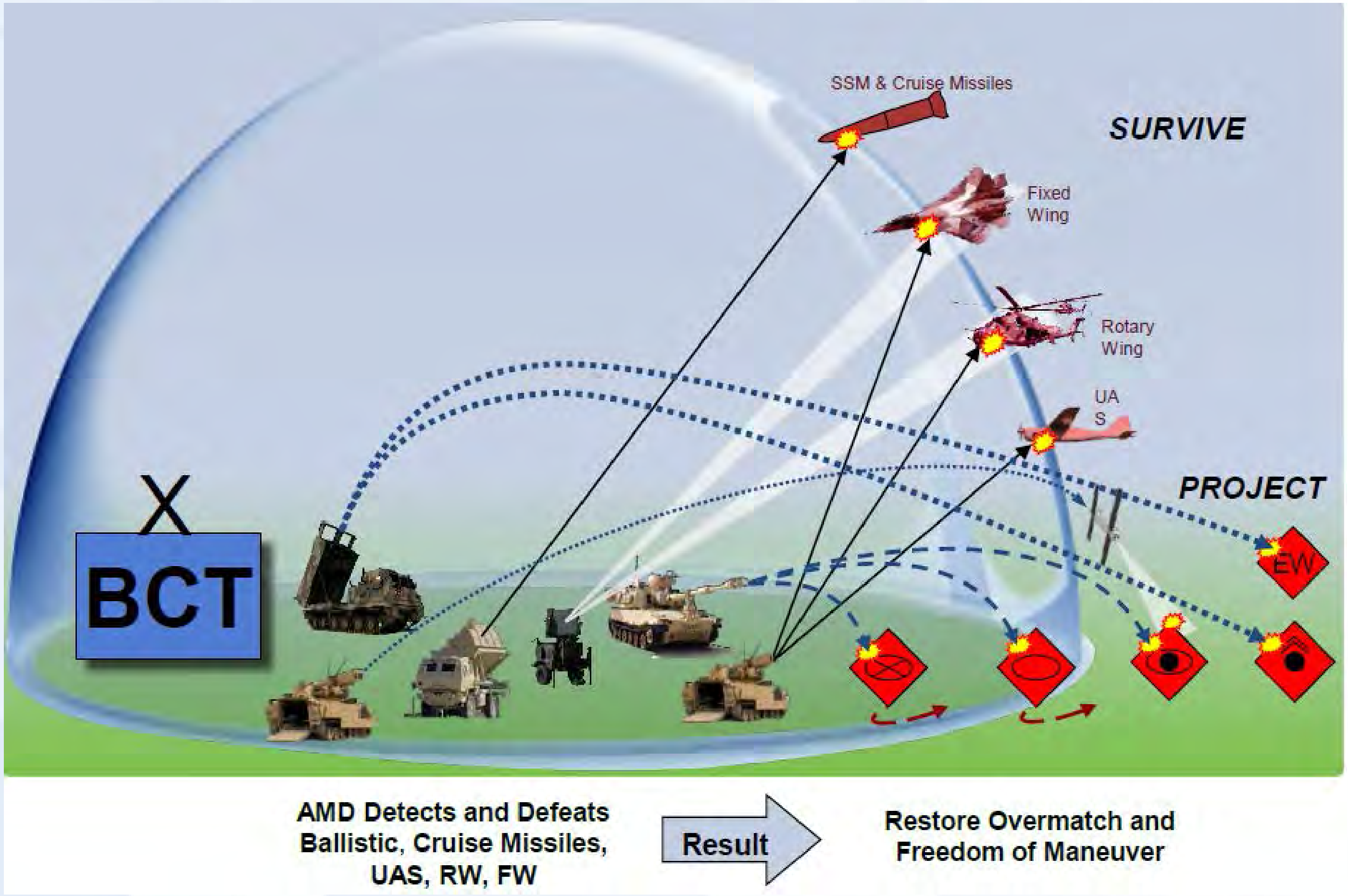
Goal: Provide capability to defend against enemy air attack at extended range.

Technology Demonstrations

- Low Cost Extended Range Air Defense (LowER AD)
- Maneuver AD Technologies (MADT)
- Ballistic Low Altitude Drone Engagement (BLADE)
- Accurate Rapid Controlled Hybrid Effects Round (ARCHER)
- High Energy Laser Tactical Vehicle Demonstrator (HEL TVD)
- Multi-Mission High Energy Laser (MMHEL)
- Unconventional Countermeasures & Survivability

Critical Technology Areas

- Mobile and Survivable Maneuver Short Range Air Defense (M-SHORAD)
- Counter UAS
- Operate within a Contested Environment



Technology Maturation Initiative: Multi-Mission High Energy Laser (MMHEL)

<u>Purpose:</u> Integrate and demonstrate a High Energy Laser (HEL) weapon system that can maneuver with operational forces to counter rocket, artillery and mortar (RAM), Unmanned Aerial Systems (UAS), intelligence, surveillance and reconnaissance (ISR), rotary and fixed wing Maneuver Short Range Air Defense (M-SHORAD) threats.

Multi-Mission High Energy Laser Platform

Successful 10kW HEL Demonstrations: Defeated UAS and Light Mortar in Flight

<u>Products:</u>

- 50kW-class Risk Reduction Demo on High Energy Laser Mobile Test Truck (FY18)
- TRL 7 MMHEL 50kW-class system demonstration (FY21)

This effort leverages Army S&T investments in the High Energy Laser Tactical Vehicle Demonstrator (HEL TVD) effort as well as High Energy Laser Joint Technology Office investments in solid state laser development and advanced beam control systems.

Soldier Lethality

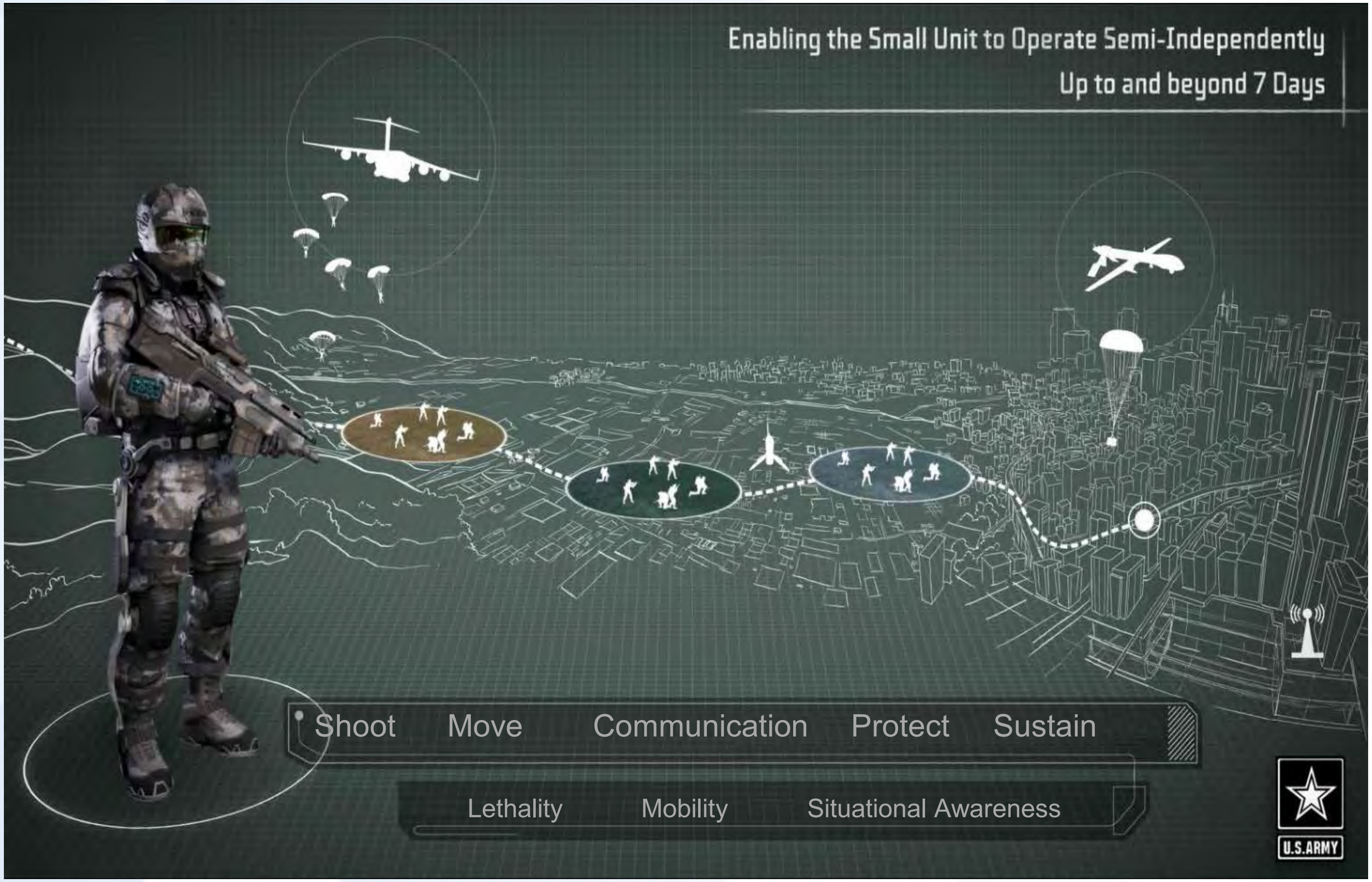
Goal: Improve Soldier and small unit performance, reduce surprise, increase protection, and enhance lethality in close combat on an intensely lethal and distributed battlefield and within complex, urban terrains.

Technology Demonstrations

- Next Gen Squad Weapons Technology
- Next Generation Family of Ammunition
- Soldier Signature Management
- Extreme Austere Environmental Protection
- Integrated Headborne Systems
- Body Armor
- Common Synthetic Environment
- Exoskeleton Systems

Critical Technology Areas

- Next Generation Squad Weapons and Ammunition
- Enhanced Body Armor
- Improved Soldier and Small Unit Performance
- Reduce the Soldier's Load and Increase Bearing Capacity



Next Generation Squad Weapons Technology

Integrated Automatic Rifle

Payoff:

- Meets critical threshold values for Next Gen Squad Automatic Rifle (NGSAR) CDD and entrance criteria for MS-B, transition to PEO Soldier/PM Soldier Weapons
- Provides a TRL 6 platform and growth for NGSAR and future squad weapons by providing the next generation cartridge (carbine, SDMR, etc.)

Purpose:

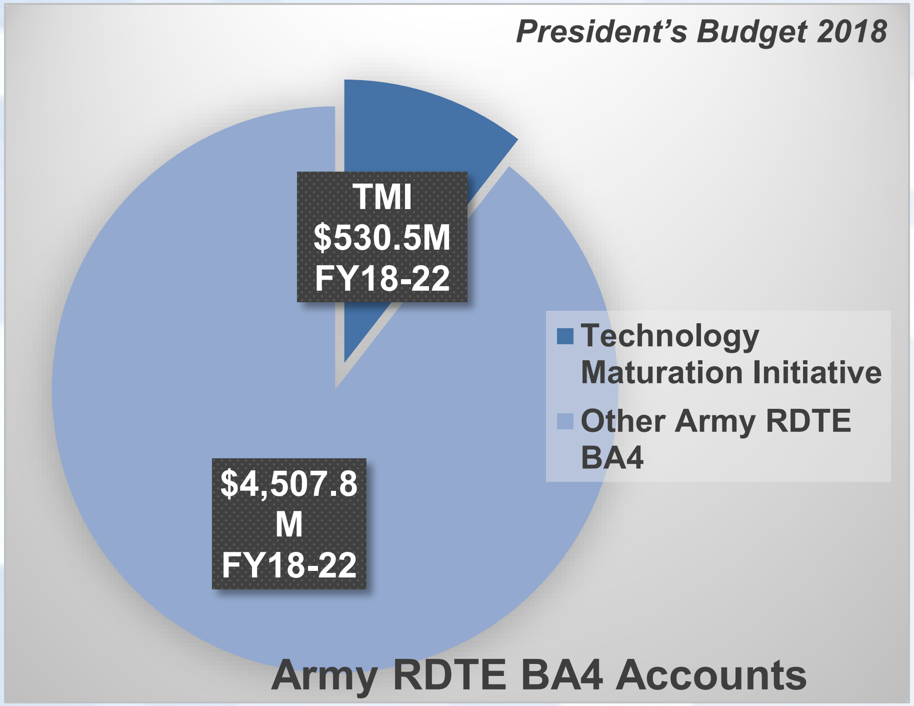
- Provide critical weapon integrated technologies for Next Generation Squad Automatic Rifle (NGSAR – M249 replacement), leveraging LSAT, FAST, 6.5mm CT Carbine, and SAAC study results
- Develop weapon technologies to enable higher pressures
- Provide for fire control integration (SCOPE program)

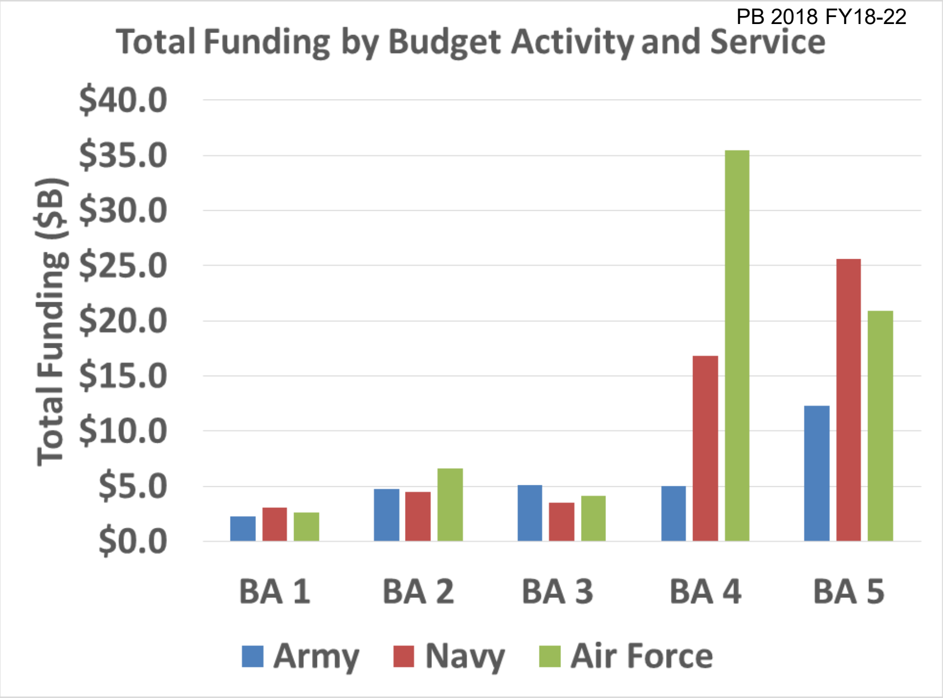
Product:

- Demonstration of Weapon/Cartridge for Automatic Rifle (TRL 6)
- Optimized Cartridge Configuration – weight/size vs. lethality
- 75-100 KSI Case Telescoped (CT) Cartridge
- Mid-Caliber (6.8mm) Projectiles (TRL 5/6)
- High Pressure Chamber lightweight materials
- High Pressure Barrel lightweight materials and processes
- Muzzle Device – recoil and signature reduction
- Integrated E/M Trigger and Intelligent Rail - interfaces for SCOPE
- TDP for weapon, ammunition, and fire control interface

Army BA 4 Technology Maturation Initiative

- Experimental and Early Developmental prototyping to inform emerging Army requirements and/or prepare S&T products for integration into future systems
- Only Army BA 4 investment not tied to a Program of Record (PoR)
  - Experimental Prototyping for future Army capabilities for which there is no PoR
  - Early developmental prototyping in partnership with Acquisition to inform and provide basis for emerging and objective requirements
- TMI oversight by 2-star Technology Maturation Executive Steering Group





Army Educational Outreach Program (AEOP)
-part of a holistic strategy to address workforce needs

Vision: A diverse, agile, highly competent STEM talent pool, representative of our nation's demographics to supply Army workforce initiatives

Mission: Offer students and teachers a collaborative, cohesive, portfolio of Army-sponsored STEM programs that effectively engage, inspire, and attract the next generation of STEM talent through K-through college programs and expose them to DoD STEM careers

Priorities:

- STEM Literate Citizenry: broaden, deepen, and diversify the pool of STEM talent in support of our Defense Industrial Base (DIB)
- STEM Savvy Educators: support and empower educators with unique Army Research and Technology resources
- Develop and implement a cohesive, coordinated, and sustainable STEM education outreach centralized infrastructure across the Army

The Army has a holistic approach to STEM capabilities

AEOP serves to broaden the future talent pool

AEOP Impacts

-FY17 unless otherwise noted

32,947
Students

2,307
Teachers

83%
Alumni reported that AEOP mentors helped influence academic career decisions

485
Universities or Colleges

92
HBCU's or MSI's

3,467
K-12 schools

FY17 included evaluation of AEOP on 21st century workforce skills

15
Strategic Partner Organizations Serving Underserved Youth

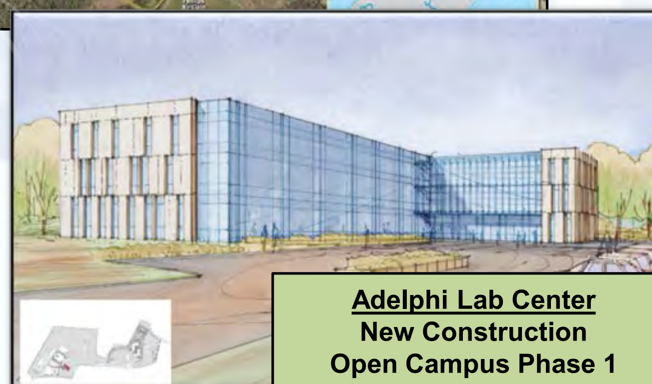
42%
of the apprentices in FY17 included students from underserved populations

FY17 AEOP Alumni Leadership Counsel Developed

95%
FY16 Alumni stated AEOP contributed to growth in STEM knowledge

Comprehensive program evaluations and assessments can be found at www.usaeop.com/impacts

Open Campus



Adelphi Lab Center
New Construction
Open Campus Phase 1
Opening 2020

Collaborations focused on Army-specific challenges of mutual importance to all partners

Partners from Army, Industry and Academia engage in research with shared access to people, infrastructure and resources

"…a role model to the broader defense research enterprise"

- Defense Science Board (DSB) Task Force on Defense Research Enterprise Assessment, January 2017

Summary

- Army Science and Technology works to Enhance Current Systems and Enable Future Systems
- In PB 2019 Army S&T resources are aligned to support the Army's Modernization Priorities
- Open Campus is continuing to expand opportunities for collaboration

Questions?

Headquarters U.S. Air Force

Integrity - Service - Excellence

FY19 Air Force President's Budget Request

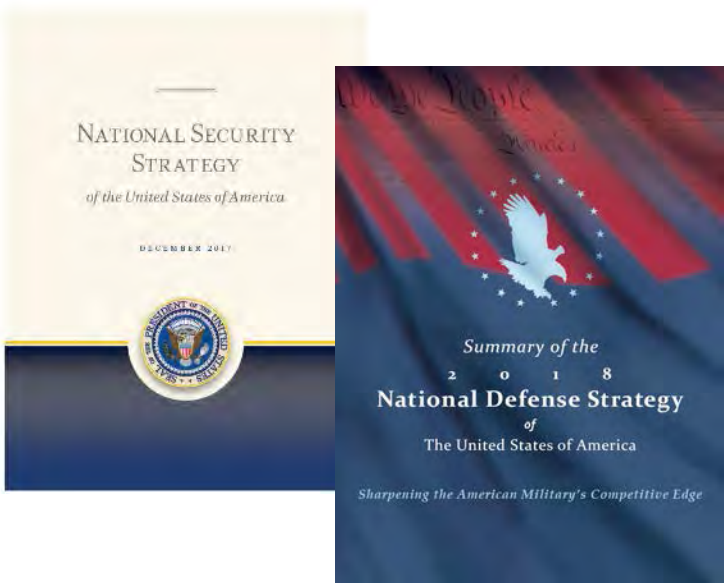
Science and Technology Overview

U.S. AIR FORCE

Mr. Jeff H. Stanley
Deputy Assistant Secretary
Science, Technology and Engineering

FY 19 President's Budget

- **S&T invests in a broad portfolio aligned to National Security Strategy and Air Force Strategy**
- **Continues to emphasize technologies that are revolutionary, relevant and responsive**
- **Increases the use of experimentation and prototyping -- Leveraging partnerships with OSD and DARPA**



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Air Force Strategy

- **2014 AF Strategy -- Forge ahead on path of innovation to achieve Strategic Agility – break paradigms & leverage technology**
- **2016 AF S&T Annex -- Design agility and affordability into capability development, requires closer relationship between S&T, acquisition, requirements, and operators**
- ***New* SECAF directed AF S&T 2030 Strategy -- Harvest new technical approaches and R&D focus areas**
- ***New* Developing AF Warfighting Integration Capability**

"**Experimentation** is the engine of **development planning** to generate repeatable and defendable empirical data that explores and matures innovative capability concepts"-- 2015 Air Force Capability Annex

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SECAF-Directed 2030 S&T Strategy

- ***Provide guidance for R&D over next decade that prepares AF for the national security challenges of 2030 and beyond and ensures our technological advantage***
- <u>OUTCOMES / GOALS</u>
  - **Draft a S&T Strategy for the AF that guides how we approach research and defines the areas of highest priority for the next decade and beyond**
  - **Evaluate innovative technical approaches and focus areas to advance the AF mission through R&D**
  - **Build and reinforce relationships between the AF scientific community and university, government, and industry partners**
  - **Make recommendations for improvements on the processes and the organizational structures by which the AF manages early stage research**

THE SCIENCE & TECHNOLOGY 2030 INITIATIVE

INVENT THE FUTURE TODAY

Engagement Schedule & Idea Submission:
www.afresearchlab.com

U.S. AIR FORCE

Revolutionary

Hypersonics

Directed Energy

Autonomy

Nano Technology

Unmanned Systems

Technology to make and keep the fight unfair - Game Changers

U.S. AIR FORCE

Relevant

Agile Combat Support

Air Superiority

Space Superiority

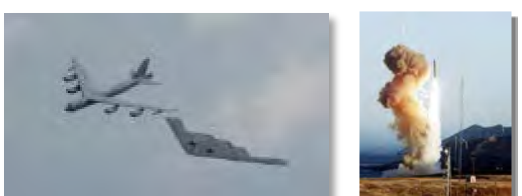
Global Integrated ISR

Command and Control

Cyber Superiority

Rapid Global Mobility

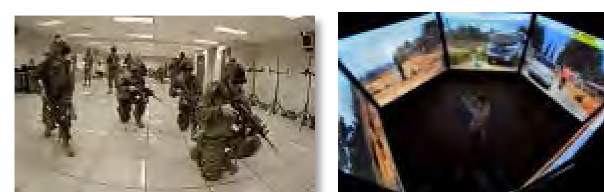
Personnel Recovery



Nuclear Deterrence Operations

Global Precision Attack

Special Operations



Education and Training

U.S. AIR FORCE

Prototyping and Experimentation

"Flavors of Experimentation"

Ops Pull
Tech Push

DP-based Push / Pull

Tech Push
Ops Pull

- Light Attack Capabilities
- Multi-Domain Command and Control – Shadow Ops Ctr
- Spectral Halo (FY18 PDM)
- Air Superiority 2030 Enterprise Capability Collaboration Team (ECCT) recommended experimentation campaigns
  - Data-to-Decision (D2D) and Defeating Agile Intelligent Targets (DAIT)
- Adaptive Engine Transition Program
- Hypersonics (FY19 PDM)
- Directed Energy Weapons
- Resilient Space (FY17 RMD)
- Low Cost Attritable Aircraft Technology

Doctrine → Organization → Training → Materiel → Leadership & Education → Personnel → Facilities → Policy

Adaptive Engine Follow-on EMD Opportunities

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AETP technology is applicable to multiple combat aircraft

(2016 – 2021)

AETP

Flight Weight Adaptive Engine Prototypes (3 per contractor)

Validating technologies in a combat installation

Direct upgrade

Scaled Common Core

Scaled Core

(or Component applications)

Potential **(2020-2025 EMD)**

F-35 Upgrade

- 30% increase CTOL/CV radius
- 18% decrease acceleration time
- 167% TMS increase (2.5x low-alt dash time)
- 3x more targets reached
- 45% reduced tanker sorties for CAP mission
- 17% more training flight hours

(2018+ TMRR/EMD)

AS2030+ Development

- 38% increase sub/super radius
- 23% increase subsonic radius
- 47% reduced tanker sorties for SEAD mission

Potential F-22 Development

- 18% range improvement
- $484M+ cost avoidance in fuel

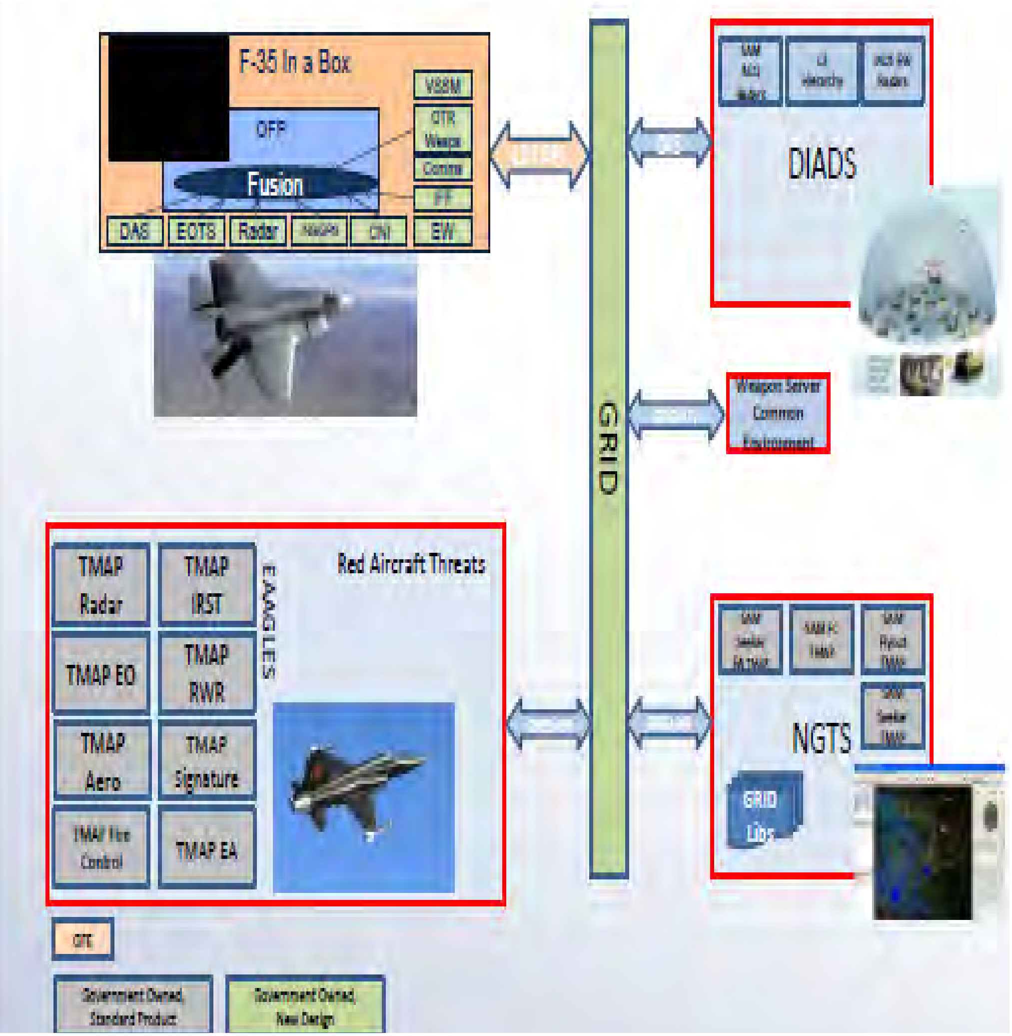
Multiple Legacy Applications

F-15/F-16

- >20% range improvement
- >15% thrust improvement

Joint Simulation Environment

- **High fidelity simulation using aircraft OFP, accreditable for test as supplement to open air**
  - **Modular environment: operator in the loop; blue/red air, threat, terrain, weather - all standardized**
- **Enables high density, high end threat replication**
- **Allows for better test of 5th+Gen capabilities**
  - **Use of war reserve modes**
  - **Cross platform, family of sys**
  - **Multi-domain**
- **Replaces standalone, proprietary contractor solutions like F-22 ACS, F-35 VSIM**



Low Cost Attritable Aircraft Technology

LCAAT will enable a family of limited function, rapidly produced, low cost, attritable UAVs to augment manned systems and force a <u>cost imposition</u> on near peer adversaries

<u>Amplifies Enduring Attributes Of Airpower</u>

- Mass
- Responsiveness
- Range
- Flexibility
- Asymmetric force
- Increased risk tolerance

AFRL Weapons Truck LCAA Variant Concept

<u>Challenge/Problem Space</u>

- Rising costs of exquisite Air Force aircraft

  "In the year 2054, the entire defense budget will purchase just one aircraft." – Norman Augustine
- Permissive A2/AD environments

<u>Foundational Knowledge and Planning</u>

- Conduct ops analysis, vehicle design, lifecycle cost, industry engagement, manufacturing studies, and define technology needs
- Develop plan: reduce risks of LCAA objective systems

<u>Technology, Capability Experimentation</u>

- Conduct a campaign of experiments to explore LCAAT, innovations and capabilities
- Validate cost and performance of key technologies
- Demo LCAAT in a capability context to the Warfighter

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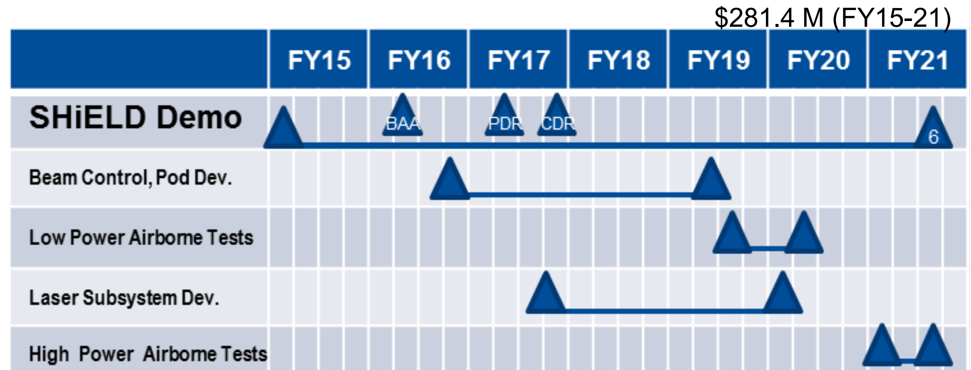
Self-Protect High Energy Laser Demonstrator (SHiELD)



Description

- Integrate Laser Weapon System (LWS) into fighter fuel tank pod
- Airborne flight test of a beam control in a transonic/ supersonic airspeeds & High-G flight
- Demos 50 kW-class power LWS in relevant flight environments for defeat of EO/IR based threats

Technology

- Packaged/ruggedized LWS within fighter size, weight and power (SWaP) constraints
- Aero optics mitigation at subsonic - supersonic airspeeds
- Agile, compact, large aperture flight qualified beam director
- Acquisition, Tracking, Pointing to defeat dynamic missile targets

Delivering

- Integrated LWS on legacy fighter to show self-protect from EO/IR air-air and ground-air threats
  - Demonstrate laser effectiveness in transonic environment
  - Characterize supersonic environment to strategize beam control advances
  - Flight qualified weapon system to explore next steps (component advancements, CONOPS, alternate platforms)
- Laser subsystems (Beam Control, power, cooling) scalable to higher power to increase range, number, target types engaged
- Multi-capable system for both defensive & offense use

U.S. AIR FORCE

Gray Wolf
Cruise Missile S&T Demo

DESCRIPTION

- Prototype flight demonstrations of low-cost subsonic cruise missiles that use;
  - Open architectures and modular design for rapid prototyping and spiral capability growth
  - Networked, collaborative behaviors to ensure mission success against enemy Integrated Air Defense Systems (IADS)
- Spiral demos of variant payloads (e.g., kinetic warheads, Electronic Attack, ISR) every 18 months

TECHNOLOGY

- Innovative manufacturing for low unit costs at low quantities and without long-lead timelines
- Low-cost, multi-function seekers and sensors
- Affordable and efficient small engines
- Robust networked collaborative (semi-autonomous) algorithms aligned with operator-defined CONOPs and Tactics/Techniques/Procedures
- Highly contested environment nav/comm suites
- Flexible/effective lethality in smaller form factors
- High-fidelity MS&A for op effectiveness studies

BENEFITS TO WARFIGHTER

- Affordable counter-IADs strike capability at range in highly-contested A2/AD environment
  - Range enhances launch platform survivability
  - Networked ops enhance missile navigation, survivability and target attack
- Low unit costs support affordable missile attrition and imposes high-cost adversary response
- Spiral experimentation framework provides rapid technology prototyping and provides multiple transition opportunities

U.S. AIR FORCE

Unmanned Systems

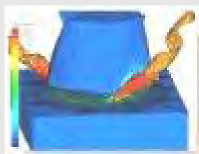
Manufacturing Technology Vision

Applied to Air Force Priorities

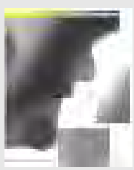
Next Generation Agile Manufacturing

Technology Efforts:

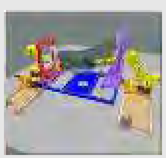
- **Moving Manufacturing Left**

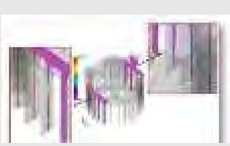
- **Cradle to Cradle Digital Thread**

- **Factory of the Future**

- **Responsive, Integrated Supply Base**




AFRL and Partners

Joint Defense ManTech Panel

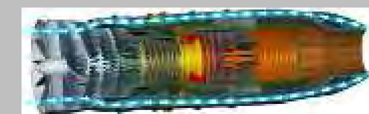
Advanced Manufacturing Partnership

Ex: Additive Manufacturing


Ex: Digital Thread

Select Applications

Advanced Turbine Engines



ISR Open Systems

Weapons


F-35

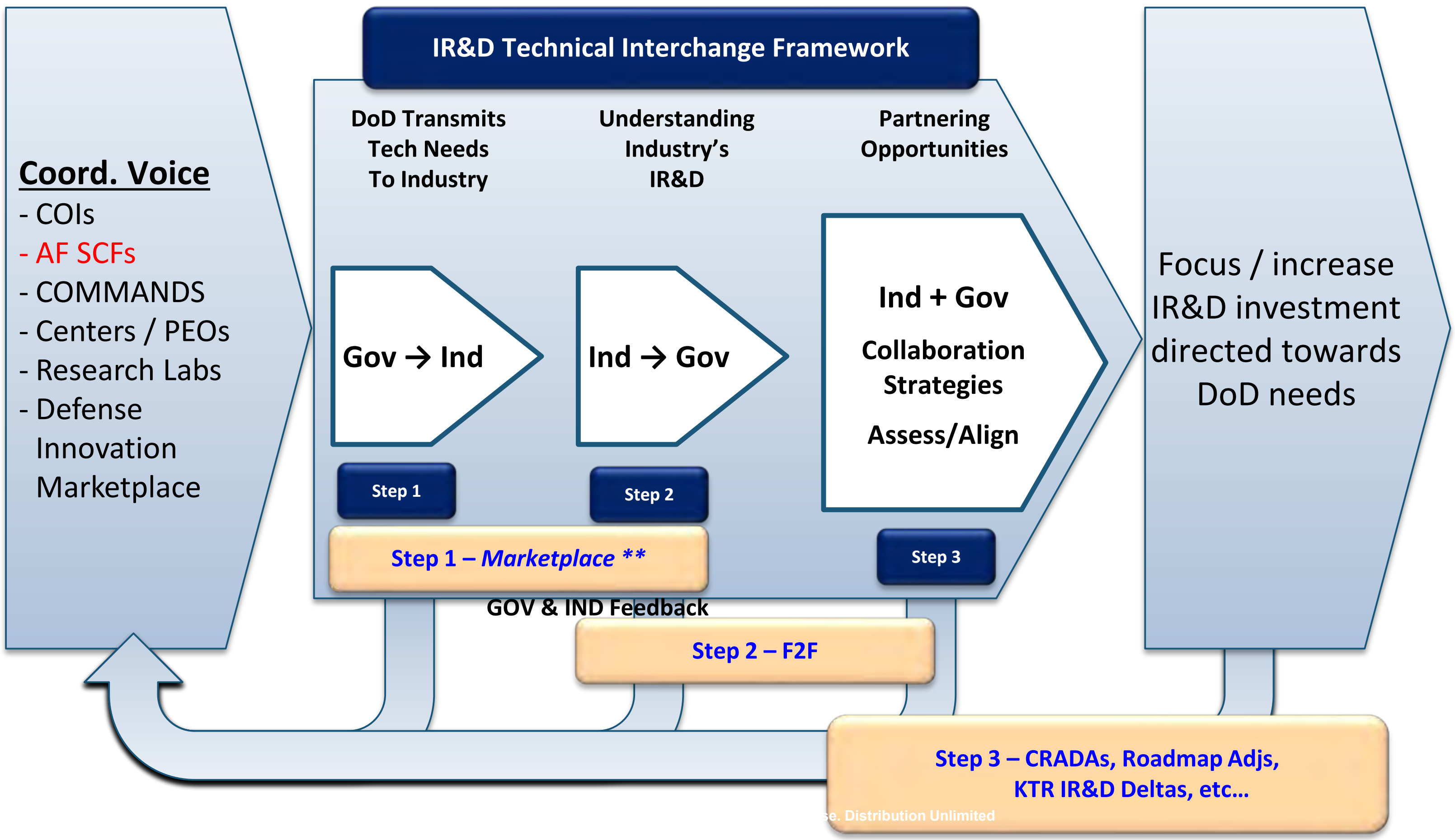
Complex of the Future

STEM Education and Workforce Development Initiatives

- **National Defense Science & Engineering Graduate (NDSEG) fellowship**
  - Air Force PE ~$50M, award ~260 fellowships annually ($6M PDM increase)
- **Science Mathematics And Research for Transformation (SMART)**
  - Sponsored 743 SMART scholars in past 12 yrs; 387 completed program, 85% working for AF, 10% getting adv deg, and 4% left due to hiring or location of facility issues; 332 scholars currently in the program
  - SMART Scholars are an essential recruitment source to replenish workforce and enable key technology advances and future STEM leaders
- **Launching LEGACY apprentice scholarship pilot**
- **Expanded AFA StellarXplorers from 131 to 180 teams; scholarships being given by Air Force and matched by ULA**
- **Cyber/EW ROTC Pilot Program Phase 2 on contract**
  - **Air Force and Navy funded ~$6M; 140 plus cadets and midshipman**

U.S. AIR FORCE

IMPLEMENTATION of the AF IR&D INTERCHANGE FRAMEWORK



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DoD/AF IR&D
Technology Interchange Meetings

Jun 17	2017 HS COI IR&D TIM	Washington DC
Aug 17	2017 C4ISR & Cyber SCF IR&D TIM	Rome NY
Sep 17	2017 AFGSC NDO Innovation Summit	Barksdale AFB, LA
Dec 17	2017 Space SCF IR&D TIM	Los Angeles AFB CA
Mar 17	2018 Personnel Recovery SCF IR&D TIM	Wright Patterson AFB OH
April 18	2018 Weapons COI IR&D TIM	Kirtland AFB NM
May 18	2018 Nuclear Deterrence Operations SCF IR&D TIM	Kirtland AFB NM
Dec 18 or Jan 19	2018 Air Platforms SCFs IR&D TIM	San Antonio TX or Tampa FL
Apr 19	2018 Special Operations SCF IR&D TIM	SOCOM, Tampa FL

UNITED STATES AIR FORCE

Small Business Programs

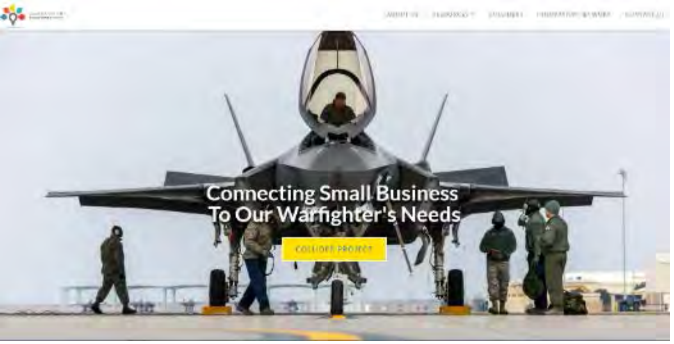
AFRL
THE AIR FORCE RESEARCH LABORATORY
LEAD | DISCOVER | DEVELOP | DELIVER

AIR FORCE RESEARCH LABORATORY SMALL BUSINESS DIRECTORATE

SMALL SOURCE | RIGHT VALUE | BIG PERFORMANCE

Connect with AF S&T

U.S. AIR FORCE




GET CONNECTED

COLLIDER EVENTS | SOCIAL MEDIA | WEB SITES

AFRL SMALL BUSINESS HUB
WRIGHT BROTHERS INSTITUTE
5000 SPRINGFIELD ST | SUITE 100 | PATTERSON ROOM
WRIGHT POINT OFFICE PARK | DAYTON OHIO 45431

In 2014, the Small Business Hub was formed with the Air Force Research Laboratory to attract innovative small businesses to solve tough Air Force problems, strengthen the Air Force industrial base and to commercialize AFRL technologies. Three of the primary services provided are Colliders, One-on-Ones and Electronic tools.

Colliders are free and open business events that promote a networking and a social component for government, academia, and businesses to engage in topics focused around technology, entrepreneurship and business growth.

There are four styles in the Collider series: *Information, Partnership, Innovative Technology and Regional Ecosystem.*

Register for Collider event notifications at www.meetup.com/collider

One-on-One's allow representatives from small businesses, industry, AFRL and other regional assets to interconnect organically and the needs and capabilities are needed and connect them to the right person or organization in the region.

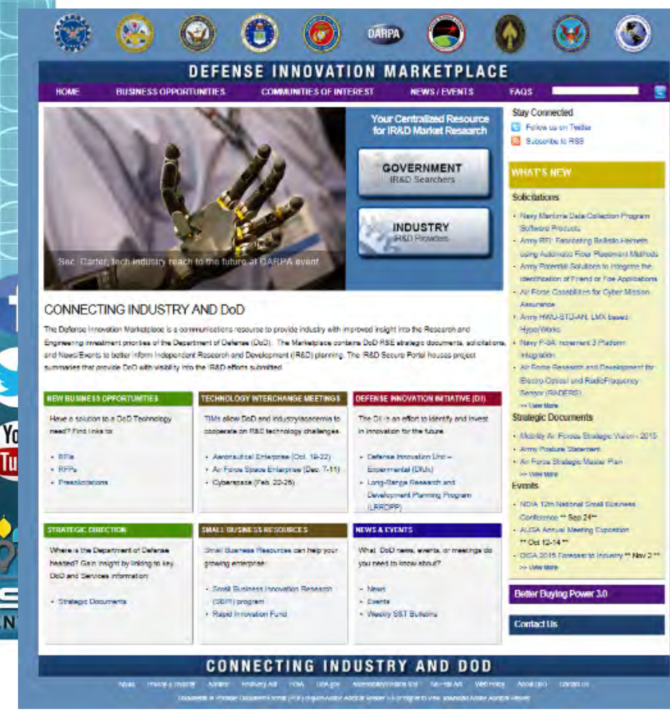
Electronic tools provide 24 hour-a-day, seven days-a-week access to a toolkit that allows innovative small businesses to capture opportunities and build symbiotic relationships and partnerships with others in their ecosystems. (See back)

Facebook
www.facebook.com/afsbirsttr
www.facebook.com/AirForceT2

Twitter
Small Business Hub @AFRLBIZHub
Small Business Director @AFRLSBDirector
Air Force SBIR/STTR @AF_SBIR_STTR

YouTube
www.youtube.com/channel/UCb3EQFQNKopw5EFvorAkTBg

AIR FORCE | SMALL BUSINESS
OPPORTUNITIES
RESEARCH AND DEVELOPMENT




The COLLIDER PROJECT

SMALL BUSINESS HUB AT WRIGHT BROTHERS INSTITUTE

Home | Members | Sponsors | Photos | Pages | Discussions | More | Join us!

SMALL BUSINESS HUB AT WRIGHT BROTHERS INSTITUTE

Dayton, OH
Founded Aug 7, 2014

Members	703
Group reviews	24
Upcoming Meetups	11
Past Meetups	124
Our calendar	

Organizers:
Jim Masonbrink, Bill Harrison, Lee McFawn, Ryan Clarke, Ryan Helbach

The Small Business Hub was created to link entrepreneurs, businesses, industry and governmental organizations in support of tech driven business growth, strengthening the Air Force industrial base and commercializing technologies for new market opportunities. It was established in 2014 as a dual effort by the Wright Brothers Institute (WBI) and the Air Force Research Lab (AFRL).

COLLIDERS

Free and open business events, known as *Colliders*, are hosted by the Small Business Hub to drive opportunity discovery and identify supporting resources. Attendance allows for engagement with fellow community members from business, government and academic circles.

Focused around technology, entrepreneurship, and business growth, there are four styles in the Collider Series, each of which offers a networking component. These include:

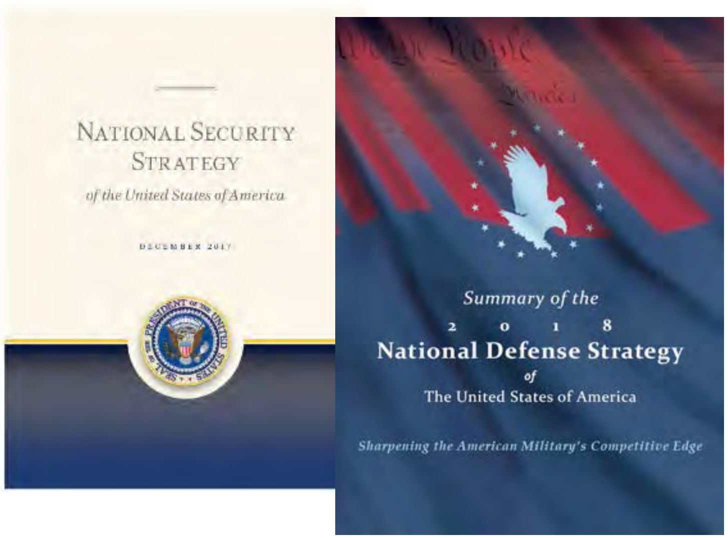
- **Information Series** – educational or learning sessions
- **Partnership Series** – networking, partnership opportunities, matchmaking, Q&A panels, and problem solving
- **Innovative Technology Series** - targets specific leading-edge research areas and technology needs
- **Regional Ecosystem Series** - cross-promotes events happening throughout the region

ONE-ON-ONE'S

While the Collider Project is a resource that enables connections to happen organically, the Small Business Hub also works to formally engage individuals and organizations through

Summary

- S&T invests in a broad portfolio aligned to National Security Strategy and Air Force Strategy
- Continues to emphasize technologies that are revolutionary, relevant and responsive
- Strong AF & AFRL leadership commitment to sustain an IR&D dialogue with our Defense Industrial Base, Academia, Nontraditionals and Small Businesses



Questions?

The Role of the Communities of Interest (CoIs)

Mr. Dale Ormond, Principal Director, Research

Office of the Under Secretary of Defense (Research and Engineering)

Reliance 21

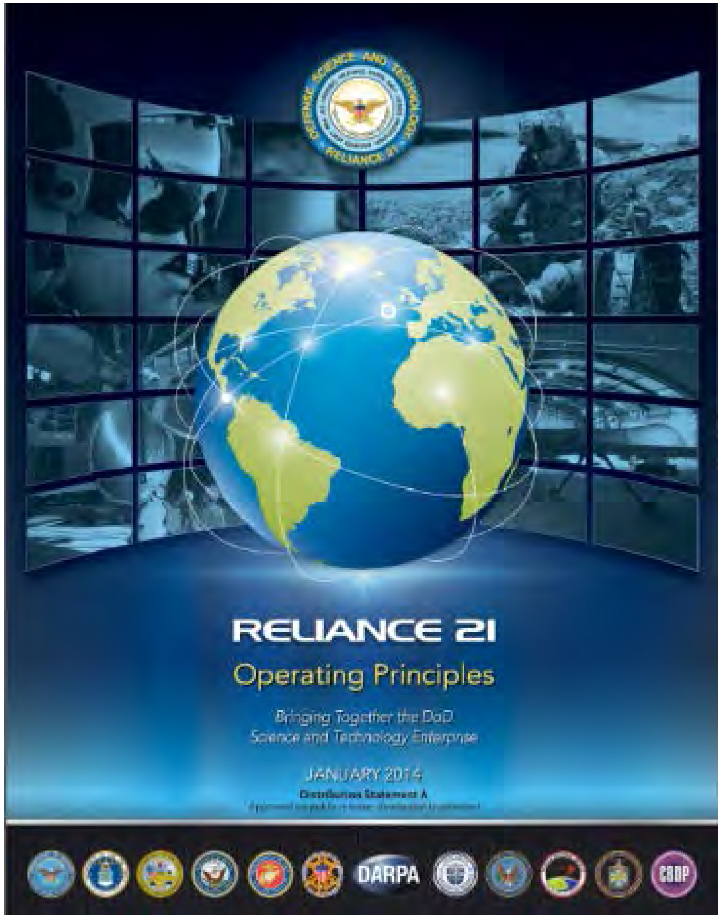
Reliance 21 is the overarching framework of the DOD's S&T joint planning and coordination process

Joint Planning - S&T Oversight

- Mitigate existing or emerging threats
- Generate affordability in the systems the Department acquires and operates
- Develop technology based surprise for our adversaries

Joint Coordination - S&T Delivery

- 17 Communities of Interest (CoIs)
- CoI S&T Roadmap Reviews
- CoI Information Exchange Meetings
- CoI Steering Groups
  - All Services and DoD Agencies Represented



Reliance 21 Overview

Reliance 21 is led by the S&T Executive Committee (S&T ExCom)

- Comprised of the major Department Components (Services, Agencies, Commands)
- Provides executive oversight and overarching guidance on S&T investments
- Ensures a collective understanding of the priorities, capability gaps, and opportunities of the DoD organizations that manage critical S&T resources

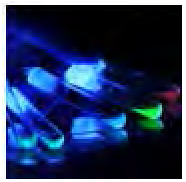
Reliance 21 is implemented through the Communities of Interest (CoIs)

- Established in 2009 as a mechanism for multi-agency coordination and collaboration
- Comprised of S&E subject matter experts in specific technology areas where there is substantial investment across multiple components
- Produces S&T Roadmaps and Reports in their technical area detailing program goals and objectives, capability gaps, and leveraging opportunities

U.S. Communities of Interest

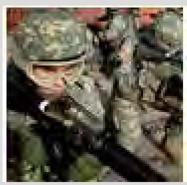
CoIs lead the innovation and the acceleration of advanced concepts and prototypes across three main focus areas:

Mission Focus
Capabilities enabled by advanced technologies & systems



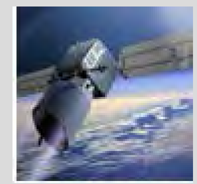
ASBREM: Armed Services Biomedical Research Evaluation and Management

Systems / Capability Focus
Multiple technologies are integrated into complex systems to achieve mission impact

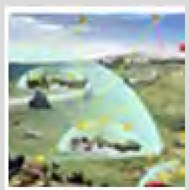


Human Systems

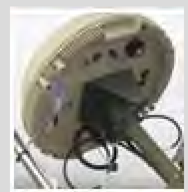
Sensors



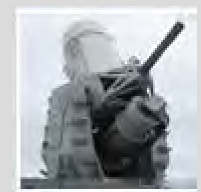
Space



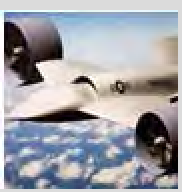
Ground and Sea Platforms



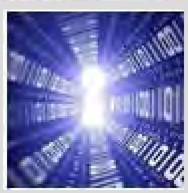
Electronic Warfare



Weapon Technologies

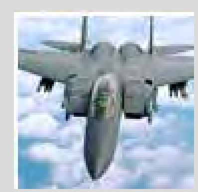


Autonomy



Cyber

Command, Control, Communication, Computers and Intelligence (C4I)



Air Platforms

Technology Focus
Technology goals with multiple applications

Energy and Power Technologies

Advanced Electronics

Materials and Manufacturing Processes

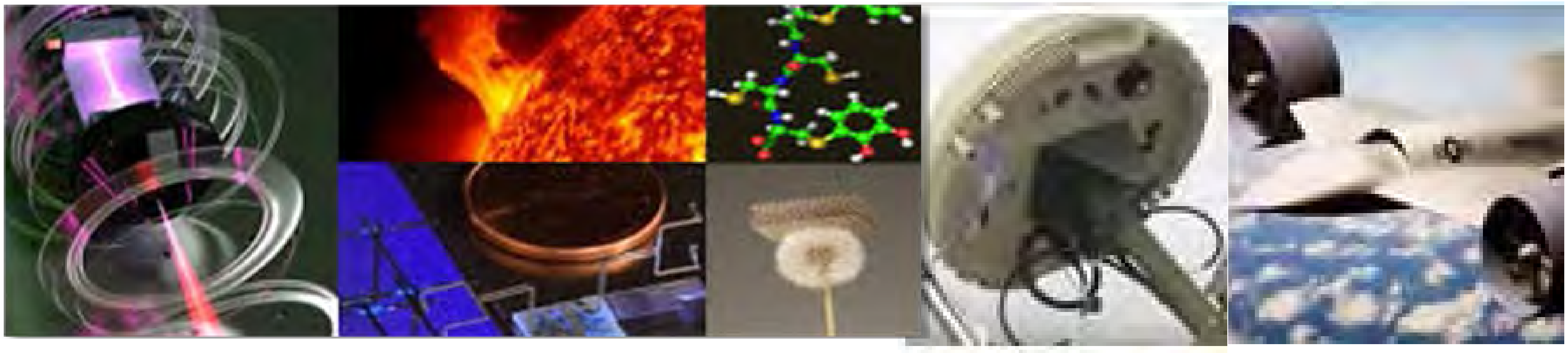
Alumni CoIs: Engineered Resilient Systems; Counter-Improvised Explosive Devices (C-IED); Counter-Weapons of Mass Destruction (C-WMD)

The Role of the CoIs

- Enable the defense of the Department's S&T investments
- Create multi-Service / Agency collaborative efforts to reduce duplication
- Develop joint S&T roadmaps
- Monitor key technology developments and engagement opportunities
- Provide technology options and advice to DoD S&T senior leadership
  - Provide recommendations to Service S&T Executives regarding opportunities to leverage other Services' investments
- Facilitate engagement across the spectrum of stakeholders
  - Combatant Command (CCMD), Intel Community, Academia, Industry

Defend the Department's S&T Investments

- Describes the Department's S&T investment in detail
- Identifies opportunities and efficiencies that allow the Department to achieve maximum return on investment
- Provides data that confirms that the Warfighters are receiving the greatest benefit from DoD S&T resources and efforts



Create Collaborative Opportunities to Mitigate Unnecessary Duplication

- Examine, comprehend, and quantify Service operational needs and explore multi-Service/ Agency collaborative opportunities

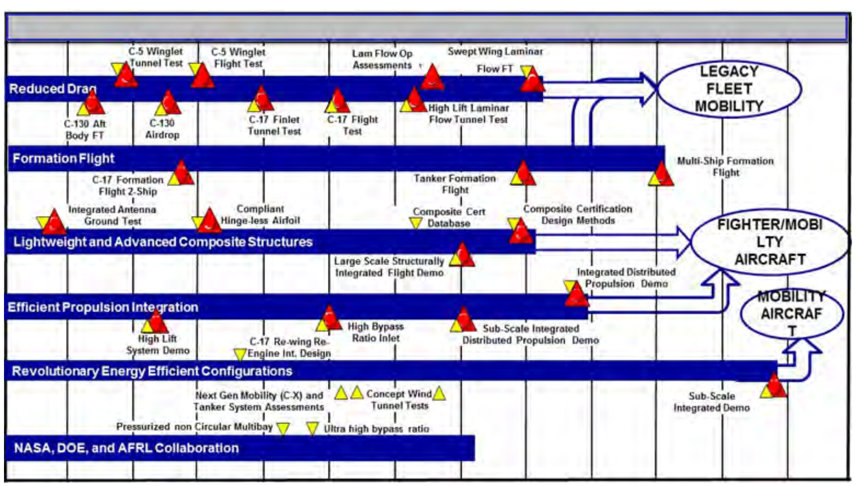
- Organize working groups across different organizations to investigate and understand inner connections and/or overlaps within the technology areas

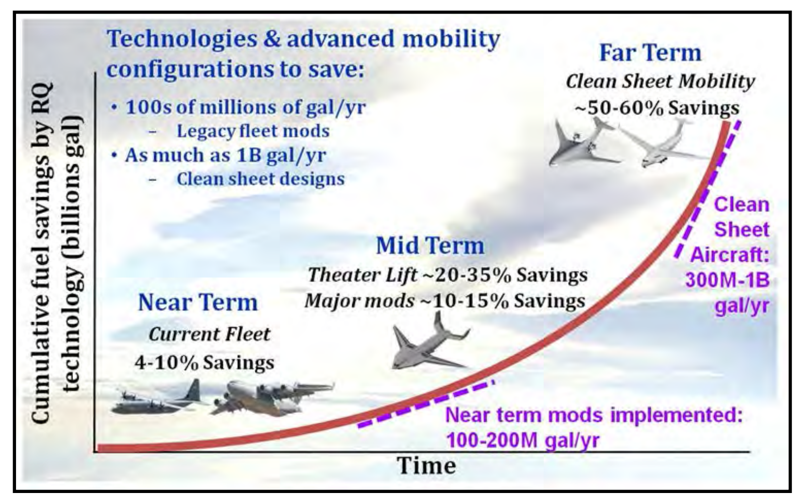
- Create clear multi-Service/ Agency program dependencies - identified by ‘Lead, Shape, or Follow’ roles

Develop Joint S&T Roadmaps

Roadmaps project a shared vision of DoD's S&T Portfolio

- Describe program objectives and key technical challenges
- Assess and address capability gaps and operational impact
- Indicate the capability gap timeline and threat development
- Propose potential Prototypes/Experiments to address the most challenging technology development needs





S&T Priorities Program

- **Program is executed out of the USD(R&E) - Research**
- **S&T Priorities program exists to:**
  - Enable high-payoff, cross-Component technology efforts
  - Develop integrated program execution plans (roadmaps) across the DoD
  - Execute Applied Research for Advancement of Priorities (ARAP) programs
    - Three-year programs, $10M-$15M/yr; two or three in each budget year
  - Fund seedlings to buy down risk in integrated plans
  - Allow fast start-ups in other areas
- **Augment Reliance 21 to foster increased collaboration**
- **Grow workforce in emerging technology areas**
- **Major program decisions involve all Components**

Applied Research for the Advancement of Priorities (ARAP)

- ARAP enables high-payoff, cross-Component technology efforts
  - Three-year programs, $10M-$15M/year; two or three in each budget year
  - Allows for fast start-ups in other areas
- Fosters Joint-Service research focused on common elements of cross-cutting S&T areas
- Facilitates concept exploration efforts and studies of alternative concepts
- Strengthens in-house laboratory research efforts and workforce

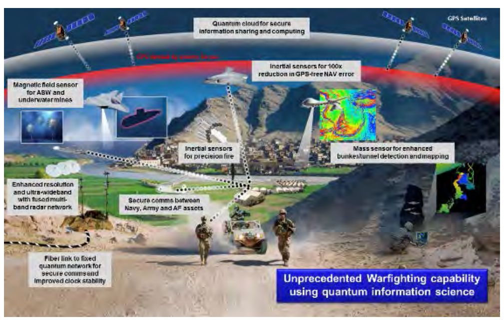
ARAP Portfolio

- NEW: Defense Optical Channel Program (DOC-P)
- Synthetic Biology for Military Environments (SBME)
- Quantum Science and Engineering Program (QSEP)
- Data To Decision (D2D)*
- Autonomy Research Pilot Initiative (ARPI)*
- Engineered Resilient Systems (ERS)*

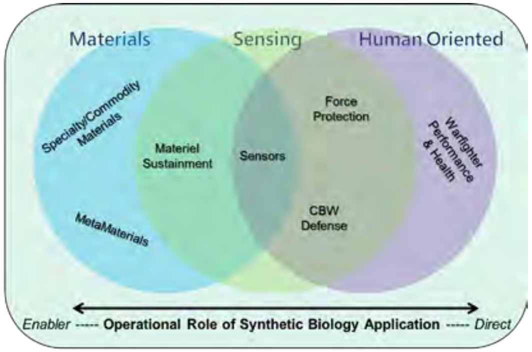
*Completed program

A Winning ARAP Proposal

- Meets the definition of Budget Activity 2 (Applied Research) funded work
- A new, emerging area of science and/or engineering where the potential exists to develop future capabilities that will give the joint warfare a technological edge in the fight
- Technically sound but pushes the leading edge(s) of science/engineering with reasonable risk to achieve success
- Multiple Services/Labs working together
- Majority of the work will be performed by DoD scientists and engineers



Quantum Science and Engineering (QSEP)



Synthetic Biology for Military Environments (SBME)

Defense Optical Channel Program (DOC-P)

Announcement of this year's selected proposal expected May 2018

Maintain Vital Engagements to Maximize Capability Development

CoI engagements are vital to addressing wide-ranging S&T needs

- **Combatant Command (CCMD) S&T Advisors (Operator Community)**
  - Provide a forum to articulate S&T priorities and investments with the potential to address CCMD capability gaps
- **Intelligence Community**
  - Evaluate intelligence information regarding current and future threats as well as emerging technologies to best align research and acquisition priorities
- **Basic Research Community (Academia, DoD Labs and Centers)**
  - Review Basic Research priorities and identify opportunities to engage future scientists and engineers
- **Industry Independent Research and Development**
  - Industry can use CoI Roadmaps to identify technical challenges

Basic Research Community Engagement (Academia, DoD Labs and Centers)

- Ensure an understanding of DoD's Basic Research investment priority in basic science
- Maintain awareness of emerging opportunities for transition to applied research and the CoIs
- Inform Basic Research of potential areas for investment that could resolve technical challenges in capability development (e.g., materials and hypersonics)

Defense Innovation Marketplace

Provides Industry:

- DoD R&E Strategic Guidance
- Service-specific S&T priorities, Virtual Technology Interchanges, events and solicitations are posted.
- DoD Investment Strategies and Technology Roadmaps
- Secure Portal to share IR&D Project Summaries

Provides DoD:

- Research for approved DoD S&T, R&D and Acquisition professionals
- >19,000 IR&D Project Summaries on Portal
- Technical Maturity and Surveillance
- Guide DoD R&E investments
- Potential for risk / cost reduction
- Opportunity to grow and expand new relationships and partnerships

Communities of Interest (CoI) (Distro A) pages available at: http://www.defenseinnovationmarketplace.mil/coi.html.

Access to DoD

One of the great strengths of DoD is our distributed network of program managers across various different Components

- **All DoD funding opportunities are posted to: https://www.grants.gov/**
  - Each opportunity will have the name and contact information of a person associated with the program.
- **OSD and all of the Components have websites that detail their programs and all of the pertinent information including topics of interest, funding cycles, calls for proposals, etc.**
  - OSD: http://basicresearch.defense.gov
  - AFOSR: http://afrl.dodlive.mil/funding
  - ARO: https://www.arl.army.mil/www/default.cfm?page=29
  - ONR: https://www.onr.navy.mil/en/Contracts-Grants
  - DARPA: https://www.darpa.mil/work-with-us/opportunities
- **OSD Basic Research office communication strategy aims to improve access and navigation in these various websites to make the most of community engagement.**
- **Program officers are afforded the flexibility to develop outreach strategies to identify scientific communities of interest and broadcast their program goals**
- **DoD has representation at many of the professional societies and symposia and is eager to engage**

Finding Grant and Cooperative Agreement Funding Opportunities

Grants.gov is the common website for Department of Defense (DoD) and the other 25 federal grant-awarding agencies to post discretionary funding opportunities and for entities to search and apply for them.

Searching for Funding Opportunities on Grants.gov

- Any member of the public may search for funding opportunities at Grants.gov.
- Users who register with Grants.gov also have the ability to save their searches, and have updated search results emailed to them by signing up for subscriptions. Registered users may also subscribe to receive notifications about Grants.gov news, all new funding opportunities, and when changes are made to specific funding opportunities they identify.

Applying for Funding Opportunities

- Registered users must be associated with an organization and be assigned the proper applicant roles in order to apply for a funding opportunity. Users should contact their organization's business office to determine the process used in their organization.

DoD Grants.gov Manager:

- Ms. Evelyn Kent, evelyn.w.kent.civ@mail.mil, 571-372-6546

GRANTS.GOV℠

https://blog.grants.gov/

@grantsdotgov

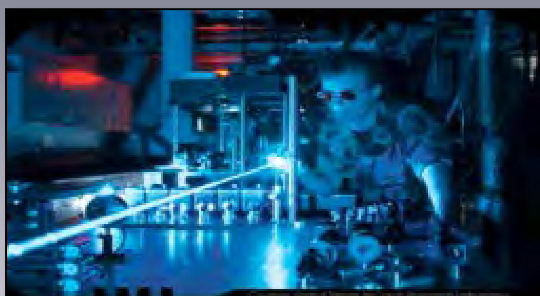
https://www.youtube.com/user/GrantsGovUS

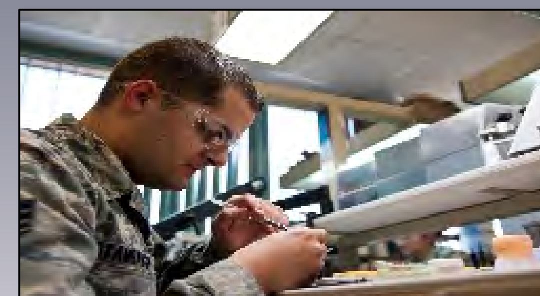
Summary

- **Established in 2009, CoIs have grown from mechanisms of information sharing and multi-agency coordination to an infrastructure that identifies opportunities for collaboration to reduce duplication**
- **CoIs enable the S&T ExCom to deliver maximum S&T impact with reduced risk:**
  - Coordinate S&T strategies
  - Share new ideas, technical directions, and technology opportunities
  - Jointly plan programs
  - Measure technical progress
  - Report on the general state of health of technology areas
- **Joint S&T Roadmaps project a shared vision of the Department's S&T portfolio, showcase joint activities, and enable defense of investments**
- **CoIs are in a unique position to engage with industry through NDIA to promote innovation in DoD and maintain awareness of the rapid technology development taking place in the commercial sector**

DoD R&E Enterprise

Solving Problems Today – Designing Solutions for Tomorrow





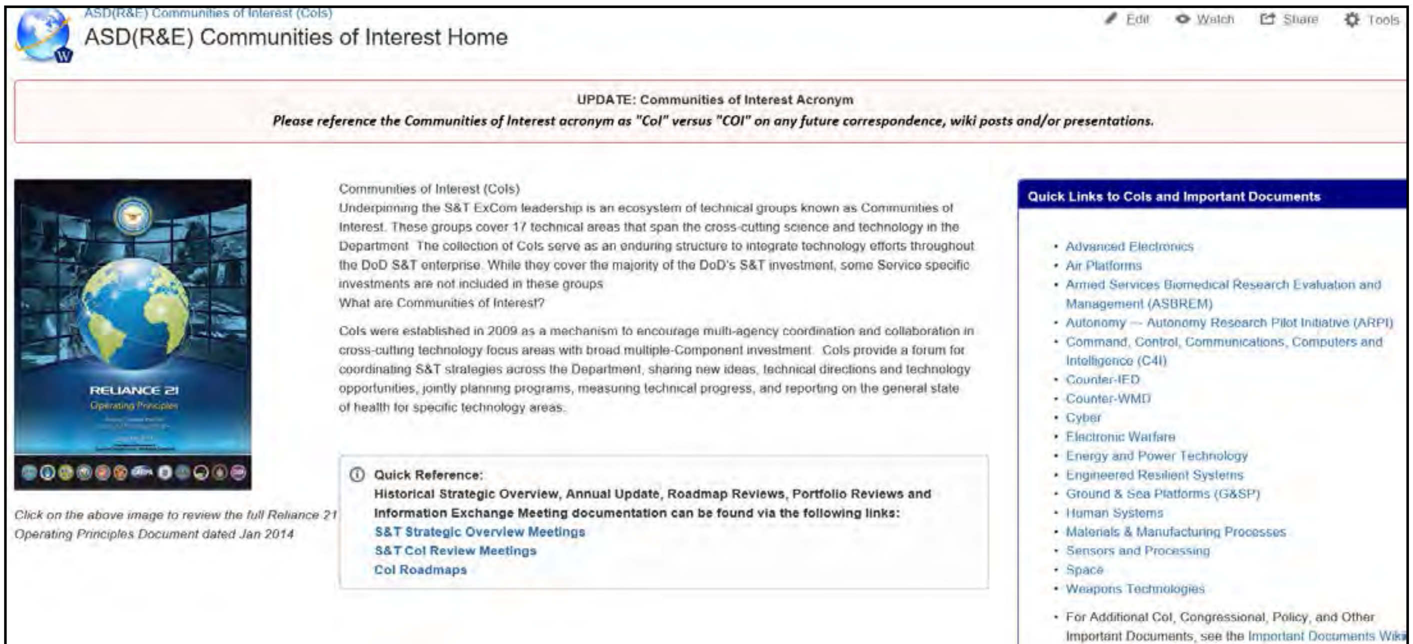
DoD Research Enterprise
https://www.acq.osd.mil/rd/

Twitter
@DoDInnovation

CoI Wiki Pages

DoD Defense Communities wiki is open to DoD Civilians and their contractors, allowing CoIs to share and contribute content, facilitating cross-CoI collaboration.

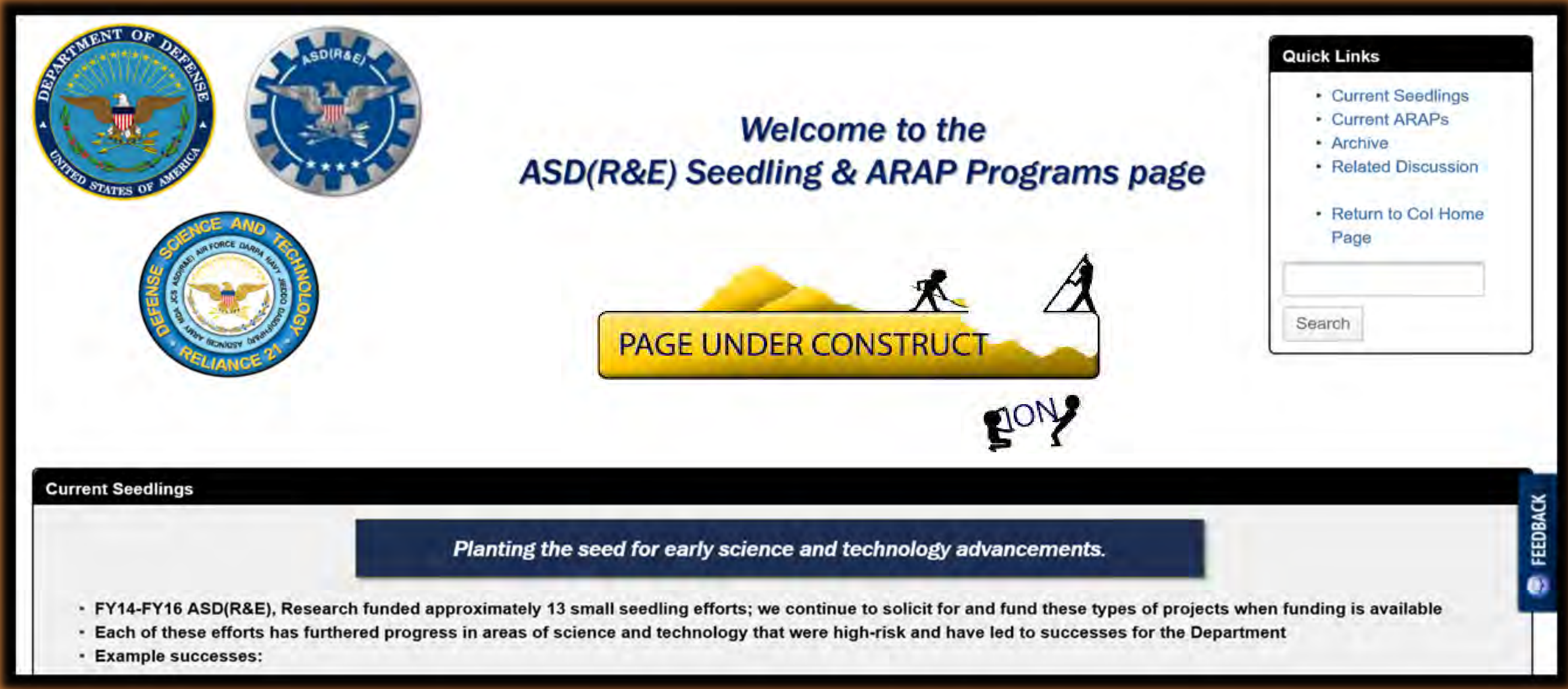
Communities of Interest CAC-enabled home page URL:
https://www.dodtechipedia.mil/dodc/x/ZIAaB



For additional information about the ASD(R&E) Communities of Interests (CoIs), please send email to: osd.pentagon.ousd-atl.mbx.communities-of-interest@mail.mil

Seedling and ARAP Wiki Page

Coming soon…



National Defense Industrial Association Armed Services Biomedical Research Evaluation and Management

20-22 March 2018

RDML Mary Riggs

Director, Defense Health Agency Research Directorate

Chair, ASBREM CoI

ASBREM CoI Overview

ASBREM **ensures the coordinated delivery of innovative and integrated healthcare solutions to our warfighters: enabling optimal readiness and lethality**

- Awareness of cross-Component needs
- Joint alignment of biomedical R&D efforts
- Coordinated & complementary use of resources
- Increased interagency collaborations

2017 Highlights

- Completed Integrated DoD Biomedical Research and Development Strategy
- Developed ASBREM Joint Technology Coordinating Groups (JTCG) Roadmaps aligned to the R&D Strategy

Integrated DoD Biomedical R&D Strategy

Jointly developed strategy enhances coordination to ensure Warfighters are:

Goal 1: Better Prepared: Warfighters are equipped with capabilities and knowledge to optimize their health and achieve peak performance in all mission domains

Goal 2: Better Protected: Warfighters are equipped with capabilities and knowledge to minimize exposure to and consequences of biomedical risks, including infectious diseases, preventable injuries, and other environmental/workplace hazards

Goal 3: Better Cared For: Warfighters are provided with health services that minimize morbidity and mortality and maximize recovery across the treatment continuum; from point of injury, during en route care, to definitive care and rehabilitation

Guiding Principles: ASBREM's commitments

- *Driving innovation in DoD biomedical research*
- *Maintaining strong biomedical R&D connections to other government agencies, industry, and academia*
- *Coordinating and integrating portfolios across the DoD*
- *Improving resource management and efficiency*

Biomedical R&D Portfolios
Joint Technology Coordinating Groups

JTCG-1 BIOMEDICAL INFORMATICS & HEALTH INFO SYSTEMS AND TECHNOLOGY (BI/HIST)

Medical Simulation and Training
Health Information Technology and Informatics
Medical Capabilities to Support Dispersed Operations

JTCG-5 MILITARY OPERATIONAL MEDICINE (MOM)

Environmental Health and Protection
Injury Prevention and Reduction
Physiological Health and Performance
Psychological Health and Resilience
Psychiatry and Clinical Psychology Disorders

JTCG-7 MEDICAL RADIOLOGICAL DEFENSE (MRD)

Hematopoietic ARS Recovery Countermeasures
Assessment of Radiation Injury (Biodosimetry)
Combined Injury: Radiation with Other Insults
Internal Contamination
Low Dose/Dose Rate and Late Effects

JTCG-9 MEDICAL CHEM-BIO DEFENSE (MCBD)

Biological Therapeutics
Chemical Therapeutics
Toxin Therapeutics
Biological Prophylaxis
Chemical Prophylaxis
Toxin Prophylaxis
CB Diagnostics

JTCG-2 MILITARY INFECTIOUS DISEASE (MID)

Parasitic Infectious Disease
Bacterial and Fungal Infectious Disease
Viral Infectious Disease
Vector Control
Diagnostics Systems

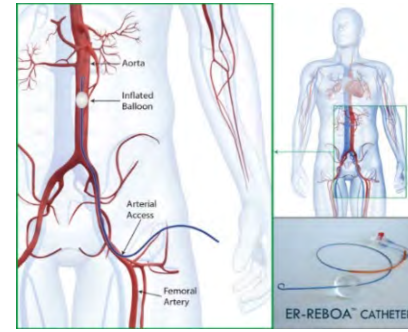
JTCG-6 COMBAT CASUALTY CARE (CCC)

Prolonged Field Care
Diagnosis and Treatment of Brain Injury
Devices and Therapeutics for Hemorrhage Control/Resuscitation/Blood Products
En Route Care
Forward Surgical/Intensive Critical Care
Treatments for Extremity Trauma, Tissue Injury, Cranio-maxillofacial Injury, Lung Injury, and Burns
Military Medical Photonics

JTCG-8 CLINICAL AND REHABILITATIVE MEDICINE (CRM)

Neuro-musculoskeletal Injury Rehabilitation
Pain Management (Acute/Chronic/Battlefield)
Regenerative Medicine; Hand and Face Transplants
Sensory Systems (Visual, Auditory, and Vestibular)

ASBREM CoI Accomplishments



Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA): Technique used in trauma for patients that are rapidly bleeding to death from injuries to their chest, abdomen or pelvis

Sufentanil Nano Tab: Rapidly acting product relieves acute pain with minimal side-effects primarily used during Tactical Field Care and Tactical Evacuation Care

Altitude Readiness Management System (ARMS): First mission composite risk management decision aid that monitors probability and severity of high altitude-induced illness or work performance impairment

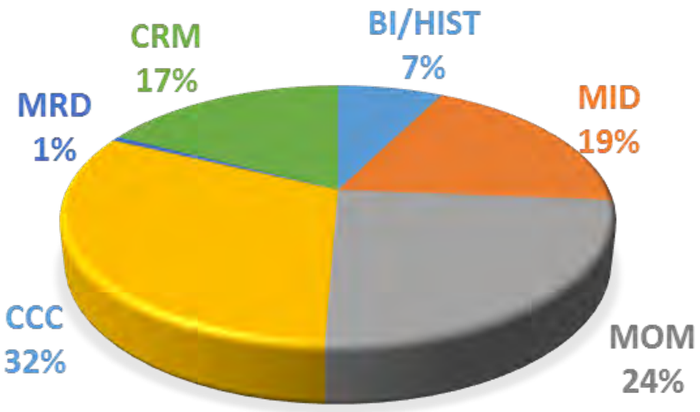
Zika Vaccine (ZPIV): Rapid 9 month development from bench to clinical trials

Coordinative Accomplishment: Blood Plasma Summit

Brought together DHA J-4, J-9, Army, Navy, SOCOM, DHP, and BARDA stakeholders to coordinate efforts in blood plasma research and development

Investment Strategy

DoD Medical RDT&E Funding Profile 2017 President's Budget



Breakdown by Research Area

DoD Biomedical R&D investments are primarily targeted in areas, or for environments, that are militarily unique for which there are limited or no commercial partners or interests

- The DoD **leads** in most biomedical research areas: e.g. prolonged field care, en route care, forward surgical/intensive critical care, hemorrhage control and blood products
- The DoD **leverages** in areas where commercial technologies exist and can be tailored for military use: e.g. medical simulation and training, diagnostic systems, pain management, infectious diseases, Health Information Technology
- The DoD **watches** areas of emerging interest: e.g. Medical Radiological Defense and other tech areas like Artificial Intelligence

BI/HIST- Bioinformatics and Health IT
MID- Military Infectious Diseases
MOM- Military Operational Medicine
CCC- Combat Casualty Care
MRD- Medical Radiological Defense
CRM- Clinical Rehabilitative Medicine

Conclusion

Key Areas of Interest

- Novel tools and techniques for prolonged field care and en route care
- Wearable technology for monitoring environmental and occupational threats
- Technologies to enable autonomous medical supply and evacuation
- Secure and reliable IT and engineering support for telehealth/telecare
- Advancing next generation medical device interoperability and security infrastructure
- Validated models for use as clinical tools to guide therapeutic interventions and predict optimal patient outcomes

Engaging industry is key to the success of military medical R&D.

We look forward to engaging with you.

Advanced Electronics CoI
2018 Overview

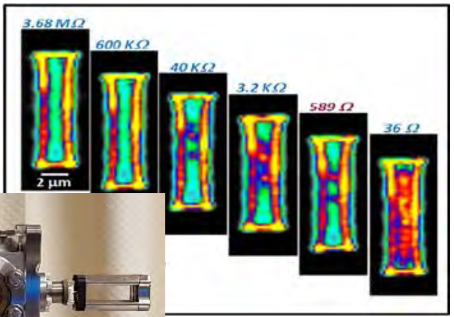
Dr. Romeo del Rosario

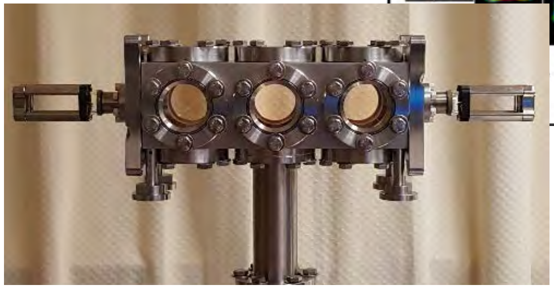
March 21, 2018

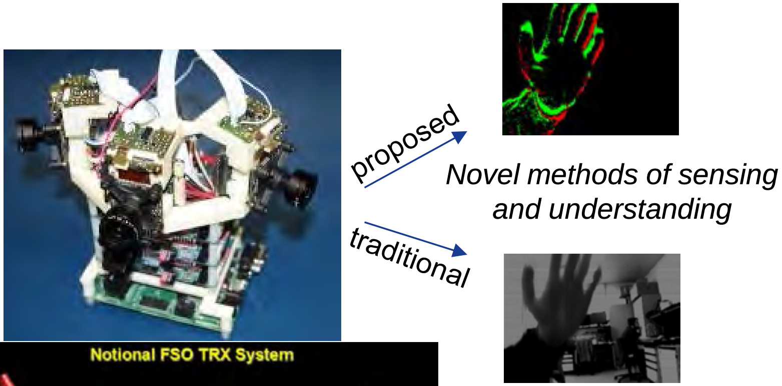
Strategic Priorities

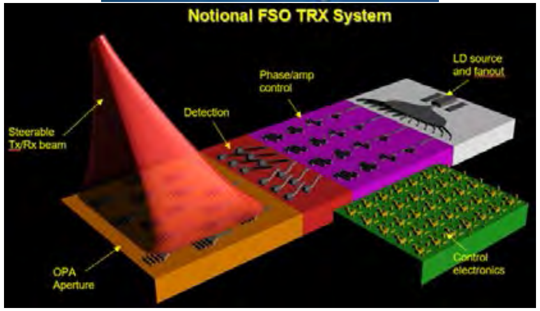
- Provide electronic materials, devices and components that ensure ownership of the electromagnetic spectrum for Sensors, Electronic Warfare, Directed energy, and Cyber-EW
- Develop quantum S&T for revolutionary performance after OSD's Quantum Science and Engineering Program (QSEP) ends:
  - Sensing
  - Assured references – position, navigation and timing (PNT)
  - Networks & Computational applications
- Understand and exploit electronics for artificial intelligence (AI), machine learning and robotics
  - Neuromorphic processes and sensors
  - Advanced power electronics and energy delivery
  - Autonomous operation
- Accelerate technologies that integrate the use of photons and electrons within a circuit or microsystem (integrated photonics) to significantly advance miniaturization and performance
- Identify and develop lasting and affordable solutions to provide trusted and assured electronic components and access to leading edge integrated circuit technologies

Share and evolve best practices









Taxonomy

- **Electronic Materials**
  - Growth and Characterization Technologies
  - Electro-Optics
  - Flexible Electronics and Displays
  - Micro/Nano Electronics
  - RF Components
  - Power Electronics
  - Synthesis
  - Additive Manufacturing

- **Digital, Analog and Mixed Signal Integrated Circuits**
  - Custom Manufacturing
  - Design
  - Leading Edge Digital, Analog, and Mixed Signal Integrated Circuits
  - MEMS and NEMS
  - Heterogeneous Integration
  - 3D/2.5 Integrated Circuits
  - Neuroelectronics components

- **RF Components**
  - Antenna Support
  - Control Components and Filters
  - Sources - Solid State
  - Sources - Vacuum Electronics
  - Sensors - Solid State
  - Sensors - RF Photonic
  - Electromagnetic methods and techniques
  - Heterogeneous Integration
  - Manufacturing Technologies

- **Cross Cutting Technologies**
  - Anti-tamper
  - Radiation Hardening
  - Trust, Assurance, and Availability - IV&V
  - Trust, Assurance, and Availability - Supply Chain
  - Reliability
  - EMI/EMC/EMP Hardening
  - Counter DEW Hardening
  - Computational Methods

- **Power Electronics**
  - Wide Bandgap Semiconductor Devices
  - Silicon Devices
  - Power Integrated Circuits and Components
  - Enhanced Thermal Management
  - Packaging

- **EO/IR Components**
  - Display Components
  - Sources - Lasers
  - Sensors - Focal Plane Arrays
  - Integrated Photonics
  - Sources - LEDs

- **Quantum Based Components and Technologies:**
  - Information
  - Sensing
  - Computing
  - Networking
  - Technology Platforms - Solid State
  - Technology Platforms - Superconducting
  - Technology Platforms - Ion
  - Technology Platforms - Atom
  - Technology Platforms - Optical

Major Changes

- **Investment profile - Significant changes in FY18**
  - DARPA Electronics Resurgence Initiative (ERI) - AE taxonomy bin Digital, Analog, Mixed Signal ICs
  - DMEA 6.3 investment more than doubles in AE first tier taxonomy Digital, Analog, Mixed Signal ICs in two second taxonomy tier bins:
    - Custom Manufacturing
    - Leading Edge Digital, Analog, and Mixed Signal Integrated Circuits
- **Updates to major Service investments**
  - Air Force, Army, and Navy investments relatively constant-total $’s down slightly for all three in PB18
  - Chief of Naval Research has issued new S&T strategy-NRE Framework with emphasis on speeding technology innovation to the warfighter
  - Chief of Staff of the Army issued new guidance to focus S&T on Modernization Priorities:
    - Long Range Precision Fires
    - Next Gen Ground Combat Veh.
    - Future Vertical Lift
    - Network/C3I
    - Air & Missile Defense
    - Soldier Lethality
    - Precision Navigation and Timing
    - Synthetic Training Environment
- **Roadmaps Implemented in the updated taxonomy**
  - Key features of roadmaps plotted at first tier of taxonomy
  - Refine to provide greater granularity in FY18 for second tier of taxonomy

Major Changes/Accomplishments

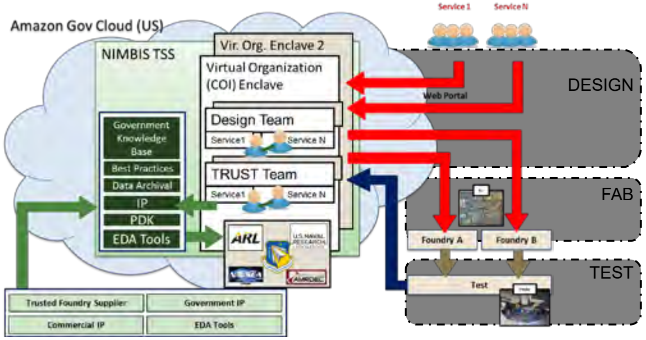
A Few Outstanding Accomplishments

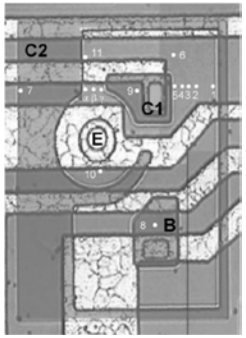
- **OSD Quantum Science and Engineering Program (QSEP): AFRL, ARL, NRL partnerships:**
  - Demo lab breadboard of a quantum dot strain sensor for gravimetry and accelerometry applications
  - Dual atom interferometer to measure rotation and acceleration for inertial navigation
  - Fabricated an entangled photon pair source
  - Completed broad progress on qubits based on vacancies in SiC and trapped ions
- **Prepared an AE CoI Report: "Leveraging 5G Technologies for DoD Application Spaces"**
- Assessed and produced reports on global gallium nitride (GaN) COTS parts and GaN Qualification (AFRL/NRL APRICOT)
- **Demo of AFRL/ARL/NRL collaborative, cloud-based electronic design automation (EDA)**
- Developed and completed a successful industry IR&D review – new format
- **Produced advanced vacuum electronics for EW**
- **Developed a laser-based 2-photon absorption tool to emulate single-event-effects (SEE) and enable SEE mapping of ICs**
- **Successful transition of the Trusted Access Program Office (TAPO) program - NSA to DMEA**
- Produced preliminary images taken on Global Foundries 14nm devices using the DMEA developed X-Ray tomography tool
- Demo'ed high-operating temperature (up to 170K), mid-wave infrared focal plane array for higher mean time between failure


Leveraging 5G Technologies for DOD Application Spaces

Department of Defense
Research & Engineering Enterprise
Community of Interest for Advanced Electronics

24 January 2018

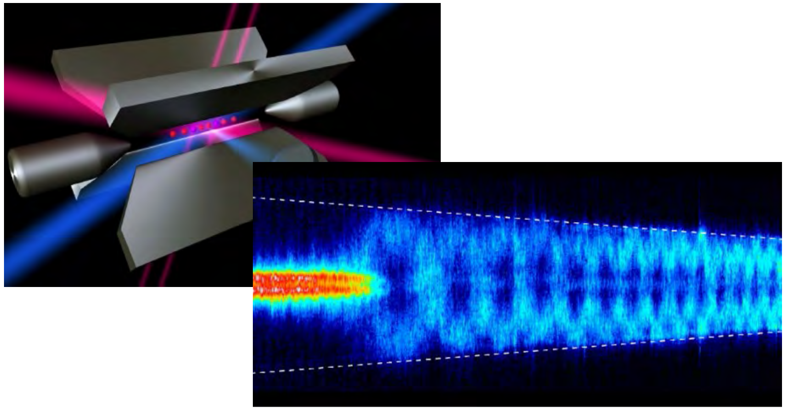




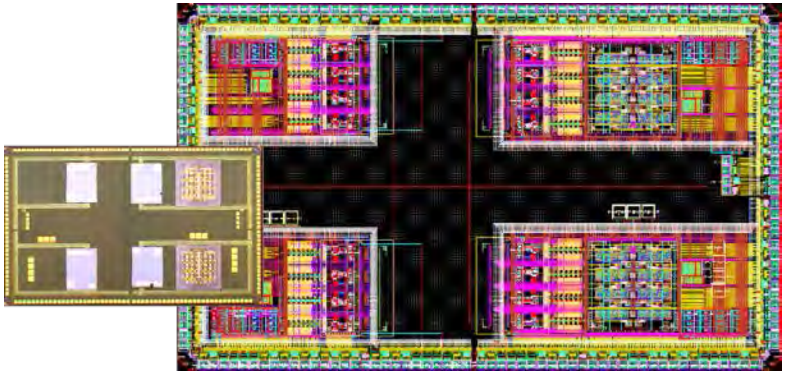
Node	ASIC	Digital Foundry: SOI CMOS	Digital Foundry: CMOS	Digital Foundry: Low-Power CMOS	RF Foundry: SiGe HP	RF Foundry: SiGe PA	RF Foundry: RF SOI	RF Foundry: RF CMOS	RF Foundry: High-Voltage CMOS
32nm	Cu-32	32SOI							
45nm	Cu-45	12SO							
65nm			10SF	10LP				10RFe	
90nm			9SF	9LP	9HP			9RF	
130nm			8RF		8XP 8HP 8WL			8RF	
180nm					7WL		7SW SOI* 7RF SOI	7RF 7TG	7HV
250nm			6SF		6WL			6RF	
350nm					5PE*	1K5PAx* 5PAe* [illegible] 5PAe			

FY17-18 AE CoI Emphasis

The CoI bridges fundamental research and commercial investments to militarily-critical hardware capability gaps and new concepts:



- **Lead** in areas in which military-unique components create superior performance
- **Watch** and **leverage** international and commercial technology base
  - fast follower with investment focus on military-unique needs or opportunities
- **Understand** and mitigate globalization trends and technology availability
  - avoid technology surprise
- **Enable** full use of electromagnetic spectrum in highly contested environments and counter other's ability to do the same
  - deliver technology surprise and <u>cost imposition</u>
- **Assure** communications and on-board processing
  - basis for autonomy and swarms
- **Reduce** size, weight, power consumption and cost
  - basis for expendable and attritable
- **Enable** open system architectures
  - provide modularity for low cost upgrades
- **Increase** capability to operate in harsh environments, supply chain risk management, and sustainment (includes tamper-proofing technologies)
- **Establish** low-power electronics base
  - supports autonomous AI



Future Activity: FY18-19

- **Initiatives and best practices to accelerate R&D process**
  - AFRL/ARL/NRL collaborative, cloud-based electronic design automation (EDA)
  - Service lab participation in DARPA programs to facilitate rapid transfer of Service lab technology to warfighter via defense primes
  - Service labs leverage DARPA technology investments to focus on warfighter need
  - Increase cross-CoI technology transfers
  - Army, Navy, AF and DMEA are working collaboratively with DARPA ERI
- **Cross-CoI, Industry, Academia, Partnerships and/or Opportunities**
  - Apply Sinara universal controller for quantum experiments, 30+ lab setups in U.S. & Europe
  - Develop advanced vacuum electronic devices for EW application and transition of design tools to industry
  - DMEA leverage the National High Reliability Electronics Virtual Center's (HiREV) lessons learned at 90nm to buy down risk for reliability
  - DMEA Trust program evolve tiers of trust methodology (e.g. DARPA SPADE & OMG programs)
  - DMEA international partnership with SELEX Aerospace and University of Greenwich with emphasis on semiconductor device reliability focused on lead free microelectronics.
  - Multiple CRADAs with universities and commercial entities by all AE CoI stakeholders

Future Direction

- **International Semiconductor Activities**
- **Synchronize efforts to address trust, supply chain integrated circuit challenges, and AE-CoI priorities.**
- **Actions Underway for FY18:**
  - Transition QSEP to lasting service initiatives, lead Quantum S&T Strategic Road Mapping Study, and pursue recommended actions from the Study
  - Refine Roadmaps in updated taxonomy
  - Continue interactions with other CoI's to help shape tech advances to best address warfighter needs
  - Determine Way Ahead for a Tri-Service unified approach to EDA
- **Extension**
  - Geographical
  - Technological
  - Business

Questions ?

Space COI Annual Update:
2018 Strategic Overview

Dr. Jaime A. Stearns
Dr. Thomas W. Cooley
Space Vehicles Directorate
Air Force Research Laboratory

Space COI Annual Update - Overview

COI Description

–The goal of the Space COI is to 1) Facilitate collaboration and leveraging of complementary investments of the space S&T efforts across the community in support of the intent of the nation's Space interests; and 2.) Identify gaps, establish and maintain a set of S&T roadmaps to guide Space Community research program investments, perform portfolio assessments, and provide future resource recommendations to leadership

COI Purpose

–The Space S&T COI is a forum for sharing new ideas, technical directions and technology opportunities, jointly planning programs, measuring technical progress, and exchanging advances in space S&T

Portfolio Focus

–DoD S&T investments in space-unique technologies that are essential to maintain and advance existing U.S. conventional and asymmetric military advantages enabled by space systems at the strategic, operational, and tactical levels

Technology Sub-Area 1
Satellite Communications

Technology Sub-Area 2
Missile Warning, Missile Defense, Kill Assessment and Attack Assessment

Technology Sub-Area 3
Positioning, Navigation and Timing

Technology Sub-Area 4
Intelligence, Surveillance and Reconnaissance

Technology Sub-Area 5
Space Control and Space Situational Awareness

Technology Sub-Area 6
Space Access

Technology Sub-Area 7
Space and Terrestrial Environmental Monitoring

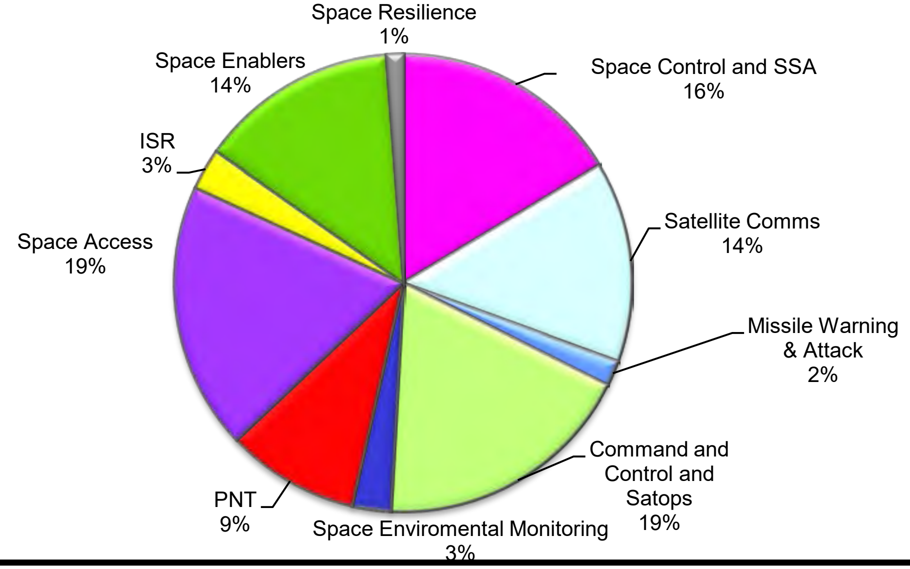
Technology Sub-Area 8
Command and Control; and Satellite Operations

Technology Sub-Area 9
Space Enablers

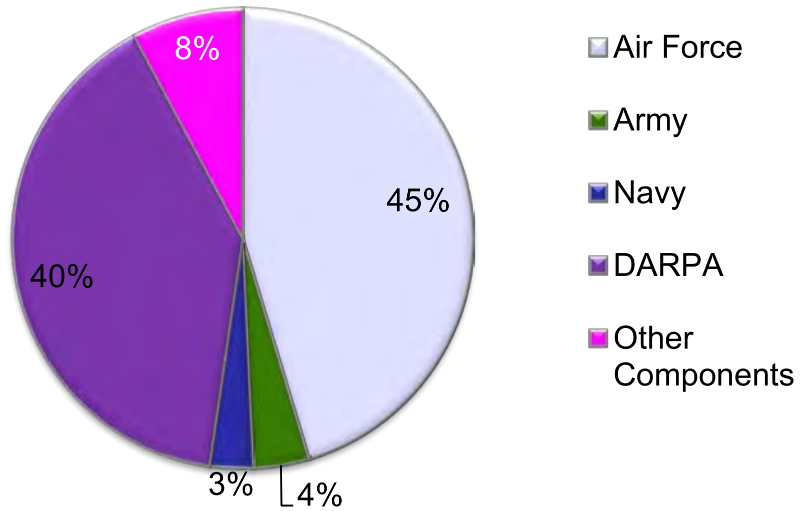
Technology Sub-Area 10
Space Resilience

Space S&T COI Investment and Performers

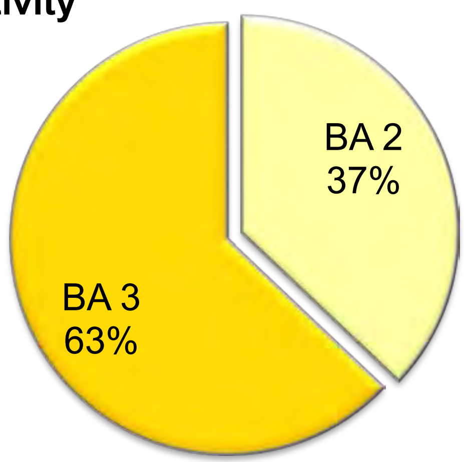
COI Sub-Areas PB18



Component Investment



Budget Activity



Intramural vs. Extramural split:

- **Army - 6.2 47/53; 6.3 38/62**
- **Navy - 6.2 60/40; 6.3 40/60**
- **Air Force - 6.2 48/52; 6.3 20/80**

Major Performers:

- **Aerojet-Rocketdyne, APL, BAE Systems, Ball Aerospace, Boeing, Dynetics, Honeywell, Lockheed Martin, MIT-LL, Northrop Grumman, NRL, Orbital/ATK, Raytheon, Sandia National Laboratory, Teledyne Brown**

1) Overview of Space COI Portfolio Changes

- **Membership**
  - New Space S&T COI Chair – Thomas Cooley, AFRL
  - Representatives from Air Force (AFRL), Army (SMDC), Navy (ONR and NRL), MDA, NRO, and DARPA
- **Investment Influences**
  - AFSPC Space Enterprise Vision (SEV) adjusting acquisition focus toward resilience and technologies that support resilience
  - Increases in space budget have not reached Space S&T Community
  - NSDC (National Space Defence Center) causing new strain on S&T budget to meet STRATCOM Joint Urgent Emerging Need (JEON). Focus BMC2.
  - Growing demands spur creative collaboration but increase program risk
- **Roadmaps Stable**
  - “New Space” commercial enterprises providing new opportunities

2) Space COI Activity In-Year

- **Major Accomplishments and Areas of Cross-Service Collaboration**
  - Awarded ARAP for Defense Optical Channel Program (DOC-P)
    - The $45 million award will fund a three-year project titled, "Joint Service Laboratories Capabilities in Quantum Sciences and Engineering," which necessitates cross-coordination between the ARL, NRL and AFRL
- **External Engagements**
  - Conducted Space IR&D Technology Interchange Meetings (Dec 2017)
    - COI technology representatives from the Air Force, Army, and Navy
    - 14 industry partners presenting 76 technology topics related to Space COI
- **Planned Activity**
  - Continue Cross-Service collaboration to updated and refine specific Space COI Technology Roadmaps (Space COI Meeting Feb. 20-23, 2018)
  - Support the OSD Space COI Review by EXCOM (May 2018)

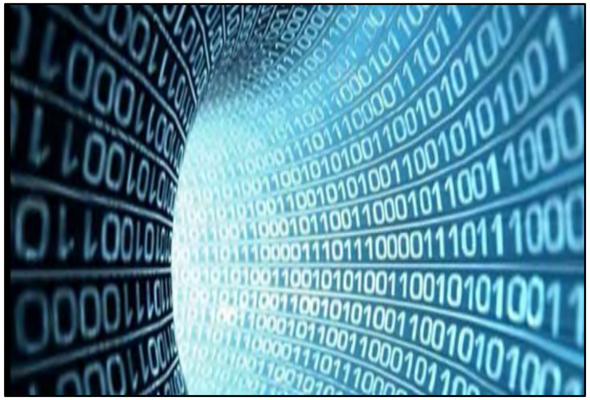
COI Success:
Defense Optical Channel Program (DOC-P)

- In Apr 2017, the ASD/R&E ARAP program awarded a three-year, $45M grant to the DOC-P proposal
  - DOC-P was submitted through the Space S&T CoI, including AFRL Space Vehicles, NRL, SPAWAR, SMDC, and ARL
- <u>Goal</u>: Establish a DoD leadership cadre that applies advances in lasercom and optical channel technology, addressing challenges in militarily relevant environments
- DOC-P will incorporate civil, academic, commercial & international entities
- Effort focuses on three tasks addressing specific defense needs:
  1) <u>Laser Comm with Channel Adaptive Techniques</u>: Assured comm with anti-jamming and LPI / LPD capabilities
  2) <u>Optical Time Transfer</u>: Free-space optical spread-spectrum comm and time transfer with miniaturized frequency combs, producing 100,000-fold increased precision over GPS
  3) <u>Quantum Comm</u>: Demo of prototype integrated classical/quantum free-space channel in daylight, with compact space-based, airborne, and ground terminals

Scientific Successes

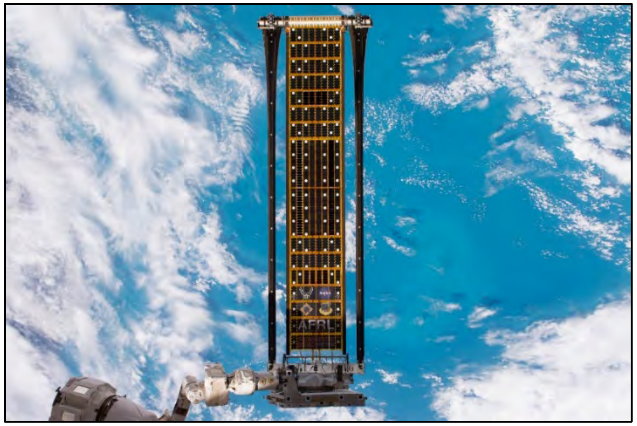
Fallen Angel

- Space system cybersecurity experiment conducted across the ANGELS system architecture at its end-of-life
- Evaluated the efficacy of experimental defensive cyber operations tools and techniques



Roll-Out Solar Array (ROSA)

- ROSA flight experiment on the International Space Station (ISS) achieved 100% of its science objectives
- ROSA is a tensioned blanket solar array that unfurls using two high strain composite booms, a revolutionary low-cost approach to space deployable mechanisms that was invented in-house at AFRL.
- ROSA reduces solar array mass by 20%, volume by 400%



Major Milestones

<u>Compact Environmental Anomaly SEnsor</u>

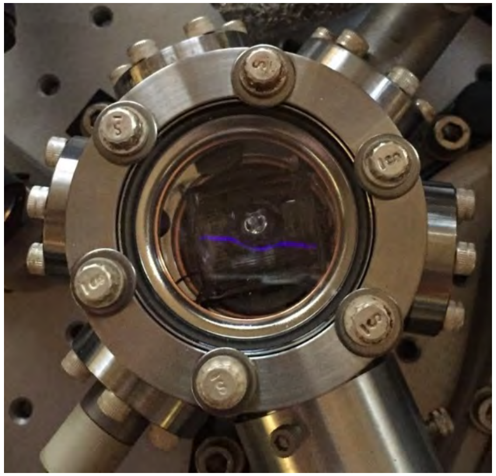
- Energetic Charged Particle sensor for rapid environmental anomaly attribution
- Manifested on first operational system (Weather System Follow-on – Microwave, 2022)
- Sensor design will transition to industry to meet SecAF-mandated placement of environmental sensors on every spacecraft

<u>Advances in Propulsion Systems</u>

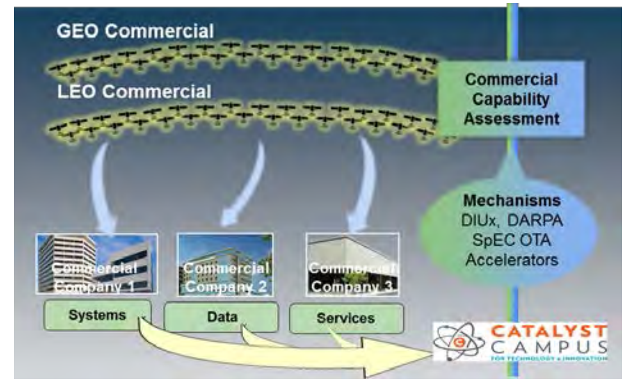
- Successfully completed the full-scale fuel kick pump test campaign as part of the Hydrocarbon Boost Technology Demonstrator (HBTD) program
- Provides key insights for future engines that use the oxygen-rich staged combustion (ORSC) engine cycle.

<u>Next Generation Atomic Clock Development</u>

- Secured funding and slot on GPS III Space Vehicle 10 for two versions of advanced atomic frequency standard



New Partnerships



Demonstrating New Business Models

- Space Accelerator adapts speed of venture capital to military acquisition of SSA and Weather capability
- Kicked off Commercial Augmentation of Mission Operations, bringing commercial Space Situational Awareness to DoD missions

C4ISRNET IT and Networks C2/Comms Unmanned Electronic Warfare Intel/GEOINT Cyber

SATCOM

Air Force looks to contractors to fly satellites

By: Mark Pomerleau

In the name of resiliency and agility within the space domain, the Air Force is looking toward allowing contractors to fly satellites.

For years, while the Air Force has been focused on command and control of these assets — essentially making the trains run on time — the job of the force now is to understand the threat environment and be able to react to it, according to Maj. Gen. David Thompson, vice commander of Air Force Space Command.

Commercial Tasking of AF Satellites

- Successfully demo'd the use of commercial ground antennas to augment the Air Force Satellite Control Network (AFSCN)
- Contractor interface allowed AFSCN users to connect to commercial antennas without having to modify existing AFSCN control systems
- Significant R&D towards resilient space communication

3) Opportunities for Industry

- **Budget constraints drive teaming**
  - Critical need for partnerships to meet current challenges in space
  - Providing industry and academic innovation to Space Warfighting Construct

- **Commercial and International investments are accelerating**
  - New models for timely agile engagement with commercial and international partners underway with OTA, DIUX, and multi-lateral partnerships

DISCUSSION

Materials and Manufacturing Processes COI

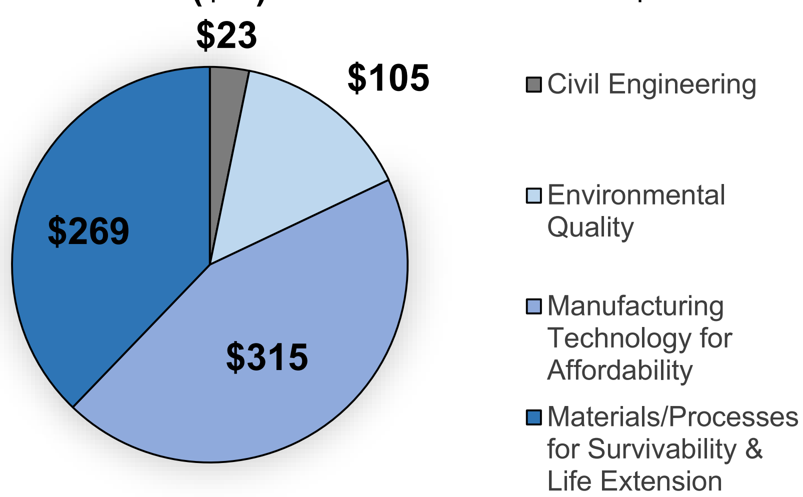
Dr. John Beatty, OSD (Army)

March 20-22, 2018

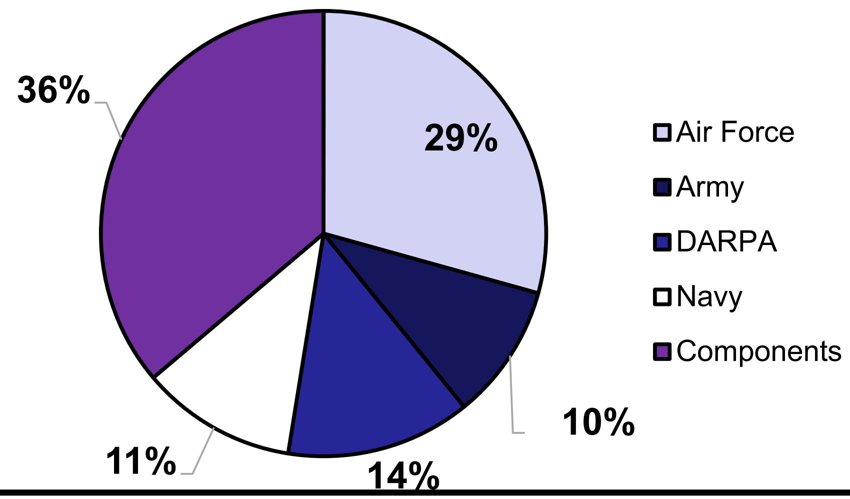
M&MP COI

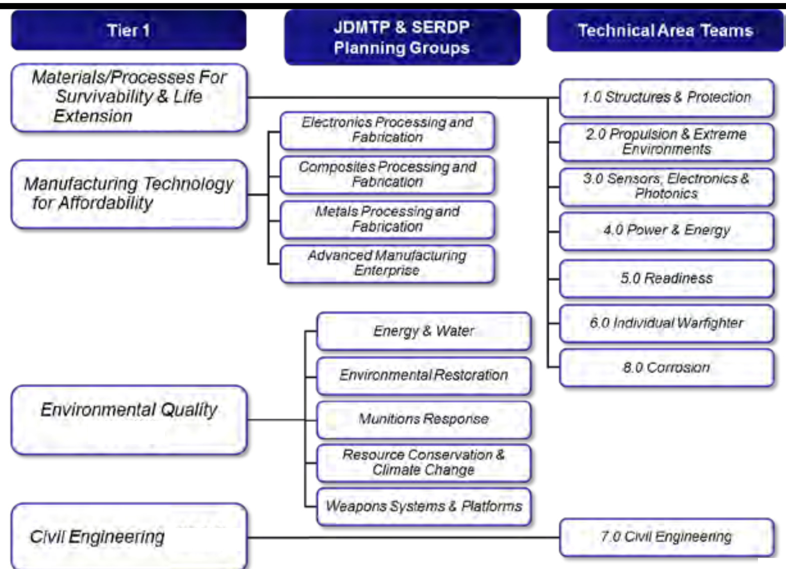
COI Sub-Areas ($M)

Total = $711M



Component Investment





Leadership

Dr. Tim Bunning, Air Force, Lead
Dr. Julie Christodoulou, Navy
Dr. Mark VanLandingham, Army
Dr. John Beatty, OSD
Dr. Steven Wax, DTRA
Mr. Ellison Urban, DARPA

(J. Russell – JDMTP – AF)
(Robin Nissan - OSD SERDP-ESTCP)

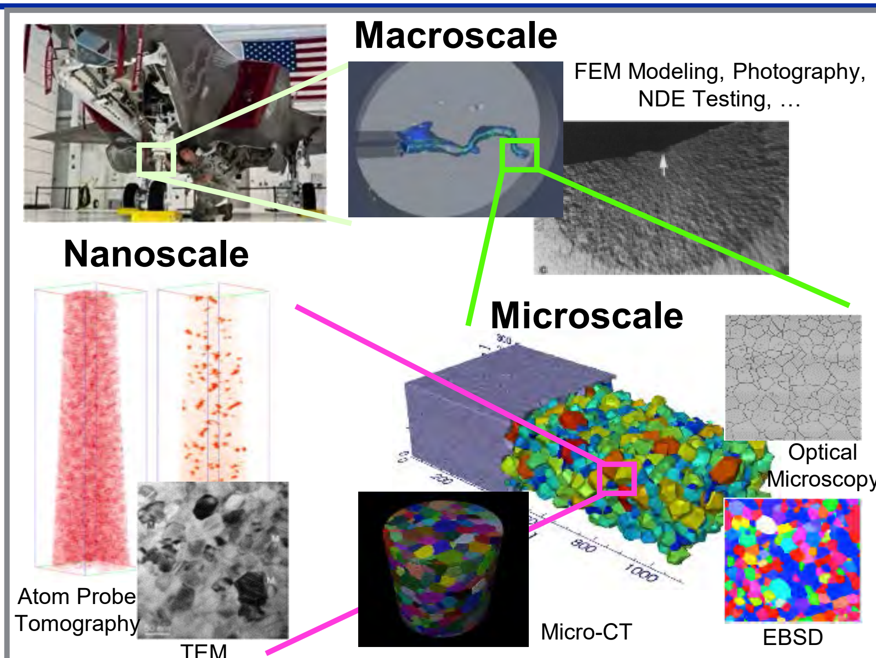
Big Rocks - COI Activity In-Year

- **Briefed NAE – Frontiers of Materials Research: A Decadal Study (due in June 2018)**
  - DMMI workshop on-line
- **Congressional Tasker- Advanced Materials Solutions for Defense Applications**
  - HR115-219, pg 272-273…activities underway to capture input
- **Successful Persh Workshop on "The Interface Between Materials and Biology"**
- **IR&D Exchange with Industry**
- **FiMAR planning (Federal Interagency Materials Representatives)**
- **Manufacturing - Large successful tri-service Defense Manufacturing Conference (DMC) Meeting**
  - High level panel looking forward to next 100 yrs
- **Tri-service Laser Hardened Materials Steering Group (LHMSG) Meeting (Materials for Counter Laser DEW)**
- **Substantial activity in Synthetic Biology for Military Environments (SBME) ARAP**
- **Annual COI meeting in Dayton, Ohio**
- **DoD/DOE Joint Munitions Workshop at Lawrence Livermore National Laboratory (LLNL) (M&MP and Weapons COI)**
- **US-UK Stocktake Principal's request - case studies of AM...initiated FY17, FY18 muscle movements**

Joint-Service Universal Materials Data Fusion and Visualization Structures
FY17 - $810K and FY18 – $810K

Issue:

- Tools to enable Integrated Computational Materials Engineering (ICME) are founded on multi-scale, multi-modal materials modeling and characterization.
- Simulation codes and characterization instruments each have their own length scales, reference frames, and distortions and biases.
- This project aims to create a single data-structure for use when merging, analyzing, and visualizing large amounts of spatial and temporal materials data – generated by separate models, sensors, and modalities -- thereby providing a pathway to a more comprehensive understanding of materials performance and decreasing the time to delivery of new systems.



POCs: AFRL - Mike Groeber (michael.groeber@us.af.mil), ARL - James Synder (james.f.snyder.civ@mail.mil), NRL - David Rowenhorst (david.rowenhorst@nrl.navy.mil)

- AM Build specimens - completed. Finalizing design of sample analysis coordinate systems and distribution plans within the next two weeks.
- Transfer specimens from AFRL to ARL and NRL for individual analyses, tracking meta data of 'inspections' - Late Winter/Spring of 18
- Design file and data structure for relating multi-modal datasets - design complete, implementation underway -- tasking with Blue Quartz and Kitware Inc to adapt Kitware's spatial distortion correction framework to operate within DREAM.3D as well as developing spec for recording corrections outside of
- NRL working with BlueQuartz to implement EBSD image montaging and correction within DREAM.3D allowing for fusion of multi-modal SEM/EBSD serial-sections within DREAM.3D. - ongoing.

Roles: **ARL** - mechanical testing with DIC of tensile specimens, CT of specimen; **NRL** - CT of specimen, 3D serial sectioning of sub-specimen, transfer of 3D EBSD montaging and distortion correction tools to DREAM.3D: **AFRL** - CT of specimen, 3D serial sectioning of sub-specimen, modeling of AM processing, guiding development of software tools through BlueQuartz.

Numerous Successes

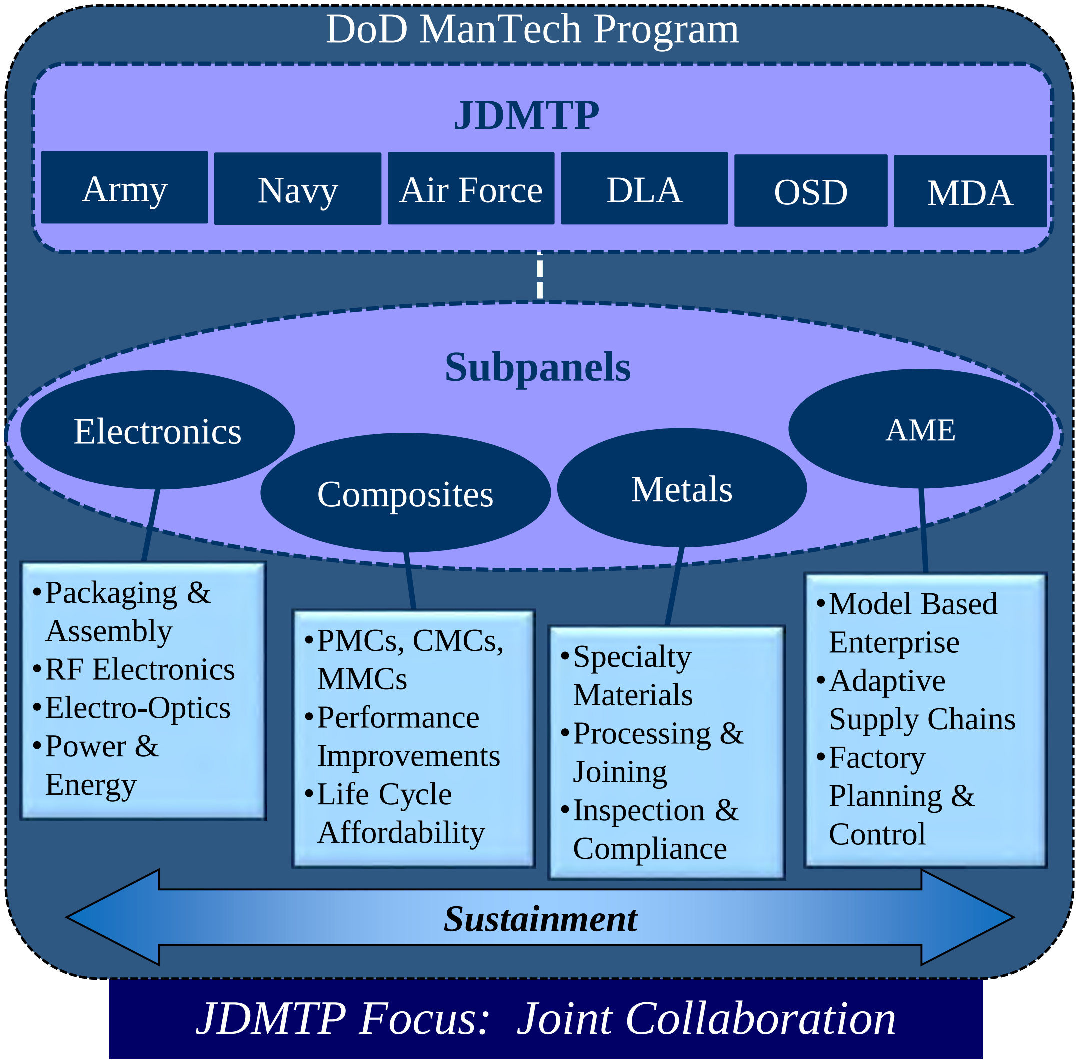
- Composite damage prediction tools are enabling multi-service component design, materials development, lifing, and certification (Air Force, Army, Navy)
- Manufacturing of Carbon-Carbon Composites for Hypersonic Applications (TAT and JDMTP)
- Graphene on 3C-SiC on Si for Low-Loss Nanophotonics (Air Force, Navy Army)
- Advanced Energy Efficient Shelter System (Air Force, Army)
- Laser Eye Protection (Air Force, Army, Navy, DHS)
- Port Improvement via Exigent Repair (PIER) Joint Capability Technology Demonstration (JCTD) SPIRAL 1 DEMO (Army, Navy)
- Tri-service Corrosion capabilities soon to be on-line: ACES (Accelerated Combined Effects Simulation) and C-COAST (Army, Navy, Air Force)

M&MP COI

- **Key leverages (some examples) :**
  - Air Force, NAVY armor - leverage Army
  - Air Force, Navy individual warfighter - leverage Army
  - Navy, Army next generation propulsion mtls - leverage Air Force
    - Air Force/ARMY environmental/thermal barrier coatings - leverage Navy
  - Air Force, Army corrosion - leverage Navy
  - Army, Navy aerospace composites - leverage Air Force
  - Army, Navy laser hardened matls - leverage Air Force
  - Air Force, Navy civil engineering - Army

- **Concerns**
  - Confluence of artificial intelligence (AI), robotics, digital composition exploration next fiver years
  - AM
  - Future warfare foci (bio, cyber, quantum (new new vs new old)) – portfolio shifts?
- **'Big' CY 18 activities**
  - Defense Materials, Manufacturing and Infrastructure (DMMI) workshop(s)
  - Congressional Tasker
  - COI Annual Meeting, Defense Manufacturing Conference (DMC) Conference, Stocktake Additive Manufacturing, OSD Additive Manufacturing

Mantech – Organization (JDMTP)



- **Roles of the Panel**
  - Conduct reviews and assessments of the program and related manufacturing issues
  - Strategic planning to identify joint opportunities
  - Information exchange with government, industry, academia, professional associations

John Russell, Air Force
John Carney, Navy
Andy Davis, Army
Jason Jouet, OSD
Kelly Morris, DLA
Rhonda Morgan, MDA

Timeline to Create Manufacturing USA

WH Advanced Manufacturing Partnership (AMP) Recommendation: "Create Public-Private Partnerships on Advanced Manufacturing"

Announcement of National Network for Manufacturing Innovation (NNMI) Concept and a "Pilot" Institute

NNMI: A Preliminary Design Report Issued by Dept. of Commerce

Revitalizing American Manufacturing Initiative (RAMI) Act Signed into Law

NNMI Rebranded to ***Manufacturing USA***

2013 and 2014 "State of the Union" Calls for NNMI

2011 | **2012** | **2013** | **2014** | **2015** | **2016** | **2017**

DoD Institutes

Significant AFRL Leadership

America Makes
Additive Manufacturing
Youngstown, OH

DMDII
Digital Manufacturing and Design
Chicago, IL

lift
Lightweight Metals
Detroit, MI

NEXTFLEX
Flexible Hybrid Electronics
San Jose, CA

AIM photonics
Integrated Photonics
Albany and Rochester, NY

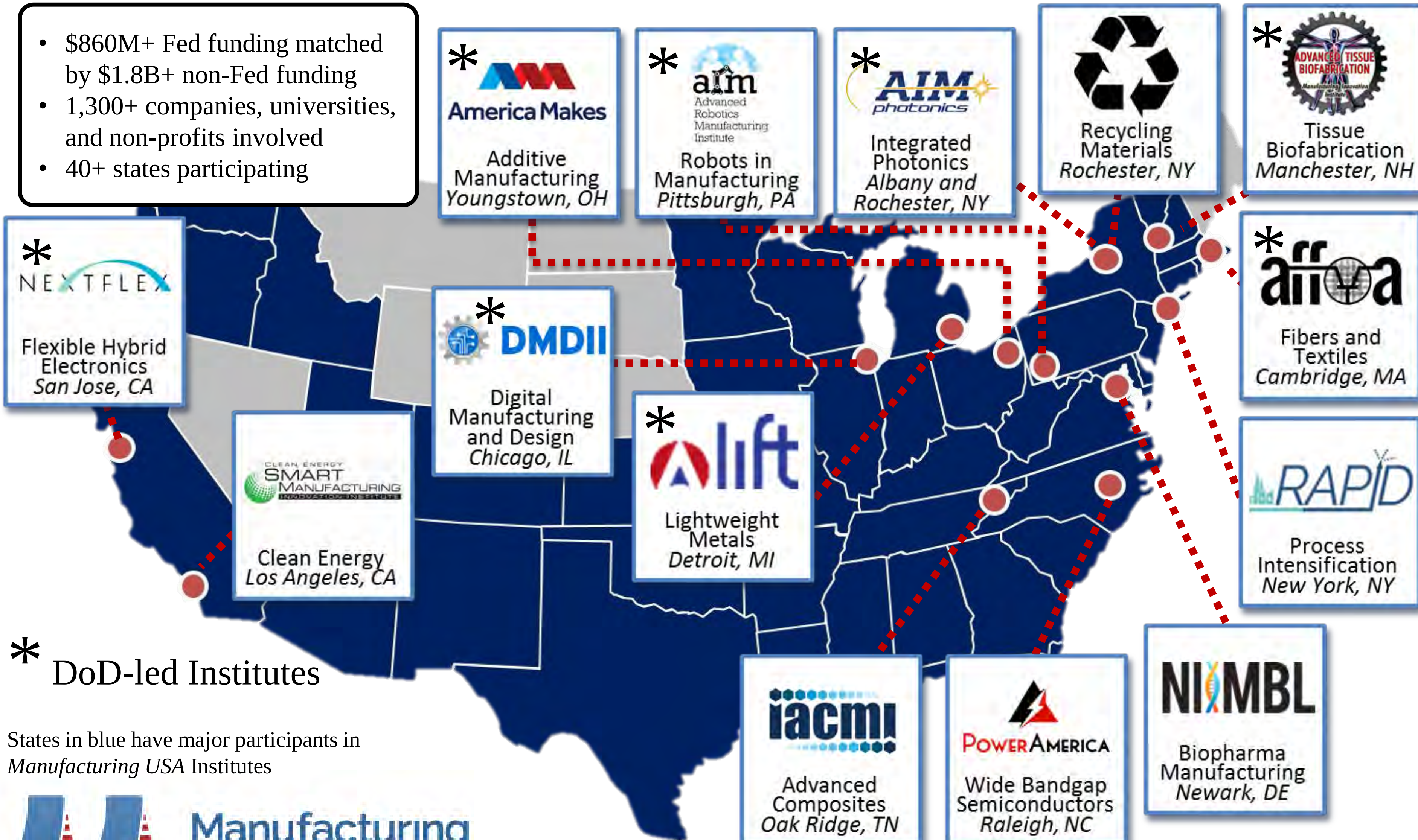
affoa
Fibers and Textiles
Cambridge, MA

Advanced Tissue Biofabrication
Tissue Biofabrication
Manchester, NH

arm
Advanced Robotics Manufacturing Institute
Robots in Manufacturing
Pittsburgh, PA

Manufacturing USA

- $860M+ Fed funding matched by $1.8B+ non-Fed funding
- 1,300+ companies, universities, and non-profits involved
- 40+ states participating



* DoD-led Institutes

States in blue have major participants in *Manufacturing USA* Institutes

Manufacturing USA

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TAT 1 M&MP for Structures & Protection

Objective:

Confident design of materials, joining and integration tools for damage tolerant, survivable, structurally efficient assets.

Garth Wilks, Air Force, garth.wilks.1@us.af.mil
William Mullins, Navy, william.m.mullins@navy.mil
TBD, Army

Program Overview:

M&MP for Structures & Protection

- Platform
- Manufacturing Science
- Survivable Structural
- Multifunctionality

Key Technical Challenges:

- Material models to enable rapid structural material certification & qualification – metals, composites, ceramic, hybrid, & multi-functional materials.
- Feedstocks, process modeling and cert/qual for Additive Manufacturing
- Difficulty joining dissimilar materials without a common processing window – modeling & manufacturing.
- Structural Protection
- Structures Affordability

Operational Opportunities:

- Increased platform survivability, lethality, and mission capability.
- Ability to anticipate/forecast warfighter structures and protection needs
- Platform SWaP constraints driving multifunctional materials.
- Adaptive response to emerging threats & needs – 50% reduction in time from idea to implementation.
- Transition leading edge technology for affordable acquisition and sustainment – 50% R&D cost savings

TAT 2.0 M&P for Propulsion and Extreme Environment Materials

Objective:

Advanced M&MP for components with higher temperature and performance capabilities to enable advanced systems for increased power projection and lethality

Eric Wuchina, Navy
Donna Ballard, Air Force
Brad Forsch, Army
Jon Davis, OSD

Program Overview:

- Turbine Engine
- Missile Propulsion
- Hypersonic Materials
- Reactive/Energetics
- Electromagnetic Railgun

Key Technical Challenges

- C/C and CMC affordability and scale up – automation/rapid manufacturing and repair
- Domestic SiC (2400-2700˚F) Fiber Sources
- Rayon replacement for structural insulators
- In-process NDE
- Oxidation and corrosion resistance
- Longer Term – Integration of ICME tools into manufacturing for scaleup & process optimization

Operational Opportunities

- Enable increased range, fuel efficiency, and loiter time for military flight vehicles
- Increase standoff distance for warfighter
- Mitigate/Control Corrosion and CMAS attack in turbine engine systems for increase time between maintenance cycles
- Enable CPGS and hypersonic system into arsenal
- Enable EMRG for theater defense & fleet use
- Increase warhead lethality and reduce mass with improved energetics and reactive warhead/case

TAT 3.0 M&MP for Sensors, Electronics, & Photonics

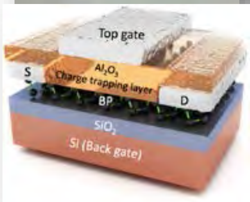
Objective:

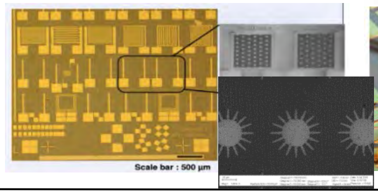
Advanced M&MP for energy efficient, ultra light-weight, conformal electronics, photonics, and sensing devices

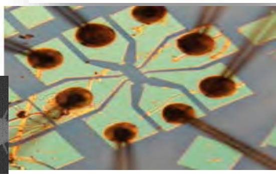
Shashi Karna, Army
John Boeckl, Air Force
Ivgeniya Lock, Navy

Program Overview

- Energy Efficient Electronics with 2D Materials
- Printable, Flexible Electronics
- Neuromorphic and Synaptic Devices
- 2D Material-based Quantum Computing and Sulphur Detection
- Van der Waals Solids for Photonics







Key Technical Challenges

- Scaled-up, low-cost production of defect-free Two-Dimensional (2D) Materials
- "Inkable/Printable" 2D Materials
- Theoretical understanding of new physical phenomena e.g. Spin quantum Hall effect, electron-phonon coupling induced pseudo-magnetic field in strained 2D materials)
- Modeling and simulation tools for device physics, transport properties, and manufacturing process development
- Material stability in ambient and extreme (T, ballistic impact, ionizing and non-ionizing radiation) environment

Operational Opportunities

- Ultra Light-weight, conformal, energy electronics, photonics, and sensors
- Point-of need manufacturing of components and devices
- High-frequency RF devices
- Quantum encryption and safe communication for protection against EW
- Reduced weight, foot-print, and power requirements in contested environment

TAT 4.0 M&MP for Power & Energy

Objective:

Advanced M&MP for affordable, safe, efficient, light-weight, long-endurance, and rugged power & energy devices.

Robert Mantz, Army, eric. robert.a.mantz.civ@mail.mil
George Orzel, Air Force, george.orzel@us.af.mil
Michele Anderson, Navy, michele.anderson1@navy.mil
Reza Salavani, AFCEC, reza.salavani@us.af.mil

Program Overview

- Integrated Computational Engineering (ICME) of Materials & Devices
- Dielectric Materials and Films for Pulse Power
- Thin Film Photovoltaics
- Batteries
- Fuel Cells







Key Technical Challenges

- Improved cycle-life, safe, and extended temperature electrolytes and new electrode materials for high energy density (> 500 Wh/kg) battery chemistries
- Computational tools for modeling multi-material and multi-scale devices as well as electrochemical processes
- Dielectric materials with both ms and ms response times that enable high energy density (> 4 J/cc) devices
- Organic photovoltaic donor & acceptor materials that enable devices with high efficiency (15%) and air stability
- Sulfur-resistant materials for fuel cells

Operational Opportunities

- Light-weight, safer, energy dense batteries for autonomous vehicles, reduced carried weight, and longer missions
- High-temperature, high energy density capacitors for directed energy and power conditioning applications
- Energy generation and storage technologies for more agile power networks for more electric aircraft/ships and FOB or infrastructure applications
- Low-cost, high efficiency solar panels to reduce FOB refueling logistics and reduce battery carried weight
- Logistic-fuel compatible fuel cells for ultra-long endurance autonomous vehicle operation and tactical power needs

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TAT 5.0 M&MP for Readiness

ICMSE Life-Cycle Models

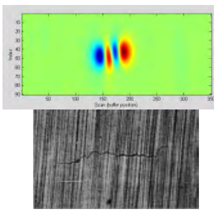
System-scale
Structural Design
Specifications Air Force: ASIP / PSIP Army/Navy: FLE
Macro-Scale
Uncertainty Engineering Bayesian Analysis
Meso-scale
Mechanisms of Risk
Micro-scale
Uncertainty Physics
Nano-scale

Characterization, Sensing and Analytics

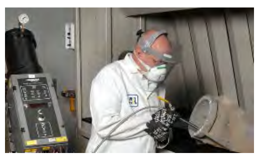
Airframe Sustainment

Propulsion Sustainment

Understand & reduce life-cycle uncertainty



Characterization Technology



Wear Coatings and Lubrication

Tools for improved mx/repair processes

Key Technical Challenges

- Understanding of fundamental material behavior beyond design life
- Inspection techniques and detection / assessment of damage precursors
- Qualification of SHM technologies
- Fundamental understanding of material behavior in complex environments
- Understanding of slight damage / perturbations / gradual degradation to legacy and new materials.

Objectives

- MSA-NDI/NDT capability improvements for the field/depot that assure structural components perform their function in a reliable and cost effective fashion
- Reduce uncertainty and expand options for safe and cost-effective life cycle management of legacy and future turbine engines and A/C structures
- Specialty materials and coatings affordability through improved inspections and repair methods

Siamack Mazdiyasni, Air Force, siamack.mazdiyasni@us.af.mil
Marc Pepi, Army, marc.s.pepi.civ@mail.mil
Ignacio Perez, Navy, ignacio.perez1@navy.mil

Operational Opportunities

- Inspectability / Repairability / Replaceability
- Material-level data (i.e. material state awareness) for future vision of Health Assessments
- Improved NDI capability/reliability/efficiency
- Damage diagnostic that is actionable information for asset/platform maintenance and/or repair

Keys to success: ICMSE, Digital Thread, Analytics, State Awareness, Life Prediction, Prognostics, V&V

TAT 6.0 M&MP for the Individual Warfighter

Objectives

M&MP for the Individual Warfighter supports materials-related needs, ensuring success by addressing critical requirements including survivability, sustainability, mobility, combat effectiveness, and quality of life.

Diane Steeves, Army, diane.m.steeves.civ@mail.mil
Peter Matic, Navy, peter.matic@nrl.navy.mil
Matt Lange, Air Force, matthew.lange@us.af.mil

Program Overview

- Warfighter Protection
- Warfighter Enhancement
- Materials for Logistics
- Bio/Bioinspired Materials

Key Technical Challenges

- Multi-threat (ballistic, blast, FR, DE, microbial, chem-bio, etc) protection without overburdening the Warfighter
- Warfighter enhancement technologies to increase speed, strength, endurance, mobility and survivability
- Low cost wearable sensors and wearable energy sources (PV, thermoelectric, piezoelectric) to power them
- Bio-functionalized textiles, self-cleaning omniphobic textiles, next generation protective garments (e.g. DTRA Second Skin program, selectively permeable membranes)

Operational Opportunities

- Increased mobility of individual Warfighter by enhancing/optimizing protection at lower weight
- Improved situational awareness of the individual Warfighter through networked individual sensors
- Operational capability with a minimal thermal burden in a CBRNE environment
- Improved capability for individual sustainment independence/“self-sufficiency” and reduction of sustainment demands at contingency bases

TAT 7.0 M&MP for Civil Engineering

Objectives

- Lead DOD in providing integrated protection solutions across the operational spectrum to include stability and support capabilities
- Provide force projection technologies and modeling and simulation capabilities for entry and maneuver planning, construction, and assessment
- Develop more efficient plans, designs, construction, operations and maintenance of installations, including contingency bases, that are mission ready, energy & water secure, highly sustainable and low lifecycle cost

Program Overview

- Expeditionary and Fixed Facility Protection
- Force Projection and Maneuver
- Sustainable Bases and Installations

Key Technical Challenges

- Need for greater force protection that is lighter and easily constructed
- Need to achieve operational maneuverability through lighter weight surfacing in austere environments
- Need for sustainable bases in all operational environments using indigenous materials
- Need for highly scalable materials and manufacturing processes
- Modeling and simulation from nm-m of materials and systems

Operational Opportunities

- New capabilities to protect the Warfighter and critical assets
- Proactive means to ensure Joint Forces can deploy and freely enter the theater of operations
- Improved ability to design, construct, and operate sustainable bases
- Dual-use materials / capabilities – protect the homeland
- Position DOD to defend from and understand capabilities of near-peer adversaries

TAT 8.0 M&MP for Corrosion

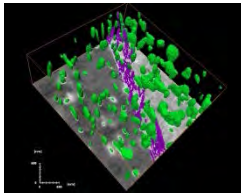
Objectives:

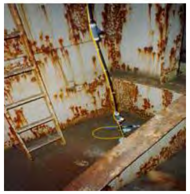
Reduce corrosion and corrosion-related maintenance cost of DoD assets during design, construction and service without compromising affordability, readiness, safety and service life expectancy

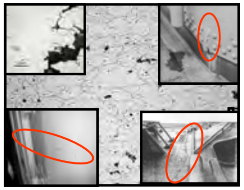
Airan Perez, Navy
Ron Pendleton, Air Force
Brian Placzankis, Army

Program Overview:

- Surface Protection and Modification
- Corrosion Resistant Materials
- Corrosion Prediction







Key Technical Challenges:

- Lack of mechanistic corrosion damage evolution model
- Inability to govern corrosion informed materials selection and design
- Inability to validate predictive performance
- Inability to assess and predict real-time in service

Operational Opportunities:

- Reduce O&S corrosion cost to enable recapitalization and modernization (35%)
- Extend service life of DoD assets (1.5X) beyond original design
- Increase readiness (2X) for present and future missions while reducing resource requirements
- Provide capability to meet design requirements for future DoD platforms

Air Platforms
Community of Interest Update

Dr. Bill Lewis
Director for Aviation Development,
U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC)
21 March 2018

Air Platform COI

The Air Platforms Community of Interest (COI) serves as a standing forum within the DoD S&T Reliance 21 framework for developing and coordinating initiatives related to air platforms, including fixed and rotary wing vehicles, high-speed / hypersonic systems, and aircraft propulsion, power and thermal management systems.


Sec. Mattis

"…we have to make certain we are not dominant and irrelevant at the same time, dominant in a past form of warfare that is no longer relevant."

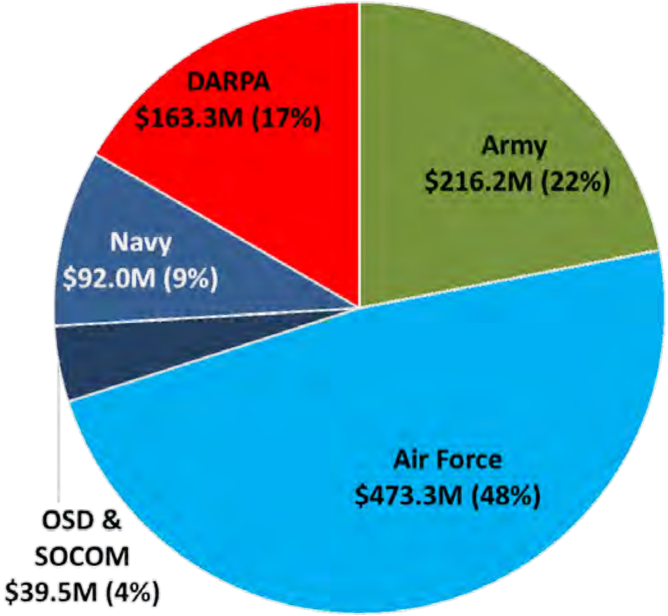
AP COI Sub Areas

AP Capability Oval

PBR FY18 Air Platforms COI S&T Investment

- **Air Platforms Community of Interest (COI) has participants from all Services, OSD, NASA**

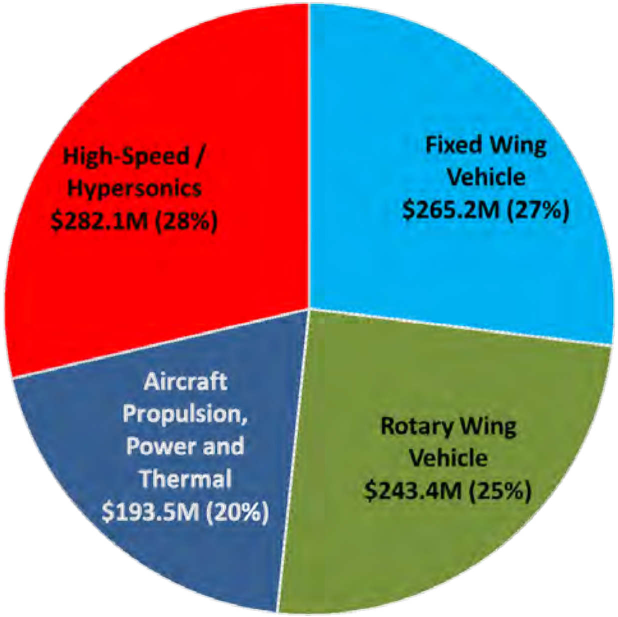
  Dr. Siva Banda (Air Force Principal – COI Lead)
  Dr. Bill Lewis (Army Principal)
  Dr. Knox Millsaps (Navy)
  Dr. Joe Doychak (OSD)
  Mr. Jay Dryer (NASA) – funding bookkept separately from DoD



Air Platforms FY18 total: $984.2M

(8.9% of DoD BA2 and BA3)

Figures based on FY18 President's Budget Request



Air Platforms COI Status

- High-level, enduring coordination within the AP COI
  - Cross-Service/Agency leadership and working-level coordination
  - Well-established Industry constituency
  - National-level forums
- AP COI expanding interactions with other COIs
  - Address integration holistically
  - Communicate better with stakeholders, industry, etc.
- Long-standing collaborative relationships with industry
- International activities aligned with Service strategies

Air Platforms COI
Sub Areas



Fixed Wing Vehicle



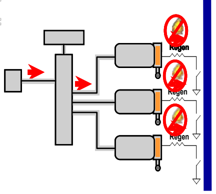
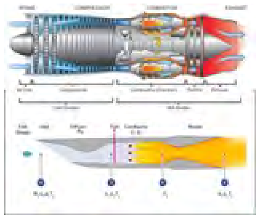
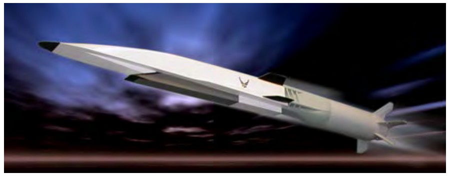


Rotary Wing Vehicle





Aircraft Propulsion, Power & Thermal

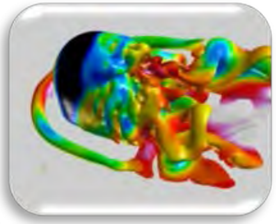





High-Speed / Hypersonics


Fixed Wing Vehicle

- **Vision**
  - Enable air superiority platforms with longer range, supercruise, greater payload and more survivability
  - Enable future mobility aircraft
  - Clearing house for sea-based aircraft launch and recovery technology
  - Enable affordable and autonomous unmanned vehicles, and enable manned and unmanned teaming operations
  - Keep legacy fleet safe, affordable, available and capable
- **Objectives**
  - Air vehicle range, payload, control, speed and low cost
  - Access, interoperability and expanded operating envelopes
  - Operational safety, efficiency and reduced pilot training
- **Technology Challenge Areas**
  - Aerodynamics, control and propulsion integration
  - Advanced kinetic and DE weapons integration
  - Unmanned aircraft systems integration and autonomy
  - Advanced structures and sustainment
  - Design and analysis (faster, more robust analyses, trades and flight simulations)



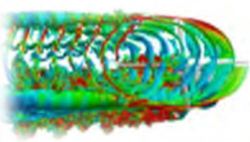




Rotary Wing Vehicle

- **Vision**
  - Fly faster and farther while carrying more
  - Enable operations in complex, contested environments
  - Integrate autonomy and reduce cognitive workload
  - Develop ultra-reliable designs towards zero-maintenance
  - Enhance legacy fleet capability, availability, and affordability

- **Specific Objectives**
  - Demonstrate advanced vertical lift platforms and integrated mission architectures by 2020
  - Conduct multi-ship degraded visual environment flight using integrated sensor fusion, pilot cueing and flight controls
  - Develop next generation UAS technology demonstrator by 2023

- **Technology Challenge Areas**
  - Durable, high performing and damage tolerant structures
  - Increased power generation with adaptive components
  - Defined standards and protocols for open systems
  - Optimized and integrated multi-spectral survivability
  - Holistic situational awareness and synergistic unmanned teaming
  - Multi-disciplinary, model-based design analysis and optimization



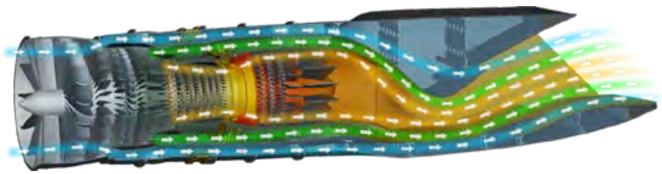
Aircraft Propulsion, Power & Thermal

- **Vision**
  - Enhanced air platform capabilities and sustainment challenges are enabled by the Aircraft Propulsion, Power & Thermal (APPT) Sub Area's technology products
  - Coordination within APPT energizes a strong technology and Industry base
- **Objectives**
  - Develop efficient, high-performing, light-weight, reliable, maintainable and affordable aircraft propulsion systems and power and thermal management subsystems
  - Deliver energy-optimized integrated propulsion, power and thermal management technology
- **Technology Challenges**
  - High power density subsystems
  - Ultra high pressure ratio compressors
  - Robust integrated propulsion, power and thermal architectures
  - Model-based design

Heat Exchanger

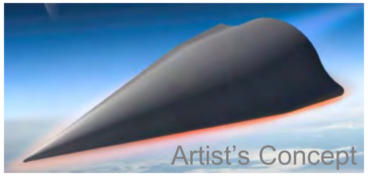
Thermal Management Systems

Starter/Generator Systems



High-Speed / Hypersonics

- **Vision**
  - Advance military systems into the hypersonic regime to enable transformational Strike and ISR capabilities
- **Objectives**
  - By 2020, develop robust, comprehensive technology options for survivable, time-critical strike
  - By 2030, develop robust, comprehensive technology options for penetrating regional platform
- **Major Research Areas**
  - Scramjet propulsion and integration
  - Rocket booster propulsion
  - Advanced materials, structures and manufacturing
  - Vehicle aeromechanics
  - Adaptive flight control
  - Military utility analysis
  - *High speed turbine engines (leveraging power and control)*



Artist's Concept

Artist's Concept

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Air Platforms COI
Some FY17 Accomplishments

Conformal Loadbearing Antenna Structure (CLAS)

- *Flight demonstrations were accomplished using TigerShark UAV. Incorporated CLAS technology enabled 70+ installed antennas to demonstrate the ability beam steer the airborne antenna array to a single ground location.*

Low Cost Attritable Strike Demo (LCASD) JCTD

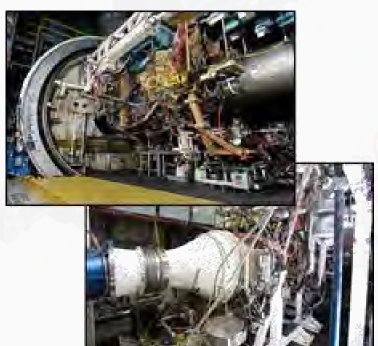
- *Passed CDR; on schedule for First Flight Summer 2018*

Joint Multi Role Technology Demonstrator

- **Bell demonstrator, V-280, first flight on 18 Dec 2017**
  - *Bell's Air Vehicle Technology Demonstrator aircraft successfully achieved first flight Dec. 18 in Amarillo, Texas. The second demonstrator from Lockheed Martin – Sikorsky is scheduled to fly in 2018.*

Adaptive Engine Technology Development (AETD)

- *AFRL partnered with General Electric and Pratt & Whitney to successfully test a new high efficiency core and adaptive fan demonstrator in 2017. These tests validated adaptability, aerodynamic performance, operability and structural designs.*



High Speed System Test (HSST)

- ***Developed multiple test support equipment to enable rapid and accurate hypersonic design***
  - *NASA Armstrong flew an inert test article of AFRL funder GOLauncher1 in Dec. 2017. This test gathered aerodynamic, flight dynamics, and structural data for carrying GO1 under a Gulfstream-III. This testing including the launch maneuver up 30deg flight path angle at Mach 0.7*

Air Platforms COI Challenges

- **Technologies supporting, e.g. Open architectures**
  - Manned-Unmanned teaming
  - Future sustainment processes
  - Increased power/thermal management demands
  - New concepts supporting mobility, high-speed/hypersonics, etc.
  - Counter-UAS
- **Leadership and culture**
  - Proactively defining/articulating and leading the Nation's military aerospace sector
  - Collectively advocating for the Warfighter cause
  - Owning the Air Domain's future viability

Continued Industry engagement and leadership required

Air Platforms Outreach Coordination

- **Air Platforms COI reaches out to other COIs and DoD organizations to coordinate and perform S&T**
- **Representatives from AP sub areas participate in various conferences and meetings**
  - American Helicopter Society (AHS) Annual Forum (May 14-17, 2018)
  - AIAA Science and Technology Forum and Exposition (AIAA SciTech) (January 7-11, 2019)
  - Turbine Engine Technology Symposium (Sept. 10-13, 2018)
  - Air Vehicle Technology Symposium (Sept .10-12, 2019)
  - Various Industry IR&D reviews
- **Data Sharing**
  - Defense Innovation Marketplace (http://www.defenseinnovationmarketplace.mil/coi.html)

Air Platforms COI to continue outreach

Air Platforms COI
Concluding Remarks

- **High-level, enduring coordination within the AP COI**
  - Cross-Service/Agency leadership and working-level coordination
  - Well-established Industry constituency
  - National-level forums
- **AP COI expanding interactions with other COIs**
  - Address integration holistically
  - Communicate better with stakeholders, industry, etc.
- **Long-standing collaborative relationships with Industry**
- **International activities aligned with Service strategies**

Providing innovative air platform technology and technology integration for survivable, affordable, effective and agile capability for legacy and future aircraft

The Weapons Technologies Community of Interest (COI)

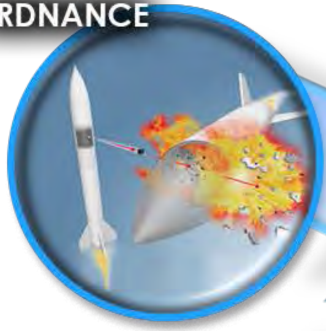
Brief to National Defense Industrial Association

March 2018

Distribution A: Approved for Public Release, SR Case 18-S-0998
Distribution is unlimited.

David E. Lambert, ST, PhD
Weapons COI

Weapons Technologies COI Areas



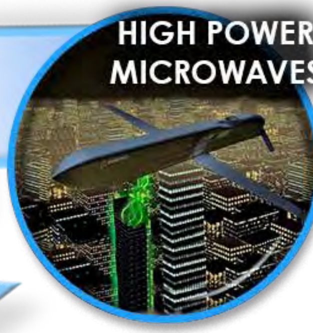
ORDNANCE

HIGH ENERGY LASERS

Common themes across components

- Greater effects at standoff and longer range
- Increased Capacity for greater mission lethality
- Navigate in controlled, degraded and operationally limited environments
- Propulsion solutions for range and end-game maneuver
- Networked and Composable/Fractionable
- Deep magazine
- Combined Effects – Kinetic and Directed Energy
- High Speed Guidance
- Defense Against High Speed Threats
- Weapon Open Architecture with Ensured Cyber-resiliency

PROPULSION



HIGH POWER MICROWAVES

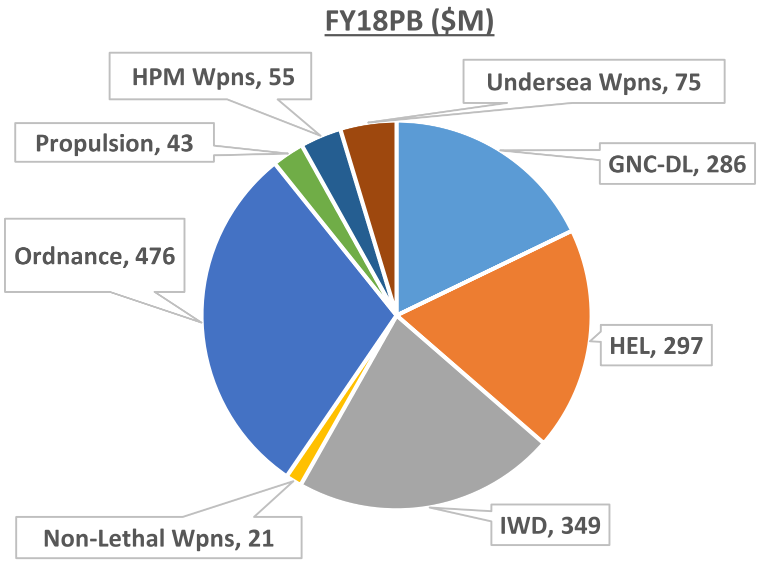
GUIDANCE, NAVIGATION & CONTROL - DATA LINKS (GN&C AND DL)

UNDERSEA

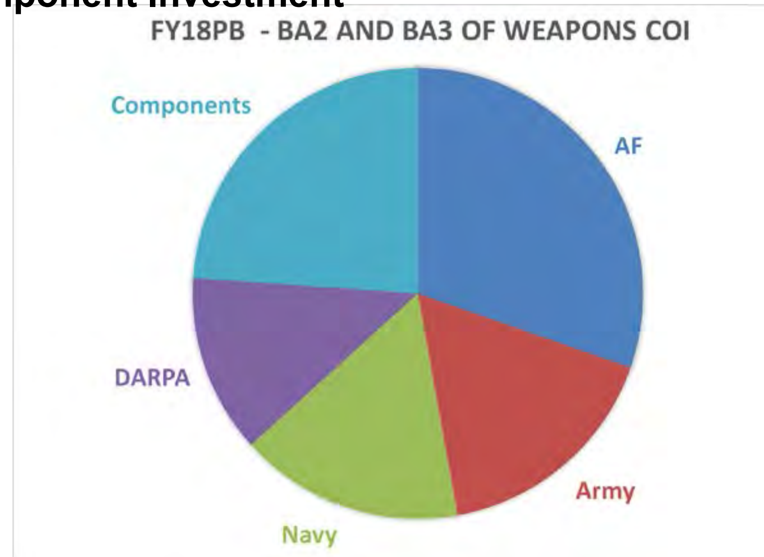
INTEGRATED WEAPON DEMONSTRATIONS

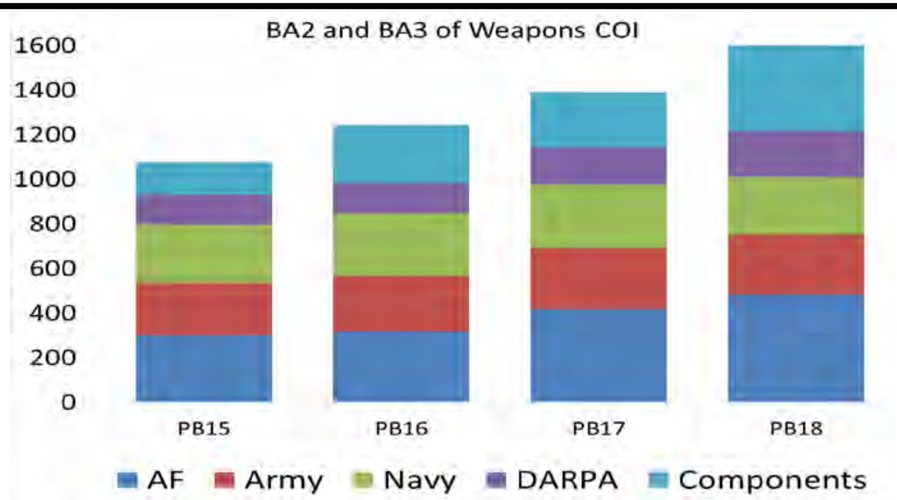
NON-LETHAL WEAPONS

Weapons Technologies COI FY 2018



Component Investment





PB18 FUNDING AND TAXONOMY NOTES

- Total $1.6B (FY18PB) increase from $1.36B (FY17PB)
- Largest change, Ordnance

- GNC-DL: Guidance, Navigation & Control – Data Links
- IWD: Integrated Weapon Demonstrations
- HPM: High Power Microwaves
- HEL: High Energy Lasers

Integrated Systems....
...Integrated Solutions

Guidance & Control

Networked Swarming Weapons

Low Cost Seekers & All-Weather

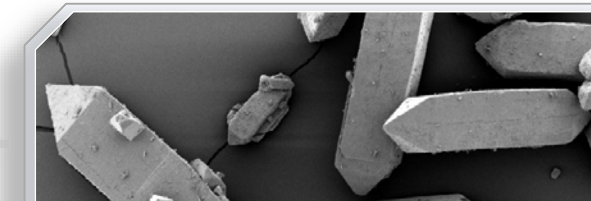
Hypersonic and Extremely Agile Missiles

Integration

Integrated Systems

(New Systems & Existing Systems)

Ordnance



Nano-energetics

Selectable Effects

High Performance, Affordable Metals

Recent Weapons Technologies COI Impact

- **Precise Robust Inertial Guidance for Munitions (PRIGM)**
  - Navigation-grade Inertial Measurement Unit (IMU) performance with microelectromechanical systems (MEMS) cost, size, weight, and power (CSWaP)
  - Prototype sensors delivered and are under test at government lab
- **Navigation for Weapons in Contested Environments**
  - Demonstrated nonlinear estimation (particle filter) and image processing algorithms for single and multiple munitions
- **Joint Insensitive Munitions Technology Program**
  - Advances in JIMTP allow investigation of improved performance (range & lethality) while maintaining IM
- **High Speed Strike Weapon**
  - Successfully conducted S&T demonstration tests of advanced tactical booster technologies
- **Non-Lethal Weapon Technology**
  - Millimeter Wave Active Denial Technology (ADT)
  - High Power Microwave Weapons for Vehicle and Vessel Stopping

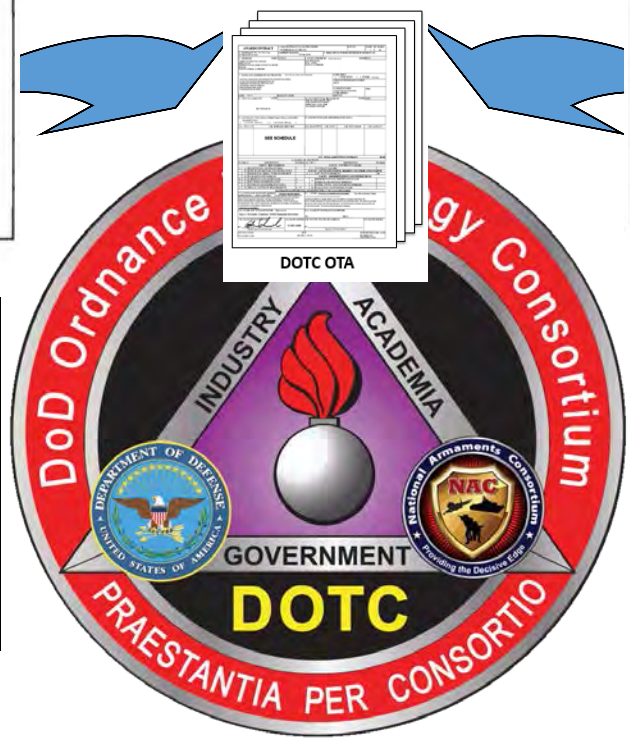
The DOTC Enterprise

Overarching Agreement
Section 815
Other Transaction

DoD Ordnance Community

OSD Charter

- OUSD (AT&L) LW&M
- Department of the Army
- Department of the Navy
- Department of the Air Force
- Special Operations Command
- Defense Advance Research Projects Agency (DARPA)
- Defense Threat Reduction Agency (DTRA)
- Other Agencies and Departments



National Armaments Consortium

NAC CMA

- Defense Contractors
- Small Businesses
- Academic Institutions
- Non Profit Organizations
- Not -for-Profit Organizations
- Non-Traditional Defense Contractors

The DOTC Consortium… Partnership to Accelerate Warfighter Superiority

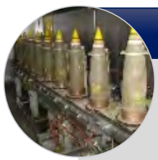
DOTC Objective Areas – FY18

Ammunition (AMM)

- Small Caliber
- Medium Caliber
- Large Caliber
- Non-Lethal Ammo
- Mortars
- Grenades
- Logistics

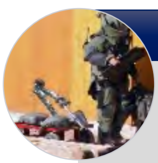
Joint Insensitive Munitions (JIM)

- High Performance Missile Propulsion
- Minimum Signature Missile Propulsion
- Blast Fragment Warheads
- Anti-Armor Warheads
- Gun Propulsion
- System Level Demonstration



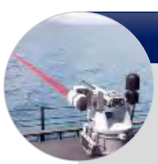
Demilitarization(DEM)

- Disassembly of Munitions
- Munitions Recycle, Recovery, and Re-Use
- Munitions Destruction and Final Disposition
- Removal of Energetic Materials from Munitions
- Waste Stream Treatment
- Disposal Logistics



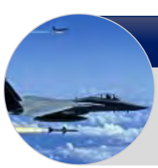
Protection & Survivability (PAS)

- Threat Detection and Tracking
- Countermeasures, Counter Countermeasures & Anti-Tamper
- IED Detection and Destruction Technology
- Explosive Ordnance Disposal
- Armament Survivability
- Equipment Survivability
- Demolitions
- Active and Passive Armors



Directed Energy Warfare (DEW)

- High Energy Lasers
- Electro-optic
- Radio Frequency
- Multispectral
- Magnetism
- Acoustic
- Particle Beam, Thermal and other Energy modalities
- Prime/Pulse Power
- Beam Forming
- Directed Energy Weaponization



Rockets, Missiles, and Bombs (RMB)

- Air-to-Air
- Air-to-Surface
- Surface-to-Air
- Surface-to-Surface
- Shoulder Launched

Enabling Technologies (ENT)

- Materials
- Manufacturing and Process Technologies
- Modeling and Simulation and Virtual Prototyping
- Precision Guidance
- Power Sources
- Weaponization
- Autonomous Systems
- Soldier and Soldier Weapon Performance

Sensors & Sensor Systems (SSS)

- Multispectral
- Data Processing and Data Links
- Tactical Cyber
- Electronic Warfare
- GPS Denied
- Intelligence, Surveillance and Reconnaissance
- Command, Control and Networking

Energetic Materials (ENR)

- Explosives
- Propellants
- Pyrotechnics
- Ingredients
- Additive Manufacturing for Energetic Materials

Warheads/Lethal Mechanisms (WLM)

- Shaped Charge/Explosively Formed Penetrator
- Kinetic Energy
- Multipurpose
- Unitary

Fuzes (FUZ)

- Hard Target Fuzing Technologies
- Tailorable Effects Fuze Technologies
- High Reliability Fuze Technologies
- Enabling Fuze Technologies
- Safe and Arm Fuzes
- MEMS
- Fuze Producibility
- High G-Force
- Fuze Sensors

Weapon Systems (WPN)

- Small Caliber
- Grenade Launchers
- Medium Caliber Cannons
- Mortars
- Large Caliber Artillery
- Non-lethal Weapons
- Mechanisms & Effects
- Fire Control
- Accessories
- Electric Weapons
- Area Denial

Pathway Forward

- **Focus Going Forward**
  - Propulsion solutions for range and end-game maneuver
  - Networked, scalable and modular technologies
  - Long range effects in controlled, degraded and operationally limited environments
  - Low cost, size, weight
  - Increasing output power DE weapons

- **Engagement Opportunities with Industry**
  - Industry IRAD Technical Interchange Meetings
    - **http://www.defenseinnovationmarketplace.mil/coi_weaponstech.html**
  - Component BAA's
  - Component Industry Days
  - Air Force S&T 2030 Strategy Engagement Events
    - **https://www.afresearchlab.com/**
  - Army Open Campus Program
    - **https://www.arl.army.mil/opencampus/**
  - DEFENSEWERX: Doolittle Institute, AFWERX, SOFWERX
    - **http://defensewerx.org/**

QUESTIONS?

Ground & Sea Platforms Community of Interest

Dr. John Pazik
Office of Naval Research
Department Head, Expeditionary Maneuver Warfare

NDIA 19th Annual Science & Engineering Technology Conference
20-22 March 2018

Ground & Sea Platforms COI Portfolio Overview

Steering Group Leads
- Dr. Jennifer Hitchcock (Army)
- Dr. John Pazik (USMC)
- Dr. Thomas Fu (Navy)

Deputies
- Mr. Gary Schultz (Army)
- Mr. Sam Kirby (USMC)

Survivability
- Dr. Thomas Meitzler (Army)
- Dr. Roshdy Barsoum (Navy)
- Mr. Troy Hendricks (USMC)

Unmanned Platform Integration
- Dr. Bob Brizzolara (Navy)
- Mr. Matt Deminico (Army)
- Dr. Michael Qin (USMC)

Mobility
- Mr. Dale Martin (Army)
- Mr. Don Hoffman (Navy)
- Mr. Jeff Bradel (USMC)

Maintainability/Sustainability
- Mr. Billy Short (USMC)
- Mr. Adam Brennan (Army)
- Dr. Airan Perez (Navy)

G&SP COI Taxonomy

Taxonomy Areas	Technology Sub-Areas
Survivability	Ballistic Protection
	Hit & Kill Avoidance
	Blast Protection
	Signature Management / Directed Energy
	Lightweight Platform Structures/Materials
Unmanned Platforms	Autonomy
	Platform Enablers
	Capability Enablers
	Usage Enablers
Mobility	Fuel Economy
	Terrain Maneuverability
	Powertrain
	Seaworthiness/Stability
	M&S Capabilities
Maintainability / Sustainability	Plan and Direct Logistics Operations
	Efficient & Responsive Force Sustainment
	Logistics Demand Reduction
	Fleet Maintenance

Ground & Sea Platforms COI Technical Challenges

Scope and Technical Challenges

1.0 Survivability

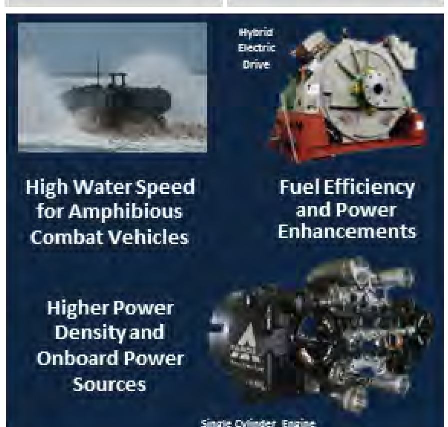
Capabilities that allow a platform and its crew to remain functional and mission capable in a hostile threat environment. This includes denying the adversary the ability to target and successfully engage a platform (susceptibility), withstanding the weapon effects of a successful attack (vulnerability), and restoring functionality after sustaining damage (recoverability).

- 1.1 Improved Blast Protection
- 1.2 Directed Energy Threat Mitigation
- 1.3 Enhanced Ballistic Protection
- 1.4 Hit and Kill Avoidance
- 1.5 Detection Avoidance (Signature Management)
- 1.6 Enhanced Cyber Defense

2.0 Mobility

Capabilities that provide an agile, mobile, and survivable platform and force to extend the operational reach across all potential battlefield environments. The force must maintain a high operational tempo while maneuvering in space and time and minimizing the logistics burden. In addition Lightweighting will be considered to reduce weight.

- 3.1 Reduced Weight
- 3.2 Improved Design for Higher Speed
- 3.3 Enhanced Propulsion
- 3.4 Enhanced Energy Efficiency



3.0 Unmanned Platforms

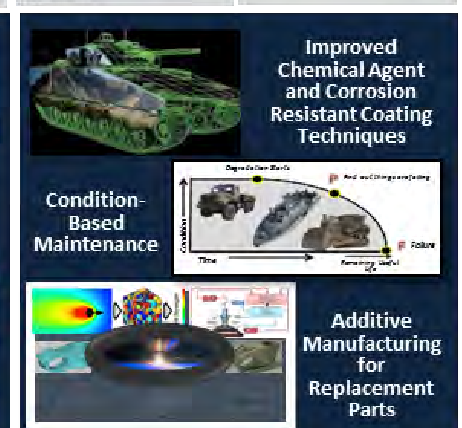
Capabilities that effect operational and tactical mobility and maneuver through the use of unmanned systems. Includes unmanned ground vehicles, robots, sea vehicles, UxV swarms, etc. that work collaboratively with the Warfighter. These act as force multipliers, able to collaborate and share information while reducing operator workload by relieving the individual Warfighter of physical and cognitive burdens.

- 4.1 Enhanced Platform Autonomy
- 4.2 Optimized Platforms by/for Unmanned Operations
- 4.3 Enable Configurable Autonomous & Unmanned Payloads
- 4.4 Enhanced Assured Trust in Unmanned Systems

4.0 Maintainability / Sustainability

Capabilities that reduce the total ownership costs to maintain ground and sea vehicles and equipment. This includes increasing the operational availability of platforms while decreasing the maintenance cost and man-hours required to maintain and repair these platforms.

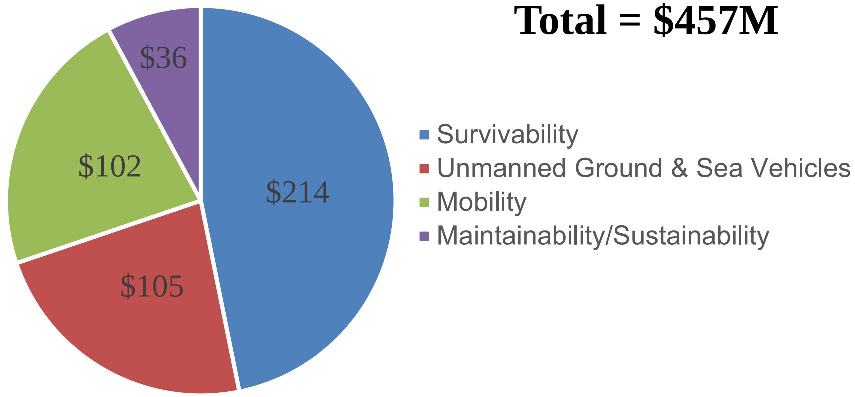
- 5.1 Condition Based Maintenance
- 5.2 Advanced Manufacturing for Rapid Component Replacement
- 5.3 Advanced Corrosion & Wear Resistant Systems



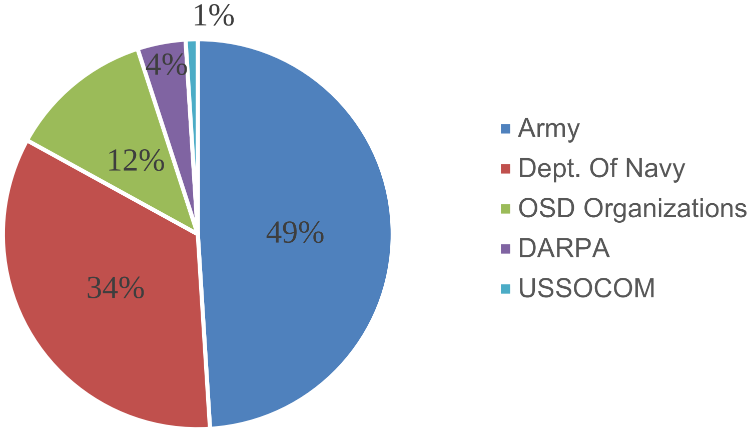
COI Portfolio Overview – Overall G&SP COI Investment Profile

COI Sub-Areas ($M)

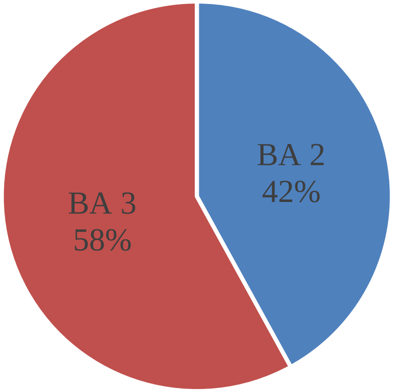
Total = $457M



Component Investment



Budget Activity



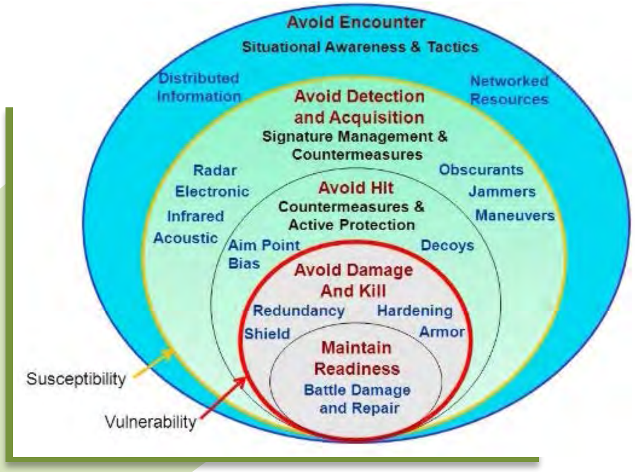
Source: OSD OUSD AT&L

2017: Changes and Major Accomplishments

- **Dissolution of the Modularity Taxonomy Area**
  - Difficulty establishing its S&T identity; modularity pervasive across taxonomy areas
  - Membership and funding was redistributed among the other taxonomy areas/OSD
- **Electronic Stability Control/Antilock Braking Systems transition to PEO CS/CSS (USMC/Army)**
- **Wingman JCTD (Army/USMC)**
  - Developed an effective weaponized robotic system by integrating robotic controls, target acquisition, and remote weapon system onto a HWWMV
  - Wingman JCTD had 2 live fire test events (May @ Camp Grayling and Aug @ Ft. Benning)
- **Collaborated on Armored Reconnaissance Vehicle concept development (Army/USMC)**
  - Army organized a Marine Innovation Workshop with the College of Creative Studies for Concepting and Ideation

1.0 Survivability
Accomplishments & Gaps

Accomplishments:
- Navy, USMC, and Army and other Industry/Government organizations participated in the 49th Combined Light Armor Survivability Panel(CLASP).
- Navy and Army – Soldier-Ground Vehicle System Using Quadrotors (SQUAD) developed and demonstrated area searching algorithms, stowage enclosure, and optical detection of enemy UAS.



Reliance Services:
- USMC engaged and collaborating with Army on Active Protection System development (Expedited APS & MAPS)

Gaps/Risk:
- Directed Energy Weapon defeat
- Recovery of Group 1 UAS on a moving vehicle
- Signature Management and Control

Mobility
Accomplishments & Gaps

Accomplishments:

- Army, Air Force, and Navy initiated and established common requirements for the ASD sponsored Ultra High Density Hybrid Energy Storage Module for Laser Weapon System and Electronic Warfare Operations (HD HESM) program
- Army and Navy supporting USMC effort to develop simulation environment for amphibious and landing craft operating in the surf zone

Reliance Services:

- Army is currently investing in high-efficiency powertrain technologies that the USMC is following and interested in leveraging

Gaps/Risk:

- Mobility in Extreme Operational Environment, in particular Arctic operations
- Army, Navy and USMC recognize range is a limiter to operational performance
- Terrain traversability and station-keeping technologies to allow operations in no-go terrain or sea states

3.0 Unmanned Platforms
Accomplishments & Gaps

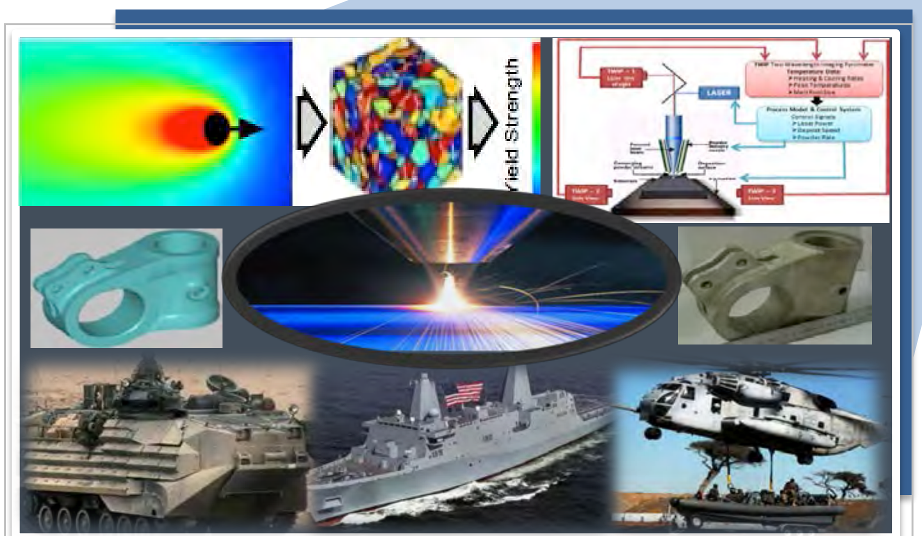
Accomplishments:
- Multiple Army/PEO CS&CSS programs (MTRS Inc II, CRS-I) using Navy Multi-Robot Operator Control Unit(MOCU) software
- Army/Navy/Air Force ROS-G info exchange meeting with ~15 Government agencies(DoD, DoE, DoT, NASA, NIST, DARPA).
- Leveraging NASA-developed multi-agent control algorithms and mission planning

Reliance Services
- ROS-M / ROS-G enables shared software repositories & software re-use

Gaps/Risk
- Open architectures and “autonomy as an app” are critical enablers for employment of unmanned systems
- Working towards a common ground vehicle architecture as much as possible

4.0 Maintainability/Sustainability
Accomplishments & Gaps

Accomplishments:
- Navy, USMC, and Army held joint workshops for three technology focus areas
  - o Advanced Manufacturing – Naval Special Warfare Carderock
  - o Advanced Corrosion and Wear Resistant Systems – Logistics Management Institute HQ
  - o Condition Based Maintenance - TARDEC
- USMC established a new joint program for Army/Navy/USMC platforms performing data analysis and research prognostic model frameworks



Reliance Services
- Navy/USMC leveraging Army efforts in corrosion resistance, cure times, and modeling
- Army/Navy leveraging USMC IR spectroscopy for advanced oil and fuel analysis and CBM
- Navy relying on Army/USMC for material properties and adhesion for Cold Spray repair

Gaps/Risk
- Logistics and Operational data integrity and availability
- Qualification and Validation process for additive manufacturing capabilities

Opportunities for Industry to Participate

NDIA Ground Vehicle Systems Engineering & Technology Symposium
7 – 9 August 2018
Novi, MI

Naval Future Force S&T Expo
2019
Washington D.C.

Long Range Broad Agency Announcement for Navy/Marine Corps S&T
Arlington, VA

Modern Day Marine
25 – 27 September 2018
Quantico, VA

TARDEC Industry Days
24-25 April 18
Warren, MI

Michigan Defense Exposition (MDEX)
25-26 April 18
Warren, MI

Army S&T Symposium
23 August 18
Washington D.C.

Questions

CLEARED
For Open Publication

Mar 09, 2018

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

SLIDES ONLY

NO SCRIPT PROVIDED

DoD Autonomy Roadmap

Autonomy Community of Interest

NDIA 19th Annual Science & Engineering Technology Conference

March 21, 2018

Kris Kearns
Autonomy CoI Lead
AFRL Senior Advisor for Autonomy Research

Briefing Outline & Flow

- **Overview of the Autonomy CoI**
  - CoI Purpose & Organization
  - Investment Profile
  - Technical Taxonomy
- **Key Challenge Areas**
  - Goals and Hard Problems
- **Overarching Autonomy Message & Wrap-up**
  - Notable Recent Achievements
  - Autonomy CoI Way Forward

Autonomy Community of Interest (CoI)

Purpose: **The Autonomy CoI's purpose is to advance autonomous systems by assessing Science & Technology investments, gaps, and opportunities, and initiating critical enabling technology development.**

The Autonomy CoI provides a framework for DoD scientists, engineers, and acquisition personnel to:

- **Engage in multi-agency coordination and collaboration**
- **Report on the "state-of-health"**
- **Identify emerging research opportunities**
- **Measure progress**

Autonomy CoI Steering Group:

Autonomy CoI
Technology Portfolio

Autonomy is the computational capability for intelligent behavior that can perform complex missions in challenging environments with greatly reduced need for human intervention, while promoting effective man-machine interaction.

What's driving Autonomy S&T?

- Manpower efficiencies (reduce human footprint and personnel cost)
- Rapid response and 24/7 presence (timely, persistent, enduring)
- Harsh and unpredictable environments (day, night, bad weather, rubble, barriers)
- New mission requirements (increasing competence enables new capabilities)
- Advanced medical applications (critical response, end-to-end critical care)
- Logistical support (reduce logistics burden: hold, transport, carry, watch)

Technology Taxonomy (Tier 1 – Key Challenges Areas)

Machine Perception, Reasoning and Intelligence

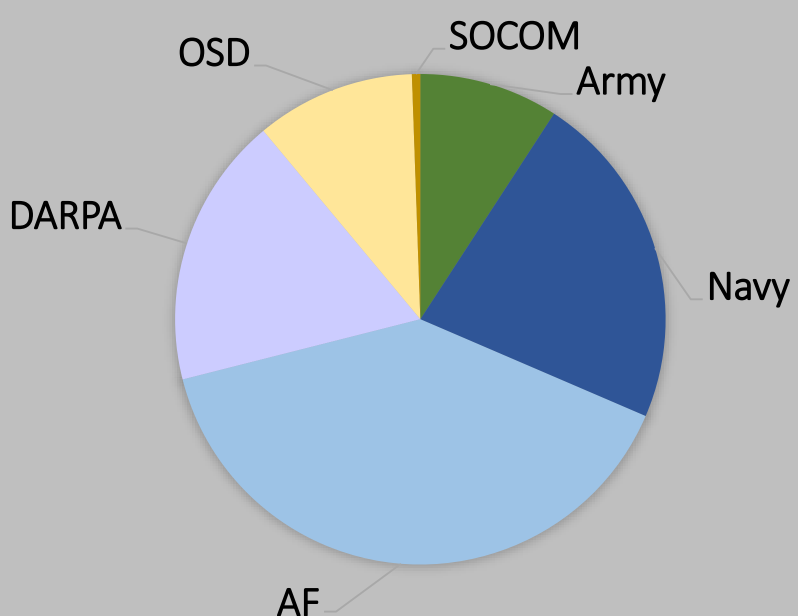
Human/Autonomous System Interaction and Collaboration

Scalable Teaming of Autonomous Systems

Test, Evaluation Validation and Verification

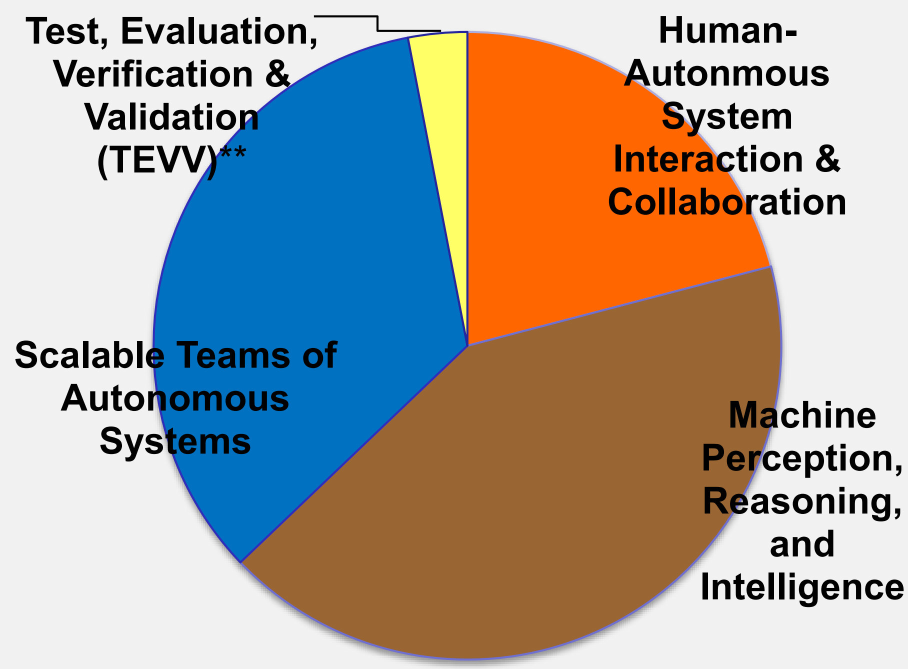
Autonomy CoI Funding Breakdowns

FY 2018 PRIMARY + ANCILLARY DATA



Approx. FY18: $520M

BREAK-OUT OF SERVICE INVESTMENTS



Dedicated TEVV research efforts continues to be area of low investments

** Some TEVV research is captured in programs binned against other areas

Tier 1 Technical Challenge Area's Descriptions and Goals

Machine Perception, Reasoning and Intelligence (MPRI): *The underlying perceptual, reasoning, and learning capabilities to greatly reduce the need for human interventions, while enabling effective teaming with the warfighter.*

Goals:

- Common representations/architectures
- Learning and Reasoning
- Understanding the Situation/Environment
- Robust capabilities/decision-making

Human/Autonomous System Interaction and Collaboration (HASIC): *Effective human-machine collaboration, enabled by trust and shared understanding, and supported by natural interaction, communication and learning.*

Goals:

- Calibrated trust and transparency
- Common understanding and shared perception
- Human-agent interaction
- Collaboration
- Interactive learning

Scalable Teaming of Autonomous Systems (STAS): *Shared mission intent &execution (decentralized and collaborative) incorporating both homogeneous and heterogeneous groups.*

Goals:

- Mission-level task allocation/assignment
- Robust self-organization, adaptation, and collaboration
- Space (air, land, water) management operations
- Sensing/synthetic perception

Test, Evaluation, Validation, and Verification (TEVV): *From algorithms to scalable teams of multiple agents – Developing new T&E, V&V technologies needed to enable the fielding of assured autonomous systems.*

Goals:

- Methods, metrics, & tools assisting requirements development and analysis
- Evidence-based design and implementation
- Cumulative evidence through R&D, & operational testing
- Run-time behavior prediction and recovery
- Assurance arguments for autonomous systems

Human/Autonomous System Interaction and Collaboration (HASIC)

Goals

Calibrated Trust and Transparency

- Understanding of and confidence in the others' actions.

Common understanding and shared perceptions

- Information in a form easily understandable by both human and autonomous teammates.

Human-agent interaction

- Fluid and natural interactions and communication using various modalities.

Collaboration

- Flexible levels of autonomy, graceful hand-offs of authority.

Interactive learning

- Acquiring new information and skills as a team.

Technology Challenges

Transparency-enabled approaches to autonomy

- Complex AI decision process summarization.

Improved methods for sharing of authority

- Dynamically changing levels of interaction/collaboration.
- Improving methods for determining, and transitioning to different agents having authority.

Cognitively-compatible behavior

- Human-compatible situational awareness.
- Robustness to incomplete, uncertain, and inaccurate information.

Context-aware interaction

- Awareness of "commander's intent".

Dynamic bi-directional information flow; dialogue with AI

- Prediction of human teammate needs/performance.
- Explanation of AI or human decisions to teammates.

Ad hoc collaboration

- Between "untrained" human teammates and "uncalibrated" autonomous system.
- Changing interactions with team maturity.

Machine Perception Reasoning & Intelligence (MPRI)

Goals

Common Representations/Architectures

- Think & fight as team: systems must reason about situation & orders for rapid collaboration
- Communicate critical estimates for decision-making (explain situation, propose actions with rationale)

Learning and Reasoning

- Development of methods for entities to evolve behaviors over time based on a complex and ever-changing knowledge base of the battle space.

Understanding the Situation/Environment

- Understand threats: systems must rapidly learn to recognize concealed, camouflaged, and deceptive obstacles, behaviors & threats, adaptively.
- Intelligent exploration and coordination across entities within the environment to minimize uncertainty.

Robust Capabilities

- Fundamentally explore system paradigms to ensure behavioral stability in the face of increasing complexity and uncertainty.

Technology Challenges

Common Representations/Architectures

- Representations that support perception and intelligent behavior.
- Computational models for representing knowledge of the mission space, rationale, and machine agent capabilities.

Learning and Reasoning

- Learning in complex data environments.
- Learning context, adaptive recognition and scene understanding.

Understanding the Situation/Environment

- Processing of sensor data, to information, to actionable understanding presented to the warfighter and the system.
- Integrate small teams of humans & artificially-intelligent agents to provide improved decision-making with less data & in less time.
- Autonomously adjudicate between behaviors, e.g. task priorities.

Robust Capabilities

- Learning for robust control: enabling systems to incorporate decision makers in an action, in both planned and unpredictable scenarios.

Scalable Teaming of Autonomous Systems (STAS)

Goals

Mission-level task allocation/assignment:

- Collaborative and distributed ensembles easily tasked/re-tasked, under uncertainty & partial info.
- Responsive to mission-level changes in operator-directed intent.

Robust self-organization, adaptation, and collaboration:

- Dynamic adaption, ability to self-organize and dynamically restructure
- Agent-to-agent collaboration.
- Robustness to dynamic changes in contested environments with denied infrastructure

Space management operations:

- Operation over diverse spatial areas, flexibly to adapt with distributed intelligence to update, within-mission boundaries, incorporating scalability and timelines for mission success.

Sensing/synthetic perception:

- Distributed perception, learning, and sharing via a variety of sensing modalities.
- Ability to overcome individual platform limitations.
- Integrate human and intelligent system perceptions.

Technology Challenges

Task allocation/assignment

- Scalable, self-organizing organization appropriate to mission tasking.
- Task allocation/assignment, planning, coordination and control for heterogeneous systems.

Self-organization, adaptation, and collaboration:

- Robust to limited communications
- Appropriate coordination and relationships between individual unit intelligence, team, and coalitions.
- Balancing multiple competing and conflicting performance metrics, and individual platform vs. group objectives.
- Local and global adaptation in mission, organization, roles and behaviors within commander-directed intent.

Space management

- Permitting operation in close proximity to other manned and unmanned systems.
- Dispersed operation over large, crowded areas.

Sensing/synthetic perception

- Information and data fusion from many heterogeneous sources under intermittent communications and bandwidth constraints, including varying levels of information-sharing.

Test and Evaluation, Validation and Verification (TEVV)

Goals

Methods, Metrics, and Tools Assisting in Requirements Development and Analysis:

- Precise, structured standards to automate requirement evaluation for testability, traceability, and consistency.

Evidence-Based Design and Implementation:

- Assurance of appropriate decisions with traceable evidence at every level to reduce the T&E burden.

Cumulative Evidence through Research, Development, and Operational Testing:

- Progressive sequential modeling, simulation, test, and evaluation to record, aggregate, leverage, and reuse M&S/T&E results throughout engineering lifecycle.

Run-time Behavior Prediction and Recovery:

- Real time monitoring, just-in-time prediction, and mitigation of undesired decisions and behaviors.

Assurance Arguments for Autonomous Systems:

- Reusable assurance case-based on previously evidenced "building blocks".

Technology Challenges

Requirements that are mathematically expressible, analyzable, and automatically traceable to different levels of autonomous system design.

- Dynamic requirements generation & feedback, Design time and run time transparency

Methods and tools enabling the compositional verification of the progressive design process.

- Trust / transparency in design, "Correct by construction" synthesis

Systems that are "licensed" to perform functions after requirements satisfied.

- Transparency Learning Algorithms,
- Pedigree-Based Licensure

System constrained by set of allowable, predictable, and recoverable behaviors, shifting analysis/test burden to more deterministic run-time assurance mechanism.

- Run time analysis prediction,
- Transparency models for past performance and future behaviors.

Argument based notations, structures and semantics of arguments, implicitly tied to requirements

Autonomy CoI S&T Priorities with Notable Recent Achievements

- **Effective human-machine collaboration to enhance overall team performance, increase safety for human partners, and offset brittleness**
  - Successful test of IMPACT system (C2 platform) with live small UAVs cooperatively with air, ground, sea virtual autonomous systems (TTCP partners)
- **Versatile standards for autonomy modeling, design, and interfaces**
  - Autonomous Aerial Cargo/Utility System helicopter operated without a pilot during exercises; included Marines loading the helicopter with supplies, then using the application to clear it for autonomous takeoff and flight
- **Learning in complex data environments; resource-constrained AI processing at the point-of-need**
  - DoD Researchers were Winners of the Large-Scale Movie Description Challenge at the 2017 International Conference on Computer Vision in Venice, Italy, October 22-29, 2017
  - Demonstrated discovery of multi-INT ordinal and temporal patterns and anomalies using Bayesian and Causal models transitioned to customer
- **Powerful new capabilities for testing and evaluating autonomy**
  - DoD–led Workshop on Verification of Autonomous Systems, ICRA 2018
  - Multidisciplinary University Research Initiative on Unifying Stochastic, Discrete, and Continuous Dynamics in Mathematically Rigorous Verification Frameworks for Intelligent and Autonomous Systems
- **Continuous, real-time V&V of autonomy as it adapts in the field**

Autonomy CoI Way-Ahead

- **Continue to Increase Cross-COI engagement**
  - ASBREM Autonomous Medical Evacuation (AME) Workshop
  - Counter IED FOCUS Program
  - Human Systems, C4I, Sensors & Processing, Power and Energy, Air Platforms, Ground and Sea Platforms
- **Investigate Workshops:**
  - Cross-DoD workshop to review service plans for data and algorithms, to look for coordination opportunities
  - "Architecture" Workshop
- **Industry Outreach**
  - Planning for CY18 non-traditional/startup engagement in Boston
  - The Autonomy CoI looking for industry suggestions on ways to improve collaborations and share gaps, technical challenges, and technical directions

Questions

Back Up

Current Autonomy CoI Program Success: Allied IMPACT

TTCP The Technical Cooperation Program

Autonomy Strategic Challenge

Our mission is to enhance, demonstrate and evaluate the military utility of autonomous systems for future littoral operations.

Objectives	Annual Progress
Determine the potential **military utility** of autonomy technologies.	Military endorsed ASC "use-case" applications. AIM system evaluated by FVEYS military experts at two trials.
Advance and demonstrate **human-autonomy teaming** through simulation and live trials.	First four-eyes test of "AIM" system with multiple allied co-developed software parts.
Improve **interoperability** of emerging FVEYS autonomous systems.	Successful test of IMPACT system with live small UAVs cooperatively with air, ground, sea virtual autonomous systems.
Harness **industry developments** for FVEYS military requirements.	Engaged industry and identified a range of UAV, UGV, USV, UUV platforms and systems.

AIM=Allied IMPACT
IMPACT=US Intelligent Multi-UxV Planner with Adaptive Collaborative/Control Technologies

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NDIA 19th Annual Science & Engineering Technology Conference C4I COI

21 March 2018

Dr. Stephen Russell

Co-Chair, C4I CoI

C4I COI: State of Technology

Personnel Changes:

- Dr. Ranjeev Mittu (Navy) - New Steering Group Representative
- Mr. Chuck Hoppe (Army) - New Steering Group Representative
- Dr. Kevin Gluck (Air Force) – New Working Group Chair
- Dr. Morgan Bishop (Air Force) – New Working Group Chair

Taxonomy Sub Areas / Roadmap Changes:

- Information Collection/Management and Computing Software Technologies refocused to Information Systems Technology
- Systems/Analysis/Decision Tools refocused to Algorithmic Warfare
- HCI for Decision Making refocused to Optimizing Human Decision Making

Roadmap Trends:

- Information Systems Technology (IST) focused on mechanics of information access, supporting architectures, hardware and software
- Algorithmic Warfare (AW) focused on AI/ML and higher level fusion and synthesis to support autonomous reasoning and decision making (planning, execution and assessment)
- User context modeling a key focus for Optimized Human Decision Making in order to leverage expected efficiencies in IST and AW
- Increased efforts in Artificial Intelligence, Machine Learning, Autonomy at Rest, C2 Space Domain, Rapid Prototyping, Internet of Things (IoT)

C4I COI: Tier 2 & 3 Taxonomy

Information System Technology

- Acquire, Transform & Access
  - Collection management
  - Aggregation & inference
  - Info discovery, ontologies & provenance
  - Trust & access control
- System Architectures
  - Tactical cloud architectures
  - Policy-based information exchange
  - Composable software systems
  - System simulation and emulation
- Computing Hardware
  - High performance computing
  - Distributed & energy-efficient tactical computing
  - Advanced computing architectures
  - Advanced memory and storage technologies
- Software
  - Programming languages
  - Formal methods & trust
  - Parallel OS / scalable algorithms
  - Software architectures & engineering

Algorithmic Warfare

- Data Extraction, Analysis & Synthesis
  - Unstructured-to-structured extraction
  - Speech & text data analysis & synthesis
  - Information Operations
  - Data conditioning & uncertainty quantification
- Autonomous Reasoning and Decision Making
  - Artificial Intelligence & Machine learning
  - Cooperative teaming
  - Automated planning
  - Closed loop resource management
- Sensor Data Fusion and Analysis
  - Object/anomaly detection & attribute recognition
  - Scene reconstruction / understanding
  - Object / entity tracking & assessment
  - Situation & Impact Assessment
- Planning, Execution & Assessment
  - Course of action development and analysis
  - Cross-domain synchronized effects
  - Dynamic re-allocation and tasking
  - Presentation of forces & Operational assessment

Optimized Human Decision Making

- User Interaction
  - Cognitive work analysis
  - Understanding nonverbal behavior
  - Natural task & content interaction
  - Bio-psychometrics
- Collaboration
  - Distributed collaboration
  - Facilitated shared awareness
  - Virtual human behavior modeling
  - Collaboration with autonomous systems (advanced supervisory control)
- Information Presentation
  - Innovative display technologies
  - Presentation aware information derivatives
  - Task/decision based information abstraction
- Display Management
  - Task & display-aware adaptive info displays & routing
  - Progressive information disclosure
  - Spatial localization cueing
  - Adaptive aesthetics

Networks and Communications

- Radios & Apertures
  - Software defined RF
  - Spatial multiplexing & directional beamforming
  - Quantum, Optical, THz communications
  - Components
- Waveforms
  - Spectrum sensing/sharing/management
  - MAC, Link/network protocols, modulation, & coding
  - Physical layer security
- Networks
  - Software-defined networking
  - Network coding & disruption tolerant networking
  - Routing protocols & network interfaces
  - Network assurance
- Information
  - Transport protocols/services/applications
  - Data/message standards (e.g., MIBS, IFDL)
  - Managed information flows (e.g., meta-data tagging)
  - On-demand QoS-based services & prioritization

C4I COI: State of Technology Accomplishments

- **C4I COI**
- Tier 2 & 3 Taxonomy Updated / Supporting OSD AI Strategy
- Numerous technologies demonstrated / transitioned (i.e. Android Tactical Assault Kit/TAK Server Technology; Open Standards for Unattended Sensors (OSUS) to PdM EOIR; Tactical Cloud Reference Implementation transitioned to CANES PoR and deployed; Secure Cross-domain Orchestration Engine; …)
- Behavioral Cyber (Integrates human and sensor observations by illustrating cognition and behaviors of friendly/adversary actors): Emerging Partnerships (ARL, CYBERCOM, AFRL, Army Cyber Institute, Naval Surface Warfare Center-Crane, …)
- Autonomy Research Pilot Initiative (C4I-Autonomy) (ARL-AFRL-SPAWAR) resulted in two brain-computer interface demonstrations in ARL MIND Lab
- Air Force/Navy Cross Domain Solution (CDS) for Distributed Interactive Simulation (DIS) and Link-16 Protocol Integration
- Army/Navy extensions to Marine Corps Tactical Service Oriented Architecture (TSOA) Program
- Army/Navy Scientist Exchange (ARL/NRL) to define Internet of Things Collaborative Research Alliance

- **Cross-COI Collaborations**
- DoD & DoE Artificial Intelligence and Machine Learning TEM (C4I & HS COI) Sept 2017, McLean, VA
- Autonomy & Sensors COIs Automatic Target Recognition WG Meeting, December 2017, Suitland, MD
- Establishing Autonomy at Rest portfolio for near-term autonomy capabilities for warfighters (in collaboration with Autonomy COI)
- HAOME Joint Proposal (ARL, AFRL, CERDEC, NRL, ONR, DTRA J9CXQ, and MIT-LL)
- Machine Learning Centers (Army & Navy), AI/ML TEM, Feb 2018, San Diego, CA

C4I COI: State of Technology Highest Focus Areas

Information Systems Technology

Data Access, Architectures, HW, and SW

- Acquisition of information from all sources.
- Tools, algorithms and methods to convert inputs from heterogeneous sources to machine and human useable forms.
- Ubiquitous search and retrieval, information discovery, and trust and access control.

Optimized Human Decision Making

Effective, Natural Human-Machine Collaboration

- Exploit emerging HCI technologies to create an intuitive & effective collaboration environment.
- Focus on mission and task context and the efficient / effective sharing of information across commands.

Algorithmic Warfare

Complex Data Processing, Decision Making and Reasoning for Planning, Execution & Assessment

- Transform sparse, unstructured, limited data in constrained environments to actionable information.
- Use language artifacts to define ontologies & design algorithms that capture knowledge of relevant behaviors, events, tasks & mission.
- Use social media platforms, user groups, & machine learning to train software agents that derive intent for human action.

Networks and Communications

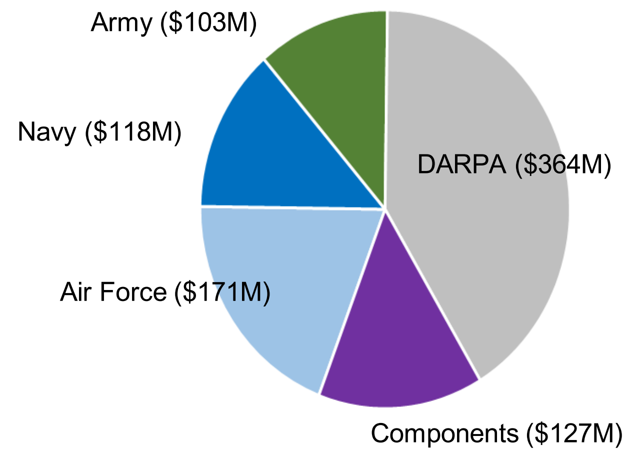
Adaptive and Resilient Infrastructure

- Improvement to network agility and resiliency across all domains.
- Enhancements to improve AJ, LPI, LPD.
- Spectrum Management.
- Advancement of high layer networking technology areas.

C4I COI: State of Technology Investments

- **C4I Investment Portfolio Leaders**
  - DARPA major investor in BA 6.2 & BA 6.3 (41% of Total)
  - Algorithmic Warfare (DARPA, Air Force)
  - Optimized Human Decision Making (OSD, Navy)
  - Information Systems Technology (OSD, Army, DARPA)
  - Networks & Communications (DARPA, Navy, Air Force)

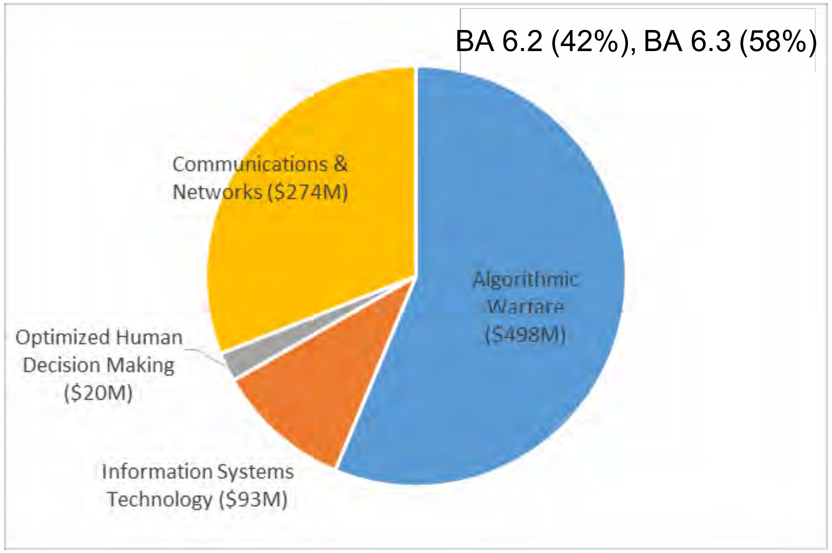
FY18 Total = $883M

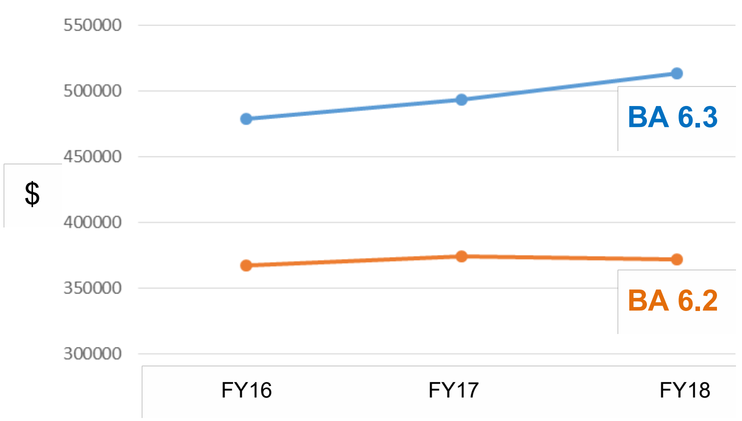


- **Risk Areas / Investment Gaps**
  - AI/ML in Command Centers as Virtual Assistants
  - AI/ML User Context Modeling for Information Filtering and Explainable AI
  - Validated M&S with Labeled Data for AI/ML
  - Autonomy at Rest (Cyber Defense)
  - Resilient Tactical Network Architectures
  - Distributed Low-Power Computing Hardware / Software Co-Design
  - EM Spectrum Operations (e.g. Quantum, Optical, mmW, THz communications and sensing)
  - Counter-C4I

C4I COI: State of Technology Investments

FY18 Total = $885M





Lead:

- Tactical Architectures / Interfaces
- User Interaction / Collaboration
- Data Extraction, Analysis & Synthesis
- Information Operations
- Spectrum Management

Leverage:

- Commercial AI/ML
- Commercial IT Systems
- Software Defined Networking

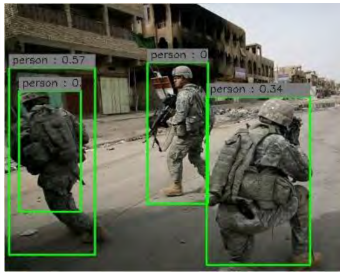
Watch:

- Information Presentation, AR/VR
- Trust & Access Control

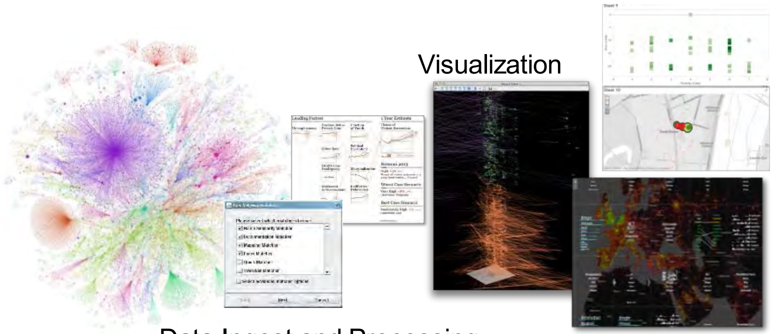
C4I COI: Future Directions

- **Cross-COI, industry, academia opportunities for collaboration**
  - Human-Agent Planning, Teaming and Execution (HAPTE) Initiative (C4I, HS, Autonomy, ATRWG)
  - C4I/Cyber COI TEM Feb. 21-22, 2018 San Diego, CA
  - ASBREM COI – Cross-COI Air Platforms, Autonomy, C4I, Energy & Power, Ground & Sea Platforms, Human Systems, and Sensors, March 2018, National Capital Region
- **Initiatives or best practices to accelerate R&D process**
  - Rapid Prototyping: Agile software/algorithm development in DevOps environments / Hardware Additive Manufacturing
  - Leveraging Visiting Researchers: Cross-Service e.g. NRL/ARL and with Coalition Partners
  - Networked Testbeds: Common or complementary
- **Take-Aways**
  - S&T / Acquisition emphasis on agility, rapid prototyping, and quickly delivering warfighting capabilities
  - Accelerated warfighter demand has produced an increased demand for BA 6.3/6.4 resources
  - Warfighter gaps drive innovation needs at basic (BA 6.1) and applied (BA 6.2) research levels not addressed by commercial products

Video Analysis



Visualization



Data Ingest and Processing

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NDIA S&ET Conference
Cyber COI Strategic Overview
20-22 MAR 2018

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Senior Research Scientist (Cyber Security)
US Army CERDEC

Cyber COI Leadership and Membership

Steering Group:

Mr. Gary Blohm, Army, Chair

Dr. Wen Master, Navy, Deputy

Mr. Timothy Sakulich, Air Force

Mr. Chester Maciag, Air Force

Ms. Cheryl Mawhinney, NSA

Dr. Steven King, USD (R&E)

Working Group:

Dr. Bharat Doshi, Army, Chair

Mr. Giorgio Bertoli, Army

Dr. Ryan Craven, Navy, Deputy

Ms. Anna Weeks, Air Force

Dr. Todd Finkler, NSA

Ms. Sharothi Pikar, USD (R&E)

Cyber COI Sub Working Groups

Protection	Access & Effects	Cyber SA	Cyber C2
Ryan Craven (Navy) (Lead)	**Philip D'Ambrosio (NSA) (Lead)**	**Giorgio Bertoli (Army) (Lead)**	**Anna Weeks (AF) (Lead)**
Alex Wancowiz (Army)	Mark Farwell (Army)	Humza Shahid (Army)	Paul Robb (Army)
Donald Coulter (Army)	Bill O'Mara (AF)	Mark Williams (AF)	John Gancasz (AF)
Juanita Riley (AF)	Dan Koller (Navy)	Danko Nebesh (NSA)	Greg Harriot (NSA)
Kim Ferguson (NSA)		Waleed Barnawi (Navy)	Joe Mathew (Navy)
TEM June 2018	TEM Sep 2016	TEM June 2018	TEM 8 Aug 2017

Cross Cutting TEMs on Topics of broader Interest:
Machine Learning and Artificial Intelligence 15 NOV 2017

Sub Working Groups Purpose & Responsibilities

- ***Increase grass roots engagements of SMEs in the four major S&T areas***
- ***Deep dive TEMs***
- ***Develop bottom-up collaboration opportunities***
- ***Proactively identify S&T gaps, help develop roadmaps, and proposals.***

Cyberspace

- **Cyberspace: Domain characterized by the use of electronics, electromagnetic spectrum, and software to store, modify, and exchange data via networked systems and associated physical infrastructure.**
- **Cyberspace is relatively new, fast growing, and dynamic**
  - Rapid growth of user base
  - Rapid insertion of new technologies
  - Rapid growth of new applications
- **Pervasive underpinning of nearly all personal life, business, public services, national security, and defense functions, across all phases of shaping and conflict.**
- **Reliance on the Cyberspace is growing rapidly.**

Cyberspace Growth, Ubiquity, & Dynamics

Personal, Commercial, and Some Public Service

- Global Internet
- Wi-Fi, Cellular telephony and data
- Critical Infrastructures (e.g. Energy, Transportation, Finance, and Communication)
- IoT, wearable electronics, machine-machine and man-machine systems, Autonomous Systems
- Brain-machine, Brain-brain

DoD/IC

- C4I Networks
  - Ground, air, space, underwater/surface
  - Wired, wireless, mobile
  - PNT, C2, Logistics, Fire, Medical, Situation Awareness
- Energy and power systems
- Platforms : G, S, A, Space
- Weapons systems
- Wearable electronics and sensors
- Distributed sensor networks
- Machine-Machine, Man-machine and Autonomous Systems (MUM-T, Robots, UAVs, UUVs, Swarms)
- Brain-machine and brain-brain communication

Cyberspace, Cyber S&T, Cyber COI and Relationships with Other COIs

- **Other COIs deal with technologies that create new cyberspace capabilities and applications**
- **However, cyberspace is vulnerable to errors and cyber attacks that lead to adverse impact on the mission via**
  - Loss of service (Availability)
  - Exfiltration of vital information (Confidentiality and Privacy)
  - Corruption of information (Integrity)
  - Loss of control; Destruction or malfunction
- **New vulnerabilities surface as new cyberspace technologies and applications are introduced. Threats and Opportunities.**
- **Cyber COI S&T is aimed at novel approaches/technologies to secure current, emerging, and future cyberspace and its applications, and to create desired effects on adversary cyberspace.**

Steps in a Cyber Attack

- Reconnaissance
- Scanning
- Access
- Escalation
- Exfiltration
- Sustainment
- Assault
- Obfuscation

Attack vs Defense Timelines

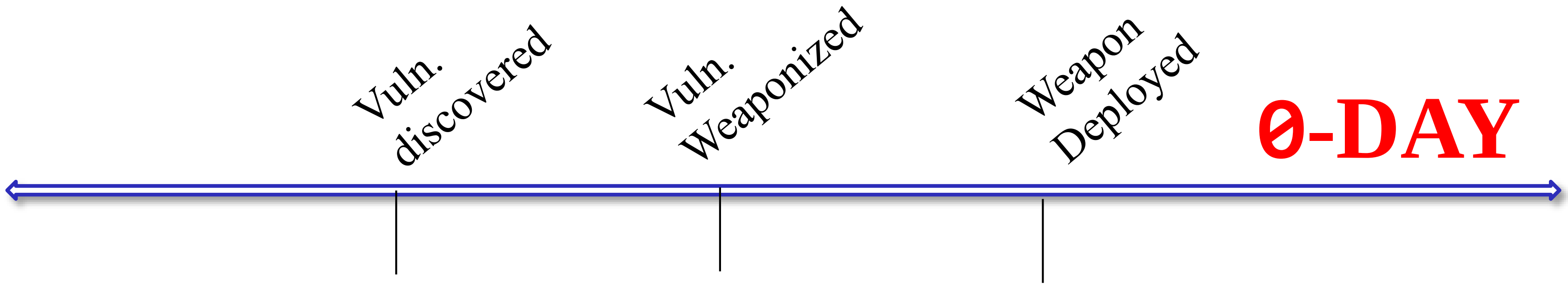


Figure: Attacker's Timeline

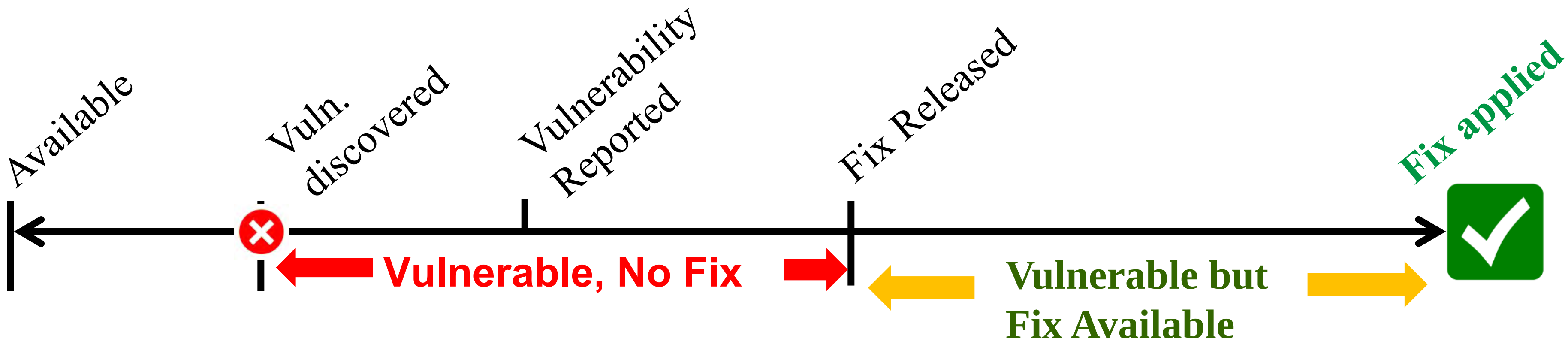


Figure: Defender's Timeline

Goals of Cyber S&T

- Technologies that autonomously prevent the adversaries from accessing blue and gray cyberspace and minimize the adverse impact if the adversary succeeds in gaining access.
- Technologies that enable desired effects on the adversary cyberspace
- Technologies and tools to help Cyber Mission Force teams, Cyber Protection Teams, and other Cyber Operators conduct winning Defensive and Offensive Cyber Operations (DCO, OCO)
- Technologies and guidelines for proactively developing architectural and design principles, sensors, and analytics to ensure that emerging and future cyberspace are secure.

Tier 1 S&T Areas of the New Two-Tier Cyber COI Taxonomy

Protection

Prevention of adversarial access to blue cyberspace. **Autonomic Cyber Resilience to** minimize the mission impact after adversarial access. **Local Sensors, Analytics, and Actions**

Effects

Successful effects in presence of adversary defenses

Cyber Situation Awareness (Cyber SA)

Technologies for collection and fusion of data from multiple sources. Analytics, machine learning, and deep learning for intrusion detection, attribution, and BDA. Echelon and role specific visualization.

Cyber Command and Control (Cyber C2)

Mission mapping. Tools for COA. Technologies, platforms, and tools for collaborative planning and evaluation of strategic and tactical plans in cyberspace.

New Two-Tier Taxonomy:
Tier 1 S&T Areas and Application Areas

Tier 1 Taxonomy, Four S&T Areas

Protection
- *Prevention*
- *Resilience*

Effects
- *Delivery Mechanism*
- *Weapons*

Cyber Situation Awareness ***(Cyber SA)***

Cyber Command and Controls ***(Cyber C2)***

Applications

- *Broadly Applicable Technologies*
- *Enterprise Level DoDIN*
- *Tactical C4ISR Networks*
- *Platforms (Ground, Sea, Air, Space)*
- *Weapons Systems*
- *Sensors and other IoBT Devices*

Key Investment Trends

Responding to Emerging Threat and Technology Opportunities

Demand Signals from Cyber Mission Force Teams and other operational communities ➔ **Increasing S&T for Cyber SA and Cyber C2**

Increasing role of cyberspace in platforms and weapons systems ➔ New vulnerabilities, consequences, and OODA loop ➔ **increasing S&T for cyber operations on DoD Cyber Physical systems**

Projected exponential growth in low cost, small SWaP, connected devices in commercial and DoD applications (Internet of Things) ➔ **Increasing S&T for cyber operations on DoD IoT**

Rapidly decreasing cost of providing controlled dynamics in low level functions ➔ **Increasing S&T for the use of the dynamics to provide obfuscation, deception, and evasion for increasing adversary work factor**

Increasing system complexity, shrinking OODA loop, cognitive overload, and multi-source data/intelligence ➔ **Increasing S&T for machine learning and autonomy in cyber defense/offense**

- **Simplicity and minimalism for security**
- **Predictability, reusability, and controllability of effects**
- **Modeling human dimensions**

Major New Initiatives

Attack Surface Reduction for the Entire Computing and Networking Systems

- SW and protocol de-bloating, removal of unneeded features
- Virtualization

Resiliency in Platforms, Weapons systems, and Critical Infrastructure

- Fast and autonomic recovery

Low SWaP and Low Resource Devices (IoT)

- Wearable, easy-to-use, multi-factor authentication
- Defense of low resource devices

Integrated Cyber-EW-SIGINT

- Integrated SA and Integrated C2
- Multi-function hardware and software

USD (R&E) Priorities

- Behavioral Cyber Science, Self-Securing Systems, Mathematical Foundations for Cyber, and Precision Effects

SW Complexity and Bloat

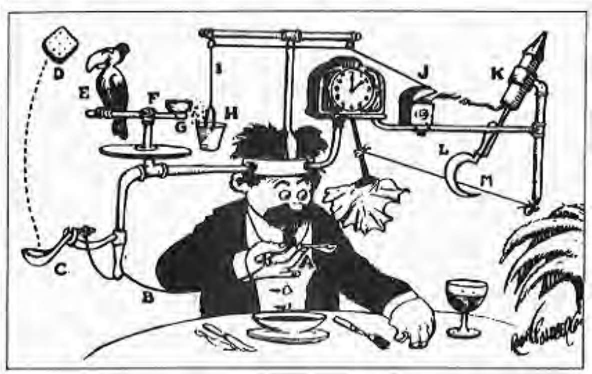
BACKGROUND: Modern software is exceedingly complex and bloated

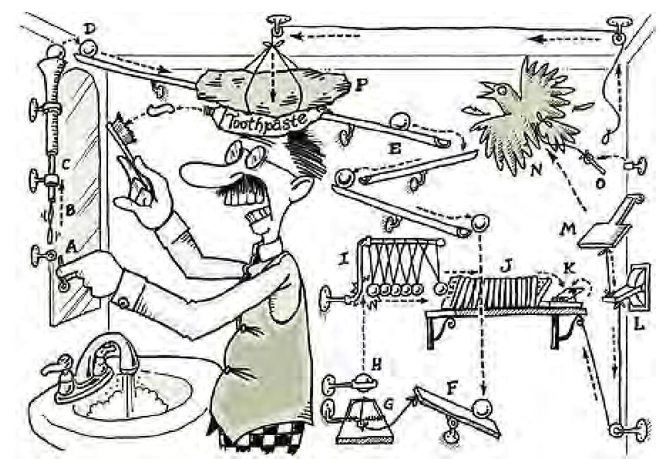
- **Current practices encourage it (OOP, layers of abstraction, etc.)**
- **Priority is to maximize code reuse and increase programmer productivity**
- **One-size-fits-all feature set**

- "In every application we looked at, an enormous amount of activity was executed to accomplish simple tasks."
- "For example, a stock brokerage benchmark executes **268 method calls** and creates **70 new objects** just to move a *single date field* from SOAP to Java."

Excerpted from:
Sevitsky et. al. (IBM TJ Watson Research Center) on framework based applications
http://lcsd05.cs.tamu.edu/papers/sevitsky_et_al.pdf

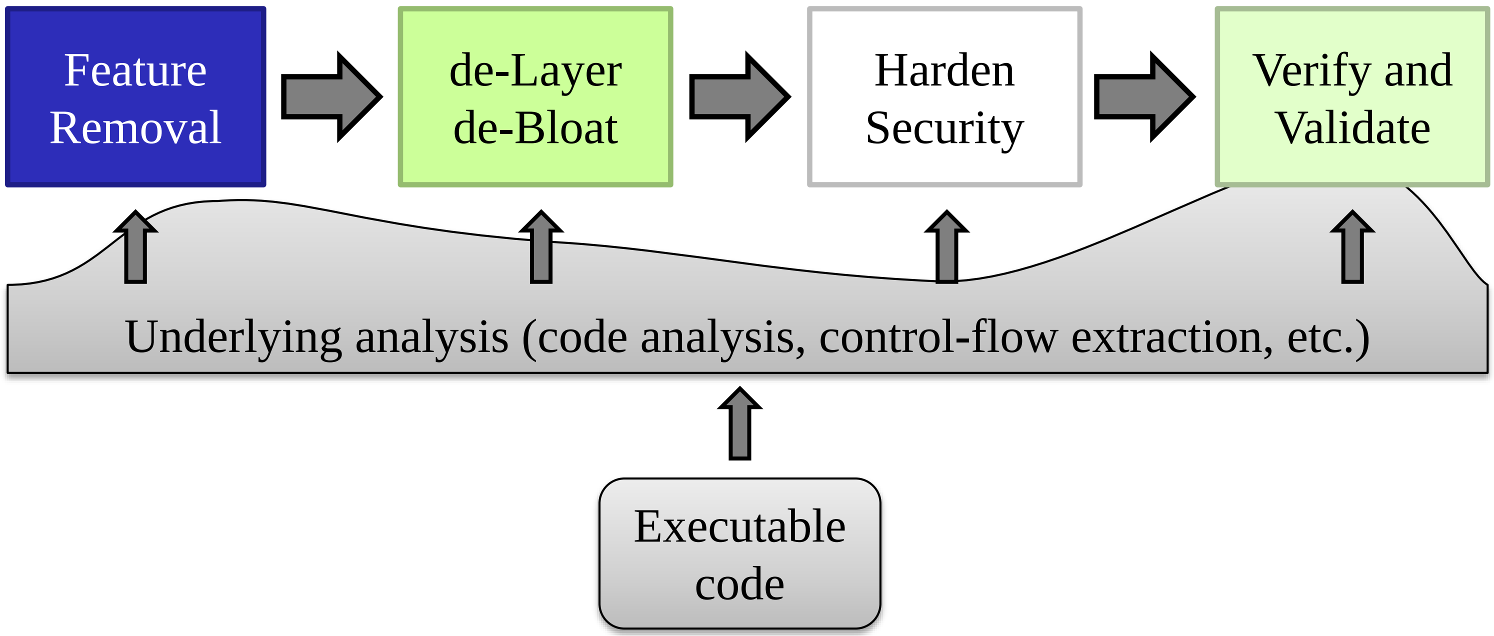
Self-Operating Napkin





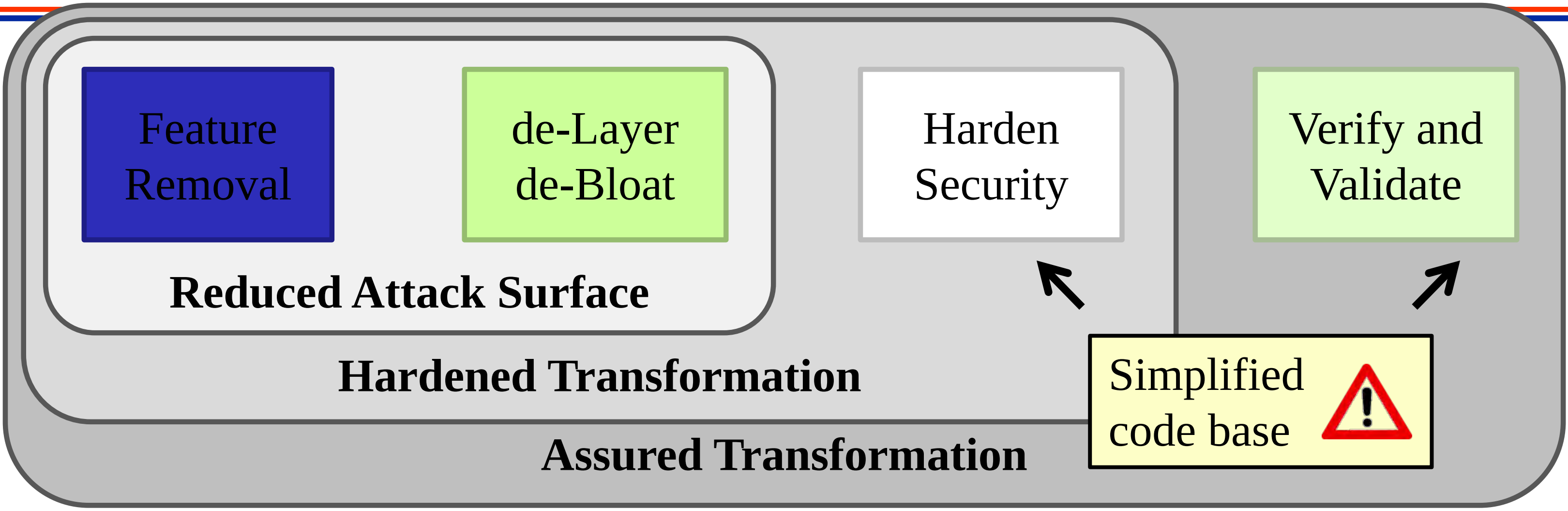
RESEARCH VISION: Late-stage / install-time transformations

- Hard to change the way people write code, so work around it
- Series of automated transformations for legacy code
- Four independent, separate steps



Improving Software Robustness and Efficiency

Architecture & Strategy for Development & Deployment



- **Feature Removal**
  - Cut unneeded functionality (admin-assist)
  - Is a functionality-preserving transformation but only for **desired** features
- **Complexity Reduction (dLB)**
  - Functionality-preserving transformation for the aggressive reduction of code size/complexity, indirection, and layers of abstraction
- **Retrofitting Security**
  - Security-focused code analysis and functionality-preserving transformations for enhancing robustness and security
- **Asserting correctness and security**
  - Automated and *in situ* verification of validation to ensure the transformation results are robust and secure

Success Stories

Protection

- SW Assurance
- SW/FW/Protocol De-bloating
- Hybrid binary/Ternary Computing
- Formal Methods for Cyber Physical Systems
- PKI for Tactical, Including Non-Person Entities
- Cross-Domain Solutions (CDS) for Enterprise, Tactical, and Tactical Edge
- System-on-the-Chip Reprogrammable Encryptor
- Cyber Defense of Microprocessors and Controllers
- Byzantine Fault Tolerance for Control Systems
- Extremely Lightweight Intrusion Detection Systems (IDS): Tactical and Tactical Edge

Effects

- Integrated Cyber Electro-Magnetic Effects
- Resilient OCO

Cyber SA

- SCADA Sensors and Remote Monitoring
- Code Attribution via Analysis of Coding Style
- CEMA SA Framework and Analytics
- Universal Composable Visualizer for SA

Cyber C2

- Cyber C2 Through Graph Visualization
- Integrated CEMA Operations Specifications
- Scalable Cyber Technology Integration
- Cyber Operations Architecture

A Sample of Recent Accomplishments

Transitions

- Low level Monitoring for popular Programmable Logic Controllers. Major impact on the security of platforms and weapons systems. Transitioned to NAVSEA and used on several ships
- Defense of embedded firmware via injection of software Symbiotes for reverse engineering, repairing, and simplifying: Transitioned to several commercial vendors.
- Several Effects Technologies transitioned to Operations and PEOs
- Visualization and post-compromise SA tools for PEOs and Operational Communities

Promising New Results

- Software De-bloating is fruitful
  - JAVA Apps: 50% Reduction
  - Java Run Time Environment (JRE): 83% Reduction
  - Firmware Bios Images: 70-85% Reduction
  - Compelling Impact on security and efficiency
    - Known bugs in JRE 50% Reduction
    - 8x Speedup on R language code
- 100-1000x reduction in memory and processing requirements for Intrusion Detection. Allows use in low resource devices and mobile networks
- Very promising accuracy in attribution using: coding style; and the attacker behavior observed in and out of the blue cyberspace
- Dynamic binary/ternary architecture for major gain in obfuscation and resilience: Demos of Cryptology; PUF; and Random Number Generator

Impact

Significant Reductions in Capability Gaps

- Secure Cross Domain Data Transfer
- Hardened Attack Surface via Static and Dynamic SW Assurance
- Cyber Resilience via Reconfiguration, Obfuscation, Deception, and Fault Tolerance
- Situation Awareness Framework and Analytics
- Low Level SA, Actions, and Recovery

Increased Mutual Reliance and Investment Leverage

- Complementary Cyber S&T Priorities for SA & C2
- Complementary Cyber S&T Priorities for Platforms and Weapons Systems
- Complementary Cyber S&T Priorities for IoT in DoD
- Complementary Cyber S&T Priorities for SW/FW/Protocol De-Bloating

Shifted Investment Focus

- Increased S&T for Cyber SA and C2
- Increased S&T for Cyber Defense/Offense for Platforms and Weapons Systems
- Stronger Interest in Machine Learning and Autonomy for Cyber Defense and Offense
- Growing Interest in Human Dimensions in Cyber Operations

S&T Focus Going Forward

Protection

- Novel Authentication Mechanisms for Tactical Environments
- SW/FW Simplicity and Minimalism
- Automated Obfuscation, Deception, and Maneuvers
- Automated Intrusion Detection and Actions, Self Securing Systems

Effects

- Predictability, Reusability, and Controllability
- Resilience and Morphability

Cyber SA

- Cyber Battle Damage Prediction and Post Attack Assessment.
- Integrated SA: Multi-Service; Organic and External Intelligence; Cyber and Electromagnetic; Cyber, EW, and Kinetic

Cyber C2

- Platform and Infrastructure Architecture
- Integrated Course of Action: Cyber and Non-Cyber

Enablers

- Machine Learning, Artificial Intelligence, and Autonomy ➔ OODA Loop, Cognitive Load
- Human Dimensions

Cyber Defense/Offense for IoT, Platforms, and Weapons Systems

Examples of Longer Term S&T

- **ML/AI and Automation with Minimal Human Assistance**
  - Vulnerability Discovery
  - Design of Defensive Techniques
  - Design and Characterization of Cyber Weapons

- **Diversity and Dynamics in Core Functions: Obfuscation and Deception**
  - Scenario Dependent Selection of Functions to be 'Randomized'
  - Orchestration of the Selected Subset for Optimal Results

- **Mutually Learning Human-Computer Teams for Cyber Operations**

- **Ubiquitous Sensors Feeding Integrated Cyber-EW Operations**

- **Cyber Operations for Tightly Coupled Man-Machine and Autonomous Systems**

- **Quantum Computing for Cyber**

Performers for DoD Cyber S&T

- **S&T Labs in Services and Agencies: AFRL, NRL, NSA, RDECOM**
- **DOE Labs, FFRDCs, and UARCs**
- **Academia**
- **Industry Players**
  - Defense Industrial Base
  - Non-traditional
  - Small Companies with Key Expertise and Products
- **About 80% Extramural**
- **Emphasis on Leveraging Industry and Academic Expertise**

Engagement Opportunities for Industry: Engagement Mechanisms & Sources of Information

- Direct Engagement with Services S&T via feedback on IR&D plans and technology directions.
- www.FedBizOpps.Gov: Industry Days, RFIs, RFPs, BAAs.
- Defense Innovation Marketplace http://www.defenseinnovationmarketplace.mil/index.htm
- Cyber Security and Information Systems Information Analysis Center. https://www.csiac.org/
- Cooperative Agreements, SBIR/STTR
- T&E and Risk Reduction

Questions

Electronic Warfare (EW)
S&T Community of Interest (CoI)
Overview

DISTRIBUTION A. Approved for public release. Distribution is unlimited. Case number: 18-S-0989.

Dr. Jeffrey Boksiner, ST (Chair, EW CoI)
U.S. Army Research, Development and Engineering Command
Communications-Electronics Research, Development and Engineering Center
Intelligence and Information Warfare Directorate

21 March 2018

EW COI Membership

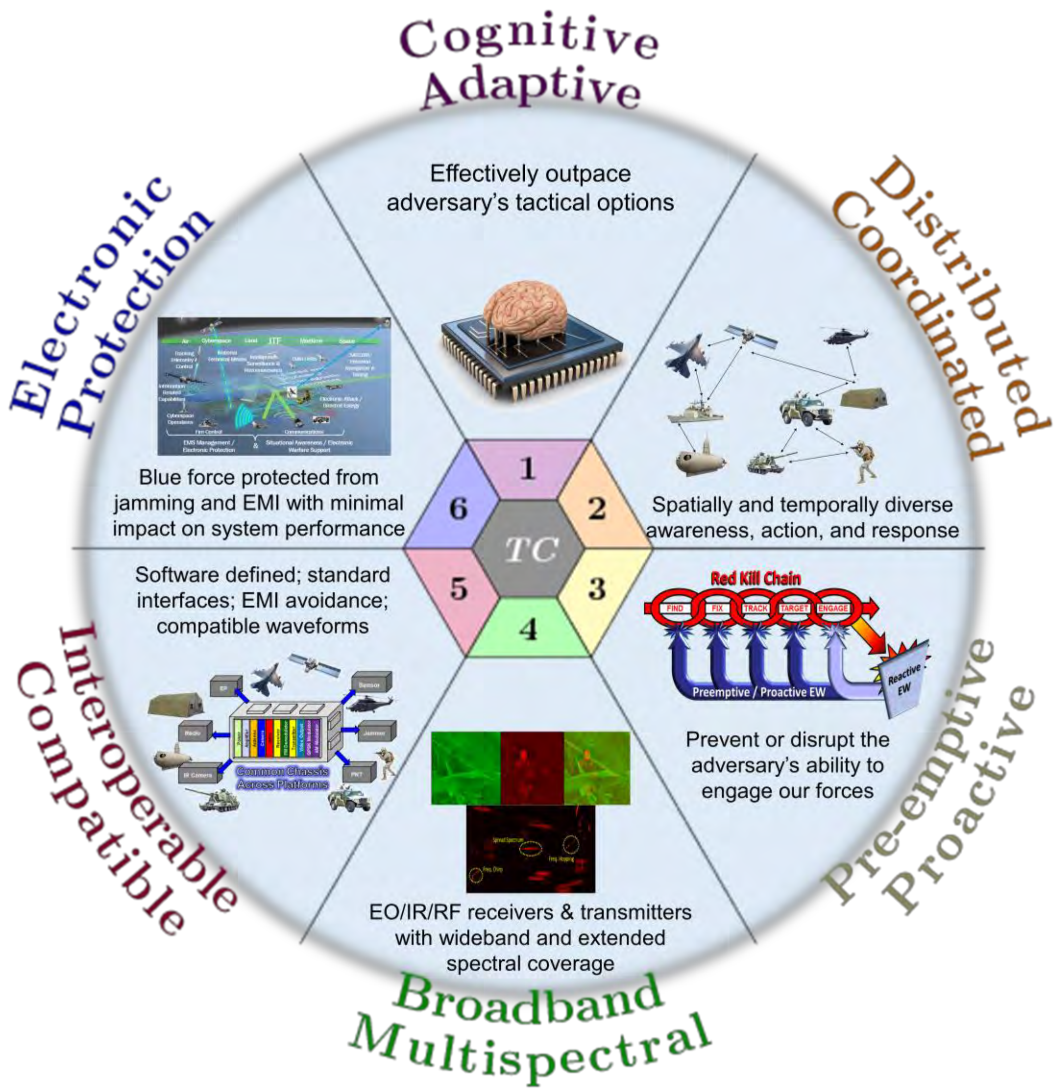
COI Steering Group

Service	Principal	Alternate
Air Force	Mr. Dale Parsons	Mr. Joseph Koesters
Army	*Dr. Jeffrey Boksiner*	Dr. Charles Dietlein
Navy	Dr. Dan Green	
ASD(R&E)	Dr. Karl Dahlhauser	
MITRE Support	Mr. Marc St. John	

Role of the Electronic Warfare (EW) Community of Interest (COI)

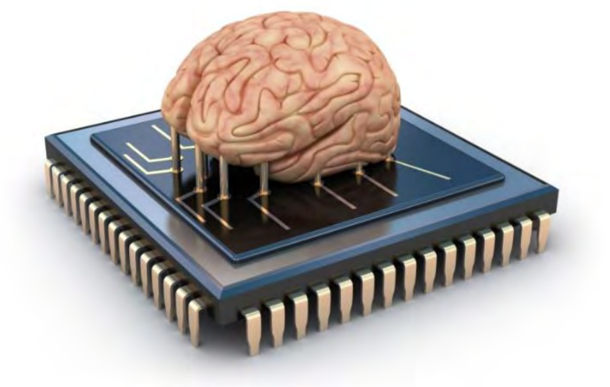
- **Be the EW S&T leadership body for the DoD**
- **Define cross-cutting EW S&T investment strategy**
- **Develop experimentation strategy & recommendations**
- **Propose/define collaborations, e.g., integrated EW-Cyber effects**
- **Engage the community in its entirety**
  - Government, Industry, Academia, International
- **Develop quantifiable metrics**
  - How will we know we've met goals?
  - How do we know what level is good enough?
  - By when?
- **Incorporate (or reference) IRAD into COI strategy/roadmaps**

Technical Challenges (TCs)



TC1: Cognitive, Adaptive Capabilities

- **Develop the ability to effectively outpace adversary decision and technical options, using:**



  – Real time learning and predictive reasoning software algorithms

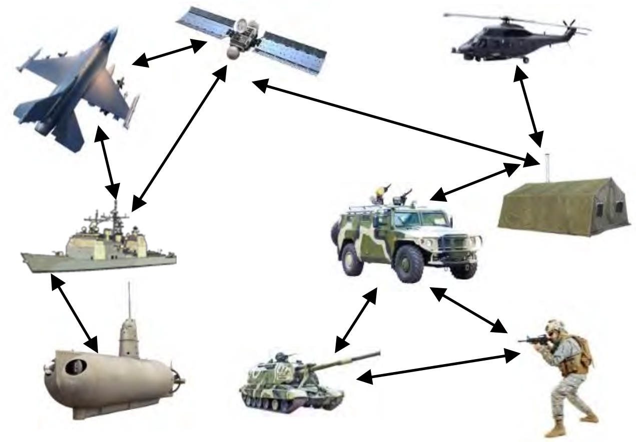
  – Autonomous asset and resource optimization in response to threat behavior

  – Automatic synthesis of countermeasure techniques against unknown threats

  – Methods for assessing EW effectiveness

TC2: Distributed / Coordinated (Network-Enabled)

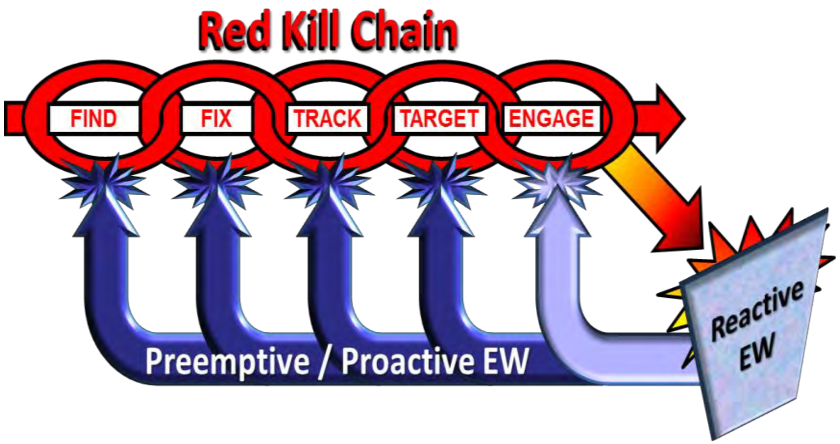
- **Achieve spatially and temporally diverse responsiveness to dense and complex threat environments**



  - EW architectural "layering" & integrated kinetic/non-kinetic resources
  - EW Battle Management and common/shared electronic order of battle
  - Real time fusion of spectral/temporal knowledge from disparate assets
  - Distributed coherent phase control for sensing and attack

TC3: Preemptive / Proactive Effects

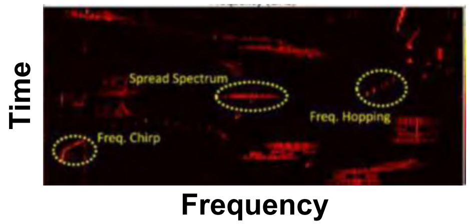
- **Prevent or disrupt the adversary's ability to find, fix, track, target, and engage our forces**



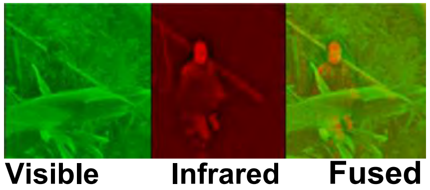
  – Real-time active/passive sensing of "silent" threats
  – "Spectrally agnostic" countermeasures
  – Early kill chain techniques and methods
  – Multispectral signature emulation

TC4: Broadband / Multispectral Systems

- **Enable the widest possible spectral extent to our control of the electromagnetic spectrum**



Broadband:
- Covers all bands at once
- Detects wideband threats



Multispectral:
- Different phenomena, observables occur at different wavelengths

  – EO/IR/RF receivers & transmitters with wideband and extended spectral coverage

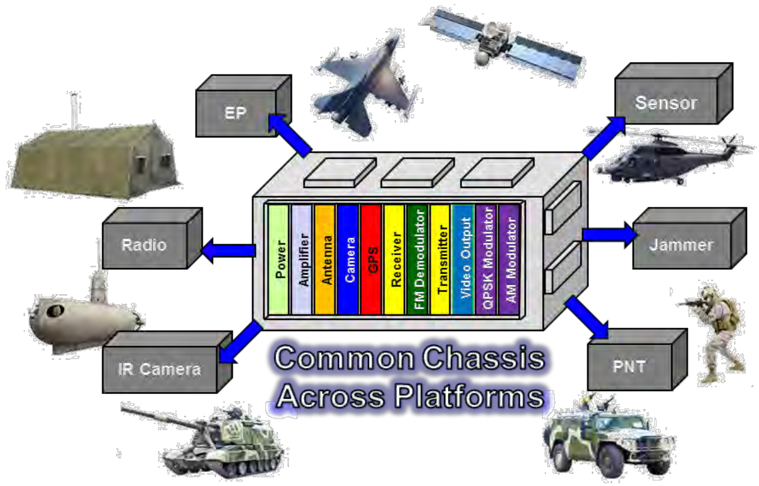
  – Advanced spectrum processing components (filters, modulators, etc.)

  – Wide-band, high power apertures (antennas, windows, beam control, etc.)

  – Spectroscopic signal sensing and ID

TC5: Interoperable & Compatible

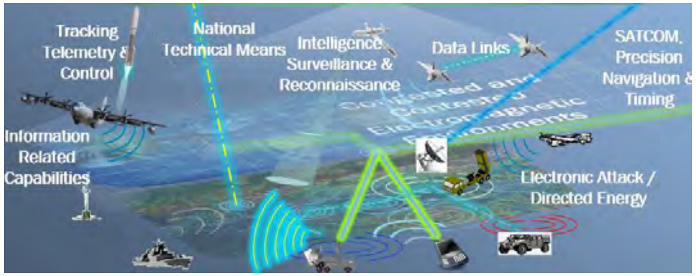
- **Achieve timely deployment or insertion of advanced EW capabilities in response to rapidly changing conditions with minimal degradation to friendly capabilities**



  - Adaptive protocols and standard firmware/hardware interfaces
  - Techniques and waveforms usable across any EW component supplier
  - Software-defined transceivers and processors
  - Scheduling to optimize resource allocation
  - Filters and other suppression techniques, interference cancellation

TC6: Advanced Electronic Protection

- **Protect against potentially deleterious effects of friendly or enemy use of the electromagnetic spectrum to enable unfettered operations in the increasingly dense electromagnetic spectrum**



  - Focus on Electromagnetic Battle management (EMBM) and common aspects of EP
  - Methods to simultaneously transmit and receive through shared or closely coupled apertures
  - Predictive EM and signal modeling
  - Directionality and diversity

Technology Evolution

- **Rapid evolution/advancement in technology**
  - Signal density and complexity
  - Systems becoming adaptable and software defined
  - Global advances in electronics
- **Global focus on Autonomy, Artificial Intelligence and Machine Learning**
  - Opportunity to use AI to understand/manage complexity & shorten response times
  - Training data
  - Battle Damage Assessment
  - Test and evaluation
  - Validation/trust

Energy & Power Community of Interest
March 21, 2018

Dr. Ed Shaffer – ARL SEDD (Army Prin.)

Dr. Rich Carlin, SES – ONR, 33 (Navy Prin.)

LEAD: John Nairus, PE – AFRL RQQ (USAF Prin.)

Dr. Dave Drazen – OASD(R&E) Staff Specialist

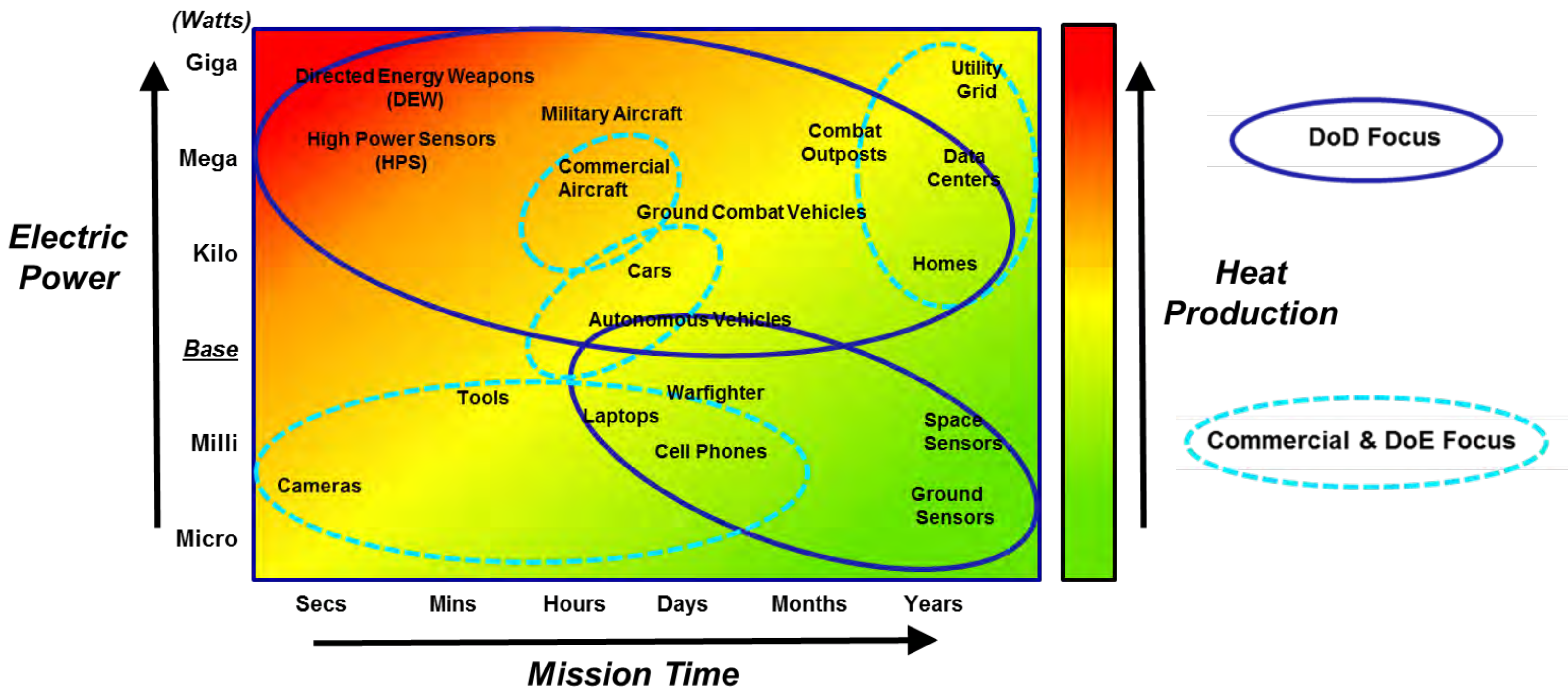
Energy & Power S&T Enables DoD Capabilities

Technical Taxonomy

Power Generation/Energy Conversion
Energy Storage
Power Control and Distribution
Thermal Transport and Control
Electromechanical Conversion

Warfighter Opportunity Areas (WOA)

Energy Optimized Platforms
Electric Weapons and High Power Sensors
Adaptive Power Networks
Autonomous Systems Power
Tactical Unit Energy Independence



Energy & Power CoI
Warfighter Opportunity Areas (WOA)

Energy Optimized Platforms: ***Optimizing platforms for a more lethal joint force.***
- Novel Metal-Ion and Aqueous Battery Chemistries
- Electric Ship Research and Development Consortium (ESRDC)
- MegaWatt Tactical Aircraft (MWTA) Program

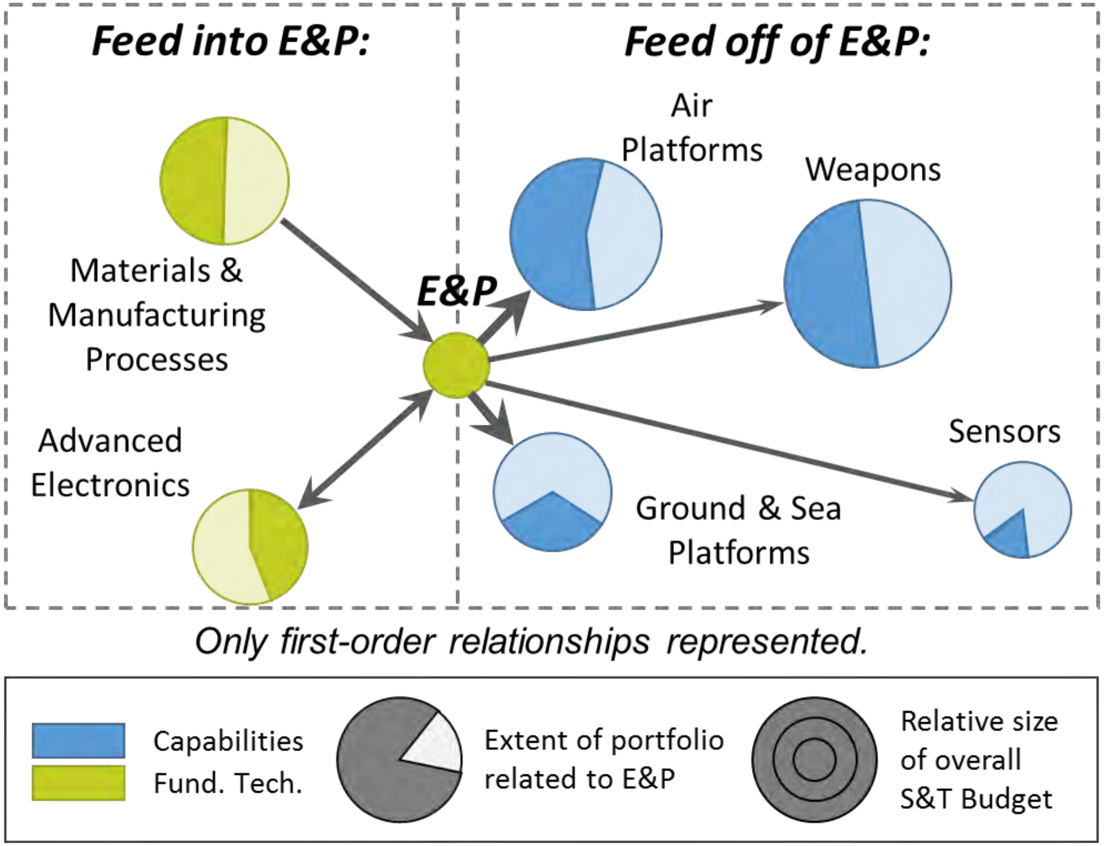
Electric Weapons and High Power Sensors: ***Enable asymmetric capabilities.***
- Ultra High Density Hybrid Energy Storage Module (UHD HESM)
- Open System for Controls of Integrated Propulsion, Power, and Thermal (OSCIPPT)
- Thermally Enabling Architecture for Pulse-Power Systems (TEAPPS)

Autonomous Systems Power: ***Enable long-duration, autonomous operation in unique and challenging environments.***
- Compact Military Power (UGV)
- Hydrothermal Vent Exploitation for Undersea Energy (HTVE-UE)
- Quiet Propulsion (Great Horned Owl, GHO) & Eyes Below the Weather (Tactical Off-Board Sensing, TOBS)
- Multi-Day Endurance of Group 2 Unmanned Aerial System (Hybrid Tiger)

Tactical Unit Energy Independence: ***Extending the reach of energy and power systems to untether Warfighters.***
- Advanced Integrated Solider Power (AISP) Science & Technology Objective (STO)
- Self-Sustaining Soldier Power (S3P) STO
- Multifunctional, Structurally Integrated Flexible Energy Storage

Adaptive Power Networks: ***Automating energy management for optimized mission performance.***
- Energy Informed Operations (EIO)
- Intelligent Power Components & Integration
- Tactical Microgrid Standards Consortium (TMSC)

Energy & Power CoI S&T Portfolio Interdependency



The remaining CoIs have a second-order relationship (e.g., C4I through Sensors & Processing)

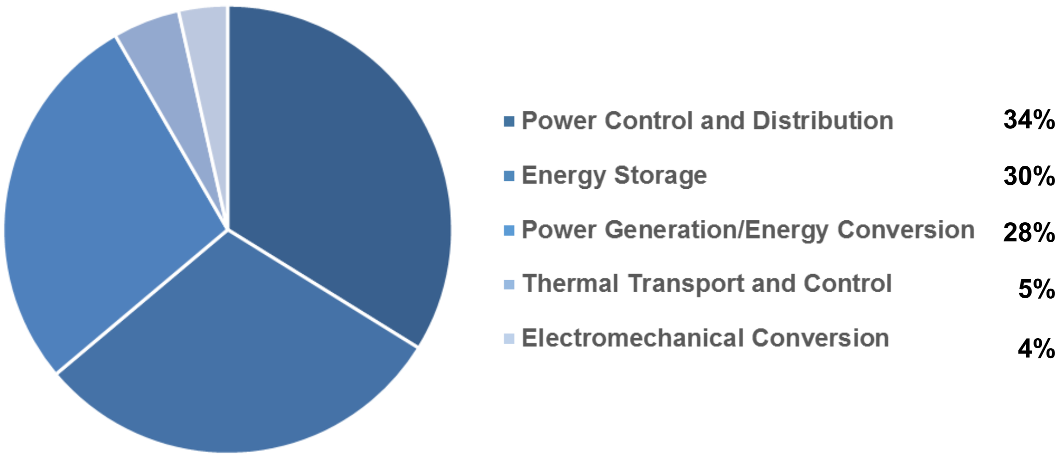
E&P develops fundamental technologies, which

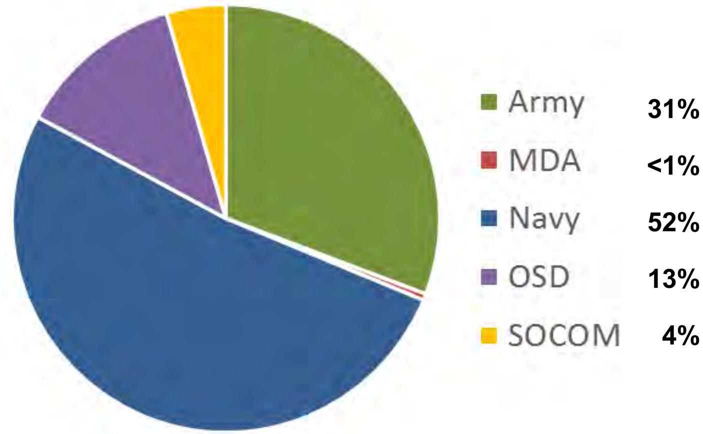
- directly feed into the capabilities developed in the non-Space platforms, Weapons and Sensors CoIs
- and rely on improvements in materials, manufacturing, and electronics.

New advancements will result additional direct relationships:

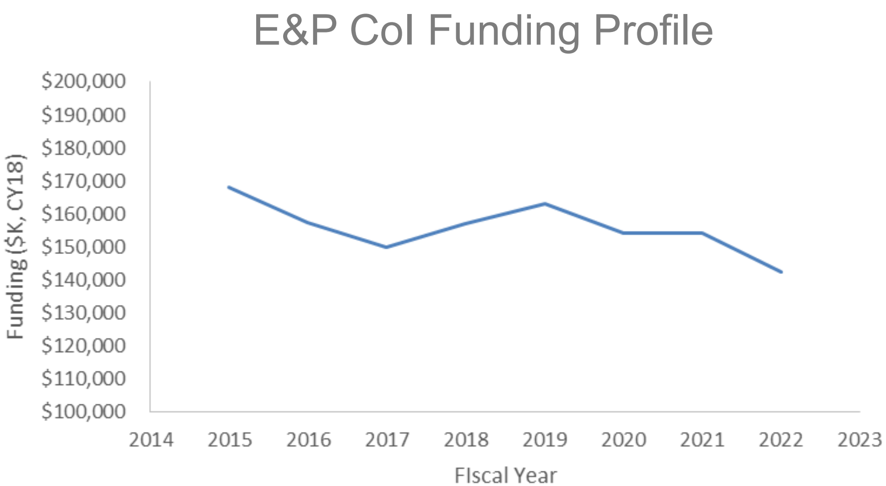
- Cyber CoI on the cyber resiliency of intelligent power and energy systems
- Autonomy CoI on advanced energy behaviors for Autonomous systems

Energy & Power CoI FY18 Funding





Air Force $$ binned under Air Platforms CoI



Investment profile:
- PB18 $156.8M, 54% BA 2 & 46% BA 3
- Significant USAF Thermal Transport and Control funding aligned with Air Platform CoI.

Energy & Power CoI
Recent Impact

- **Ongoing collaborative projects between the Services and ODASD(OE) to address identified high risk S&T challenges through OECIF**
  - **Open Syst. for Ctrls. of Integrated Propulsion, Power, and Thermal (OSCIPPT)**
    Provide common baseline controls interface for future platforms.
  - **Ultra High Density Hybrid Energy Storage Module (UHD HESM)**
    Examine HESM-enabled Laser Weapon Syst. & EW operation in power hardware-in-the-loop demonstrations with Army and USAF, plus transition to Navy Multifunctional Energy Systems FNC
  - **Thermally Enabling Architectures for Pulse Power Systems (TEAPPS)**
    Deliver advanced thermal management system architectures and components for transition to 100+ kW HEL efforts: HELIOS, SHiELD, HELMTT.
- **Collaborating with Other Government Agencies**
  - **AFRL/NASA: manned/unmanned aircraft hybrid-electric propulsion**
  - **Joint/DOE/NASA/NIST/NSF: High-voltage GaN semiconductors road-mapping**
  - **Army/JPL/NASA: Lithium Sulfur and Ultracapacitor power sources for Soldiers**
  - **Army/DOE: Advanced Vehicle Power Technology Alliance - leveraging automotive advances for combat vehicles**

Energy & Power CoI Current S&T Priorities

- **Improve power density and thermal management for air and ground platforms with significant size and weight constraints to enable high power capabilities**
  - **Army Hybrid Energy Storage System**
    Navy Multifunctional Energy Systems FNC
    USAF MegaWatt Tactical Aircraft
    OSD Operational Energy Capability Improvement Fund
  - **Outreach to platform CoIs for application and transition opportunities**
- **Secure interfaces (including cyber-physical) to mission capabilities for intelligent power and thermal control**
  - **"Assessment of Operational Energy Systems Cybersecurity Vulnerabilities"**
    Study executed using USD(R&E) CoI discretionary funds.
  - **Investigating opportunities to collaborate within DoD and DOE National Labs**
- **On-station energy harvesting/scavenging for autonomous systems**
  - **Working with Autonomy and platform CoIs to determine near-term responsibilities and long-term direction**

DoD Energy & Power S&T Risks

- **Risk: New capability development without sufficient focus on power and thermal infrastructure requirements to support and sustain**
  - **Mitigation Action: Cross-CoI "Enabling DEW & HPS" TEM validated and raised awareness of S&T challenges**
  - **Mitigation Action: E&P CoI planning a Cross-CoI TEM on Autonomous Systems Power with Autonomy and platform CoIs**
- **Risk: Limited resources for platform E&P systems integration and testing**
  - **Recommendation: Continued investment in improved M&S tools to affordably enable platform capabilities**
  - **Recommendation: Leverage prototyping and experimentation resources for integrated system testing to buy-down risk**
- **Risk: Unknown vulnerability of global supply chain**
  - **Mitigation Action: "Critical Energy & Power Technologies Domestic Marketplace Survey" and accompanying analysis tool**
    Study executed with ASD(R&E) CoI discretionary funds
  - **Recommendation: M&MP CoI examine and validate findings from E&P CoI Survey**

Energy & Power CoI Summary

E&P CoI Priorities:

- Improve power density and thermal management for air and ground platforms with significant size & weight constraints
- Secure interfaces (including cyber-physical) to mission capabilities for tactical microgrids and surface ship power & energy networks
- On-station, autonomous energy harvesting/scavenging

Potential Future Research Areas:

- Power and thermal requirements of collaborative electric weapon effects
- Energy recharge of autonomous systems
- Enabling increased platform design flexibility and scalability through more capable power and thermal systems
- Multifunctional energy structures
- Flexible, conformal, and robust power for the augmented Warfighter

Engagement Opportunities:

- Army Research Laboratory Open Campus effort
- Defense Innovation Marketplace
- NDIA Annual Science and Technology Conference
- ARPA-E Annual Energy Innovation Summit

Backup

Tier 1 Taxonomy Brief Descriptions

Power Generation/Energy Conversion:
Develop tactical, deployable power systems using available fuel and renewable/ambient sources to generate electrical energy.

Energy Storage:
Improve electrical and electrochemical energy storage devices to decrease device size, weight, and cost as well as increase their capabilities in extreme temperatures and operating conditions.

Power Control and Distribution:
Enable smart energy networks for platforms, forward operating bases, and facilities through new, greater capability and efficiency components as well as modeling & simulation tools.

Thermal Transport and Control:
Efficiently manage heat and enable higher power density systems through advanced thermal science and technology: advanced components, system modeling, and adaptive or hybrid-cycle technologies.

Electromechanical Conversion:
Increase the power density, efficiency, and robustness of motors, generators, and actuators while also reducing their life cycle costs.

Human Systems COI

3/23/2018

Dr. Kevin T. Geiss
Director
Airman Systems Directorate
711th Human Performance Wing
Air Force Research Laboratory

State of HS COI: Changes

Personnel changes:

- Dr. Kevin Geiss (AFRL) - New Chair
- Dr. Todd Nelson (AFRL) - Working Group Chair

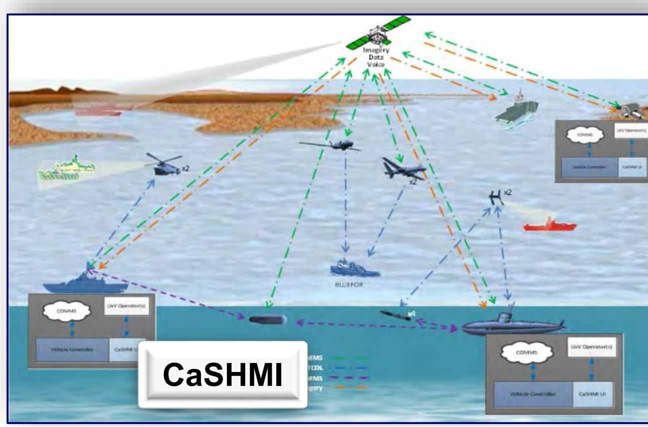
Sub Area / Roadmap changes:

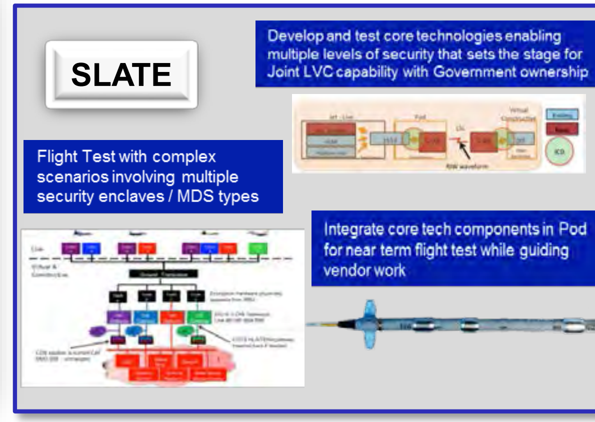
- Human Aspects of Military Environments (HAOME) refocused to Human Information, Interpretation, and Influence (HI3) thrust within SICP
- Addition of Robotic Maintenance Assistants to System Interfaces and Cognitive Processes (SICP)
- Noted AI threads in S&T Focus for SICP Roadmaps

Roadmap Trends for Human-Machine Teaming

- Development of wearable electronics to sense and adapt to the cognitive/physical state of the warfighter and environment enables more mission effective human agent teaming
- Applied Neuroscience related to operator and mission performance: focus on sensor development and assessment methodologies (i.e. machine learning)
- Advance cognitive modeling for realistic avatars, adaptive training, human agent teaming, and performance monitoring and prediction
- Neuromodulation related to protection and enhanced learning outcomes
- Increased investment and growth in biosciences (bioengineering and biosensors) and robotics

State of Technology: Accomplishments





- IMPACT: Realizing Autonomy via Intelligent Adaptive Hybrid Control: Refined tri-service "Base Defense" challenge scenario to include more unexpected, dynamic events; New rapid joint human-machine "Course of Action" tool; New Task Manager capability: system workload balancing
- Control Station Human Machine Interface (CaSHMI): Live demonstrations of AN/BYG-1 operators using CaSHMI to provide simultaneous supervisory control of a Blackwing UAS and multiple IVER UUVs concurrently
- Secure LVC Advance Training Environment (SLATE): New waveform for LVC data transmission; Enhanced range infrastructure; New standards, data specs, & interface control docs for 4^{th} & 5^{th} gen LVC
- Delivered PALMs (adaptive "flash cards") to Marines Awaiting Training for empirical testing

State of Technology: Focus Areas

Personalized Assessment, Education, and Training

Right Person, Right Job, Right Skills

- First Principles for Training Design
- Personnel Selection and Assignment

Protection, Sustainment, and Warfighter Performance

Ensuring Warfighter Safety and Survivability

- Understanding and Quantifying the Effects of Critical Stressors
- Critical Stressor Mitigation Strategies

System Interfaces and Cognitive Processes

Effective, Natural Human-Machine Teaming

- Human-Machine Teaming
- Intelligent, Adaptive Aiding
- Human Information Interpretation & Influence

State of Technology: Investments

What gaps has the COI identified as risk areas that need further investment?

- Wearable Technology and Real-time Operator State Assessment
- Performance Optimization via Adaptive Wearable Robotics enabling Physical and Cognitive Overmatch: Advancing the 3rd Offset
- Trainable Undifferentiated Agents for Rapid Constructive Force Generation
- Context-Aware Communication for Human-Machine Teaming Performers

Where is one Service relying on another Service to make an investment?

- 4th Gen Live, Virtual, Constructive (LVC) Advanced Training Environment: strategic partnership between Air Force and Navy on requirements and leveraging of funds for F15E OFP changes to reduce timeline/costs for similar OFP mods to F18 aircraft
- Directed Energy Bioeffects; Air Force is the DoD lead for Directed Energy Bioeffects

Future Direction

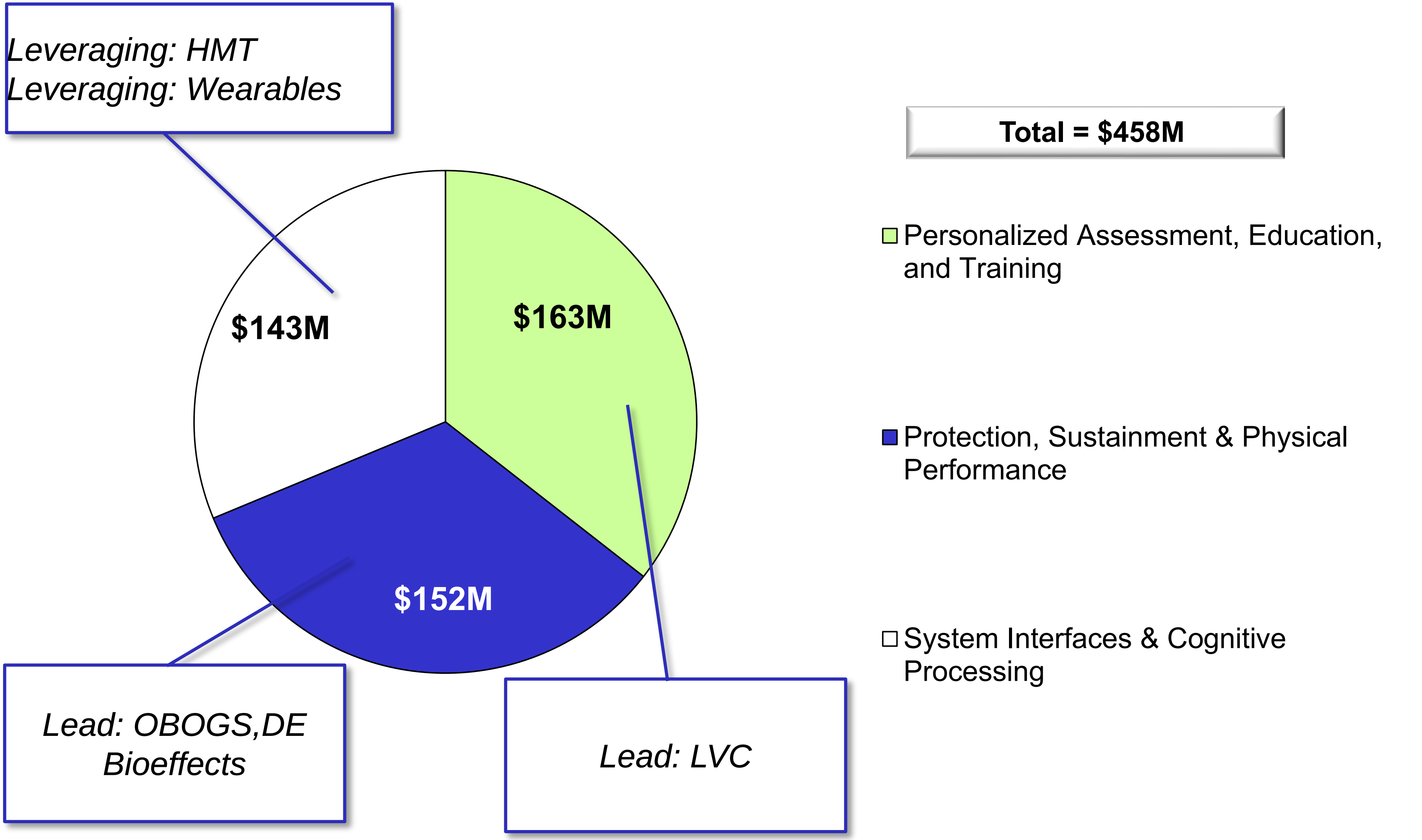
Initiatives or best practices to accelerate R&D process

- Subareas beginning monthly meetings with NDIA partners
- Continuation of Independent Research and Development (IR&D) Technology Interchange
- Participation in NATO, TTCP, and International Workshops (Singapore)
- Joint Exoskeleton Workshop

Cross-COI, Industry, Academia Opportunities for Collaboration

- ASBREM: MOMRP Wearables Meetings
- C4I: HCI for Decision Making Collaboration
- Autonomy: Machine Perception, Reasoning and Intel

Future Direction: Lead, Leverage, Watch



Take Aways for S&T ExCom

Messages:

- HS COI well-positioned to support recent Services' strategic documents to leverage the human dimension in complex systems via using synthetic environment
  - Programs in Human Machine Teaming, Live Virtual Constructive, and Wearable Sensors address key capabilities
- Continuing to self-assess Sub Area S&T alignment, scope, and direction via roadmap refinement
- Steering Group will continue to strengthen awareness of Services' S&T capabilities through a series of laboratory site visits
- Exploring collaborations with other COIs (ASBREM, Autonomy, C4I, etc.), especially for ARAP proposals

Questions?

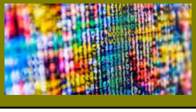
BACKUP

HI3 Overview

Human


- ❖ Individuals, Social Groups, Organizations
- ❖ Analysts
- ❖ Decision Makers

Information

- ❖ Computer-mediated messaging
- ❖ Text, images, videos, geo-locations, networks

Interpretation


- ❖ Topic modeling, affect/SN/multi-perspectives, narratives, pattern of life, relationship linking
- ❖ Deception detection, fake news, disinformation, misinformation, bots, distortion, contagion, spread

Influence

- ❖ Tailored truthful messaging with relevant platforms and emic perspectives
- ❖ TTPs for countering adversary messaging
- ❖ Metrics: Reach, Resonance, Response

Sensors and Processing CoI
March 20-22, 2018

Dr. Michael Grove
Dr. James Campbell
Night Vision &
Electronic Sensors Directorate

Sensors and Processing in the DoD

S&P CoI = Battlefield Surveillance and Targeting

Sensors

- Electro-Optical and Infrared
- Acoustic, Seismic and Magnetic
- Radio Frequency (Radar)
- Processing

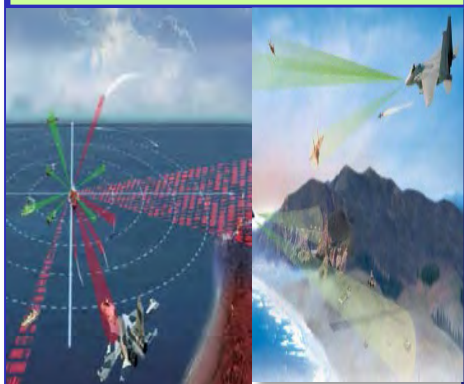
- Electronic Warfare
- Advanced Electronics
- Autonomy
- Space
- C4I
- Material and Manufacturing
- Navigation

Other COIs

Taxonomy

Sensors and Processing Technology

RF *(non-EW)*



- **RF Sensors**

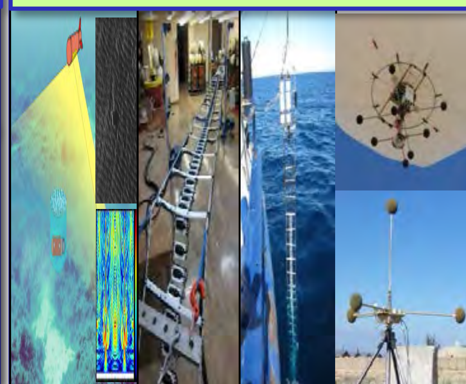
  Active
  - Monostatic Radar
  - MIMO

  Passive

  Cooperative
  - Multistatic Radar

  Non-Cooperative
  - PCL
  - SIGINT

Acoustic, Seismic, Magnetic



- **Acoustic**
  - Active
  - Passive
- **Seismic/Acceleration**
  - Ocean
  - Terrestrial
- **Magnetic/E-M Field**
  - Maritime
  - Terrestrial

Electro-Optics /Infrared

- **Imaging**
  - Active
  - Passive
- **Lasers**
  - High Power CW
  - Pulsed
- **Displays**
  - Direct View
  - Virtual

Sensor Processing

- **Sensor Processing**

  Automatic or Aided DCRIF

  Intelligent Targeting Tracking

  Compression

  Automatic Learning

  Multi-Sensor Fusion/Full Spectrum Targeting and Visualization

What is a Community of Interest (CoI)?

- **Communities of Interest (CoI): A set of technical groups led by the science and technology (S&T) Executive Committee (ExCom).**
- **Scope of each CoI shown in the Reliance 21 document which is the overarching framework of the Department of Defense's (DoD) Science and Technology joint planning and coordination process.**
- **Sensors and Automatic Target Recognition sub-area active in Technology Assessment and Requirements Analysis (TARA) days**
- **CoIs were established in 2009.**
  - Covers 17 technical areas that span DoD
  - CoI structure distributes automated exploitation needs across multiple areas
  - Processing was originally included in the 2010 briefing to the ExCom
  - The 2016 ExCom endorsed re-establishment of Sensors and Processing CoI as the home for Processing. The 2016 Annual Sensors and Processing Meeting met to define roles and Taxonomy in April 2016.
  - During the 2016 Annual Meeting options were discussed on how to incorporate Processing back into the Sensors and Processing CoI.

Why should I care? / What's in it for me?

- **Provide a forum for coordinating S&T strategies across DoD**
  - Interact with colleagues across DoD
  - Share new ideas, technical directions and technology opportunities
  - Jointly planning programs
  - Measure technical progress
  - Report on the general state of health for specific technology areas of interest across services.
- **Leverage other service's efforts/investment**
- **Participation in CoI-sponsored activities (Contractor IRAD engagement FY16, RRTO a Search for nontraditional technologies, September 26-27, 2017 at Fort Belvoir Officers' Club, Sensors and Processing, AE, and EW CoIs)**
- **ATRWG Annual Meeting, December 2017**
- **Sensor and Processing CoI annual meeting March 7-8, 2018**
- **ATRWG Annual Meeting, October 2018**

Why Does the DoD Need To Invest in Sensors and Processing S&T?

- **Long range surveillance & targeting largely a military requirement. State-of-the-art capabilities provide U.S. a strategic advantage.**
  - Most of the sensor technology in the COI Is military specific, requiring DOD investment to improve the state-of-the-art, meet new and more demanding requirements
- **Consumer applications mostly very low cost/low performance:**
  - Consumer: Focus on lowest cost and packaging (point solutions). Examples:
    - Back-up sensor (ultrasonic)
    - Driving camera (infrared)


DoD does not invest in CMOS day TV cameras

  - Military: Focus on highest performance at acceptable cost (10-1,000X consumer thresholds)
- **Some high performance commercial sensors are adaptations of military technology, where the commercial business case does not justify extensive commercial S&T investment**
  - Example: cooled Forward Looking Infrared (FLIR) cameras for scientific and law enforcement applications
- **Some commercial markets do not want to do business with DoD**
- **DoD S&T community needs to maintain awareness and invest in adaptations of non-military sensor technology where possible**
  - Examples: IR driving cameras (industry invested heavily in signal processing)
    Acoustics program focuses on processing of acoustic signals not hardware (microphones)
  - Perform “smart buyer” function for Users and Acquisition community

Why CoIs?

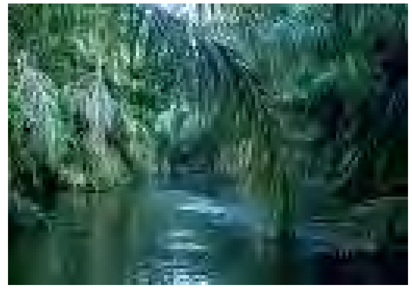
- **A forum for sharing new ideas, technical directions and technology opportunities, jointly planning programs, measuring technical progress, and exchanging advances in sensors and surveillance technology.**
- **Provide a forum for coordinating S&T strategies across DoD**
  - Interact with colleagues across DoD
  - Share new ideas, technical directions and technology opportunities
  - Jointly planning programs
  - Measure technical progress
  - Report on the general state of health for specific technology areas of interest across services.
  - Mechanism to encourage multi-agency coordination and collaboration in cross-cutting technology focus areas with broad multiple-component investment.
- **Leverage other service's efforts/investment**
- **Participation in CoI-sponsored activities (Contractor IRAD engagement in FY16, and RRTO a Search for nontraditional technologies, Sept. 26-27, 2017)**
- **A "coalition of the willing" (100% voluntary).**

Common Warfighter Needs Met By Sensors COI

- Survivable Broad Area Persistent Surveillance
- Target Detection, Recognition & ID at Standoff Ranges
- Force/Platform/Sensor Protection
- Target Tracking
- Early Warning
- Battle Damage Assessment (BDA)
- Precision Strike
- Resilient Architectures

Difficult Targets that Challenge Today's Sensors Processing Capabilities

- Submarines
- Small UAVs
- Mines
- People
- Enemy Sensors
- Low trajectory munitions
- Camouflage
- Underground
- Under Foliage
- Cruise and Ballistic Missiles



Low Contrast, Small, Fleeting Targets Challenge the Limits of Sensor Resolution & Signal-to-Noise – Processing of Signals Key Part of Systems to Detect, ID and Track these Threats

- **All made more difficult with additional emphasis on near peer competitor**

Overview of Sensor COI and Accomplishments

Personnel changes:

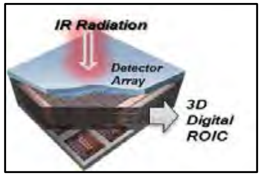
- No change of Chair, Steering Group, or RF, EO/IR, or ASM Sub-Group leads in the past year.

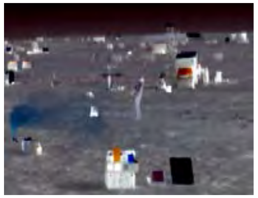
Sub-Group/Taxonomy changes:

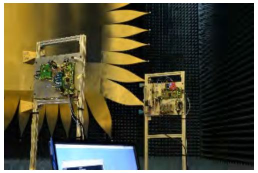
- Sensor Processing (SP) sub-group added, leads are Mr. D. Wiegmann and Ms. L. Graceffo.

Accomplishments:

- Digital ROIC design and fabrication to enhance dynamic range and on chip processing for multifunction applications.
- Large format/high performance LWIR HSI FPAs for detection of difficult concealed targets and material ID for tactical and intelligence applications.
- Low Cost Flexible Radar (LCFR) indoor range demonstration of a software defined synthetic aperture radar (SAR) mode in real time on an FPGA.
- Beginning to deploy ships with modern passive sonar
- Real time demonstration of air to ground sensor to analyst actionable intelligence determination.







State of Technology: Focus Areas

RF	EO/IR
• Autonomous multifunction RF, multi-platform sensor resource management, simultaneous mode scheduling, maximum use of diversities, simultaneous transmit and receive (STAR) apertures • Affordable ISR Initiative; C-SWaP of high dynamic range, wideband receivers, affordable AESA • Small Loitering ISR Munition (SLIM): software-defined radar/comms, low cost phased arrays, reduced processor-load algorithms	• Affordable, large format IR sensors (reduced pitch, alternative substrates, alternative material systems, sensitive across multiple atmospheric windows) • High performance sensors for difficult target detection, tracking, and ID (cross domain, multi-function, multi/hyperspectral). • High Performance Digital Readout Integrated Circuits (well capacity/gain) • High efficiency, multi-function, multi-band lasers
ASM	**Processing**
• Modern passive sonar to maintain acoustic superiority • High duty cycle active sonar • Deep water acoustic sensors that exploit low noise environments. • Long range synthetic aperture sonars (SAS) that discriminate targets	• RF and EO/IR target ID, cross-cueing and sensor fusion • Machine Learning and Artificial Intelligence algorithms for real time target detection, classification, recognition, identification, tracking, etc. • Target recognition for bistatic – monostatic radar • Autonomy focus that automates the battlefield with advanced algorithms, augmented reality, autonomous vehicles (air and ground) and asymmetric vision

State of Technology: Investments

What gaps have the CoI identified as a risk areas needing further investment?

- Cross-service, Multi-static Radar Systems have the potential to increase system performance, Survivability, and affordability.
  - Leveraging multiple assets to improve radar related asks such as (search, detect, track, etc.) is accomplished y using correlation gain to reduce measurement error.
  - Additional resources could be used to establish a cross-service multi-function radar experimental environment. An ARAP proposal is being submitted.
- Artificial Intelligence/Machine Learning are key DoD technologies. Commercial activities will continue to develop AI/ML approaches, but military specific applications and military data sets to feed those applications need future investment.

Where Is One Service Leveraging Investments From Another Service Or OSD Activity To Make An Investment?

- DROICS: Army and Air Force leveraging DARPA investments and collaborating on DROIC enabled image and signal processing.
- LWIR HSI FPAS: Army and Air Force leveraging each other's investment in Phenomenology, Component Development (FPAS), and Concept Exploration. Army and Air Force collaborated (with NATO Partners) on the Strongbow HSI phenomenology collection in Canada.
- Tri-services leveraging high speed optical interconnect seedling funded by USD(R&E) and being executed at the AIM Photonics National Manufacturing Institute.
- Army Leveraging Navy And Air Force III-V FPA Based Sub-system/System Developments (CESARS And JSF EODAS).

Future Direction

Initiatives or best practices to accelerate R&D process

- Sept. 26-27 2017, the Sensor & Processing CoI, in conjunction with the Advanced Electronics and Electronic Warfare CoIs hosted a Rapid Reaction Technology Office (RRTO) Solutions meeting at Fort Belvoir. The purpose of the event was to help Tri-Service S&T representatives identify non-traditional technology innovations to support emerging operational needs.

Cross-CoI, Industry, Academia Opportunities for Collaboration

- Military Sensing Symposium:
  - Parallel MSS on Battlefield Survivability and Discrimination (BSD); Passive; Detectors; Materials: March 19-23, 2018, Gaithersburg, MD
  - Tri-Service Radar Conference, June 25-29, 2018, Monterey, CA
  - Joint (National, BAMS, NSSDF, ATAC), Oct. 23-25 2018, Gaithersburg, MD
  - Active/EO- IRCM Conference, Los Angeles, CA, May 14-16 2019 Tentative
- Annual Sensors and Processing CoI coordination meeting: March 7-8 2018, Fort Belvoir, VA.
- ATRWG Conference, October 2018, Fort Belvoir, VA (Tentative)

EO/IR Technical Challenges

- **Affordable, large format IR sensors (reduced pitch, alternative substrates, alternative material systems, sensitive across multiple atmospheric windows)**
- **High performance sensors (multi-band, extended cutoff, low noise, reduced pitch, higher operating temps)**
- **High Performance Readout Integrated Circuits (well capacity/gain)**
- **Day/night, color, HD low light cameras and novel low noise pixels enabling HD color imaging**
- **High efficiency multi-band lasers and sources**
- **Multi-function lasers**
- **3D imaging and processing**
- **Light-weight, low volume optics and image formation strategies**
- **Atmospheric Mitigation & Image Formation Algorithms**

RF Technical Challenges

- **Long Stand-Off** - Power-aperture, low slant angle, resolution, clutter, obscuration, slow asset repositioning, simultaneous field of view, multi-static radar
- **Persistent Stand-In** - Tx: Novel waveforms and adaptive use of contested sensing spectrum Rx: Passive Multi-Mode (PMM) radar, MIMO, distributed radar processing
- **Open System Arch** - Maximum interoperability, autonomous multifunction RF, multi-platform sensor resource management, simultaneous mode scheduling, maximum use of diversities, simultaneous transmit and receive (STAR) apertures
- **Advanced Components** - High dynamic range, wideband receivers, affordable AESA components for SWAP-constrained payloads (low prime power, high performance), improved power added efficiency, element level-DREX
- **Expendable RF** - Small Loitering ISR Munition (SLIM): software-defined radar/comms, low cost phased arrays, reduced processor-load algorithms
- **Concurrent EP** - Radar/Electronic Protection, operate in spectrally crowded environments

ASM Technical Challenges

Ocean Acoustics

- High performance two dimensional passive arrays that exploit az/el variations in the noise field
- Small low power sonar and acoustic interceptors that detect acoustic threats
- Deep water acoustic sensors that exploit low noise environments
- Long range synthetic aperture sonars (SAS) that discriminate targets

Air Acoustics

- Detection of low SNR targets for ASW passive sonar systems
- Robust signal classification in complex environments and after extended propagation ranges
- Technologies to replace larger arrays with small-aperture microphone arrays or particle velocity sensors

Seismic

- Ground conditions are unknown and asymmetric due to geology variability
- Significant clutter near urban areas
- Shallow seismic susceptible to airborne acoustics
- Timely access to data from ocean bottom seismometers in tactically and strategically relevant environments

Magnetics

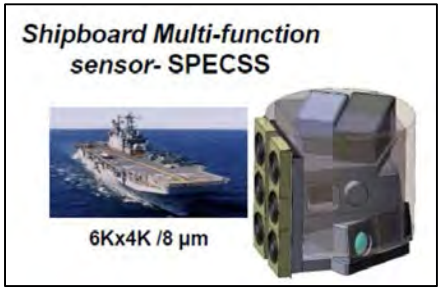
- Low SWAP-C magnetometers
- Magnetometers on unmanned platforms
- Low cost magnetometers for wide area coverage

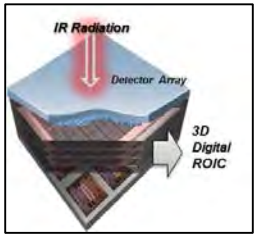
Processing Technical Challenges

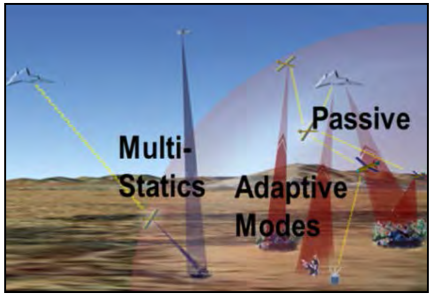
- **Complex Urban Environments**
- **High Confidence and False Alarms**
- **Multimodal and Multi-looks**
- **Training Costs**

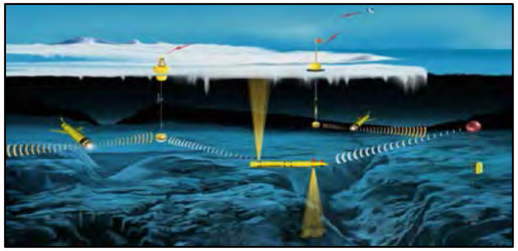
Cross Service Collaboration Efforts

- **Electro Optical / Infrared**
  - Degraded Visual Environments (DVE) – Fusing RF and EO multispectral technology by collaboration
  - Digital Readout Integrated Circuits (DROICs) – Developing real-time multi-function processing capabilities of DROICs. Applications include IR search and track, threat detection, 360 SA and pilotage/DVE
  - III-V Focal Plane Arrays (FPAs) – Tri-Services collaboration on development of an affordable large format FPA at higher operating temperatures (HOT)
- **Radio Frequency**
  - Target Detection in Concealed Environments (Foliage and Ground Penetration); combining RF and Ladar yielding significant ID capability
  - Multi-Mission/Multi-Function (M2/MF) RF Sensing HW/SW for improved capability and survivability against advanced jammers and IADS
  - Multi-Intelligence Sensor Processing, Exploitation and Processing (Multi-Int PED) for detect, track, and ID of mobile targets and enhanced intel capabilities through national to tactical tipping and exploitation.
  - Anti-Access/Area-Denial (A2/AD)Common Open Standards
- **Acoustic, Seismic, and Magnetic**
  - UUV based acoustic sensing efforts





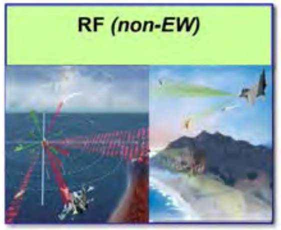


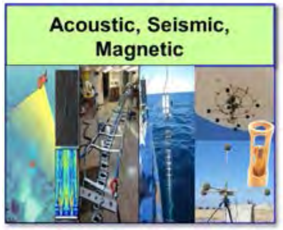


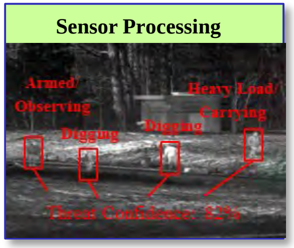
Overview of Sensor COI Portfolio Changes

Roadmap Trends for Sensors and Processing (No changes to service's technology strategies)

- (EO/IR) Digital Read-Out Integrated Circuits becoming ROIC of choice and are being integrated into production offerings fielded systems with new capabilities
- (EO/IR) Investments in III-V Focal Plane Array technology have resulted in transitions to fielded systems (JSF EODAS)
- (EO/IR) Emphasis on affordability and cost reduction aligned to the vision of expendable sensors (HSI and image-forming sensors)
- (RF) Cross-service Focus to Affordable ISR (5-7 Focus) [FY17 AF lead Phase 0 trade study included multi-domain (air, land, surface, sub-surface] ISR Collection scenarios and analysis of alternatives assessment for multi-function C-SWAP constrained ISR concept platformS
- (ASM) Major investments in submarine sonars are driving efforts to optimally exploit an expanded sensor base.
- (SP) Synthetic and Hybrid Training data being matured to try and leverage commercial advances in Deep/Machine Learning for ATR
- (SP) Significant Investments in Machine Learning and Artificial Intelligence to develop automation superiority. Office of Director of National Intelligence (ODNI) is investing significant funds in Machine Learning and Artificial Intelligence (Project Maven) with spin-off to the DoD AI Community in CY2018.







Take Aways

- Sensors and Exploitation Processing CoI is functioning as an effective Reliance 21 vehicle with good cross service collaboration in components and processing.
- The portfolio continues to be solid, particularly given the current fiscal environment.
- Good collection of CoI collaboration opportunities were executed in CY 17 with more planned for CY 18.
- Addition of Processing sub-group will assist in identifying cross service collaboration opportunities as well as leveraging of emerging thrusts from academia and non-traditionals in the sensor processing technology space.
- Continued resourcing of Applied Research for the Advancement of S&T Priorities (ARAP), and Seedling opportunities is an effective tool to stimulate additional tri-service collaboration.

Conclusion

- **The Sensor COI will continue to act as OSD's principal Reliance tool for technical and programmatic de-confliction and coordination of efforts under the purview of the Sensors CoI.**

- **The CoI stands ready to work with industry to share gaps, technical challenges, and technical directions (subject to the limitations of the FAR, disclosure policy, and other DoD directives).**

- **The CoI membership will also seek to identify key Contractor IRAD efforts and leverage to the maximum extent possible across the department.**

Qs and As

QUESTIONS

Defense Technical Information Center (DTIC)

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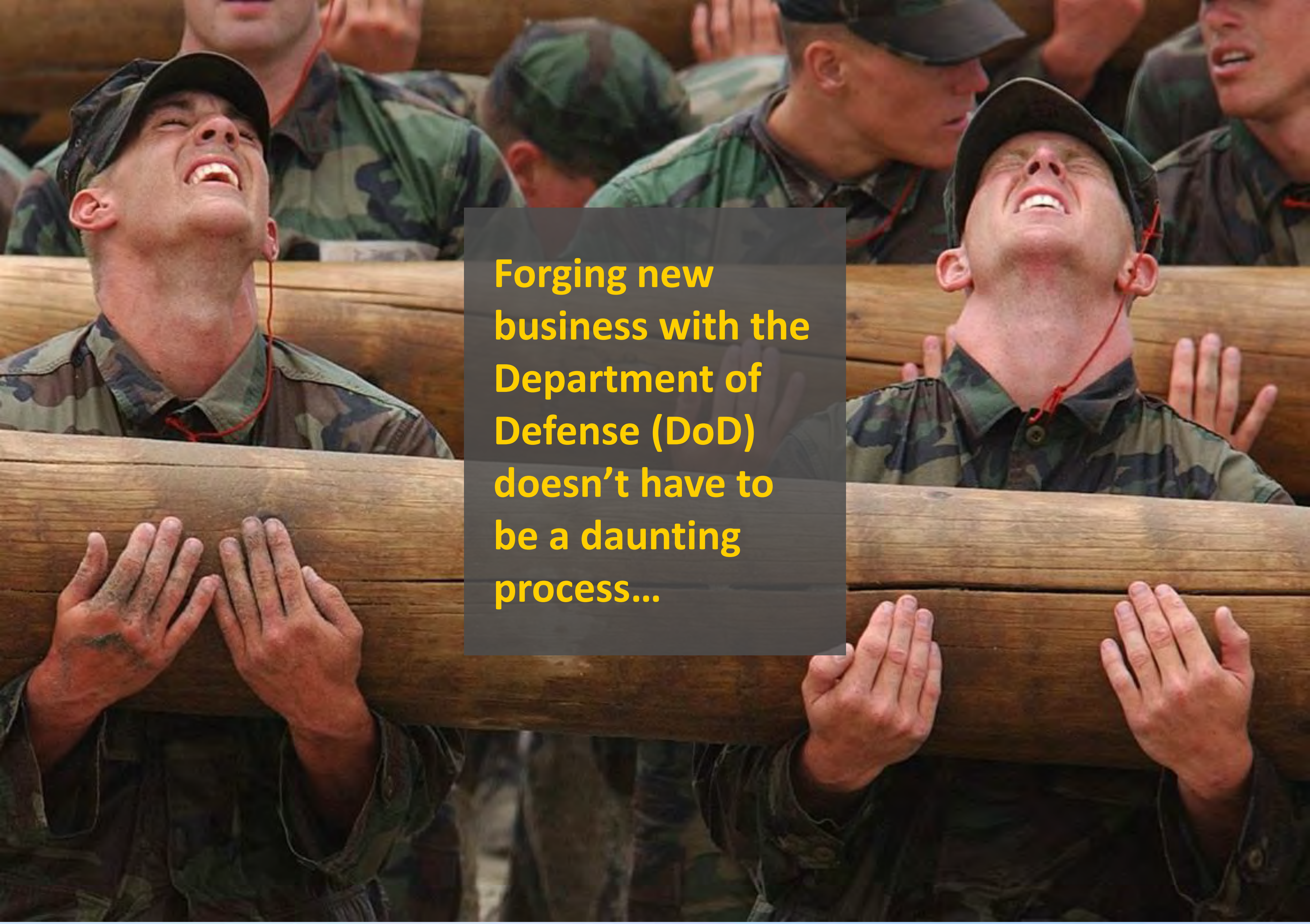
The world's finest military depends on cutting-edge technology and support from industry.



Forging new business with the Department of Defense (DoD) doesn't have to be a daunting process…

DTIC: An indispensable resource for industry/small business owners.

www.dtic.mil

- S&T Research Records Collection
- Defense Innovation Marketplace
- Combatant Command (CCMD) Classified Reading Room
- International Agreements Database (IADB)
- IACs
- Submit to DTIC
- Journal of DoD (R&E)

Build on completed research, understand where others encountered dead ends, avoid duplication of effort, save time and money.

www.dtic.mil

S&T Research Records (via DTIC's Public Search Collection) **features:**

- **Over 4 million Technical Reports and Small Business Innovation Research (SBIR) reports**
  - **Tens of thousands of in-progress reports**
  - **Thousands of current IR&D reports**
  - **Hundreds of journal articles on DoD-funded SBIR/STTR projects**
  - **Defense Funded**

Monitor DoD investment priorities and plans; industry news & events; technology trends; Combatant Command (CCMD) capability needs; new partnerships or business opportunities.

www.dtic.mil

Defense Innovation Marketplace

- **DoD R&E Business Opportunities**
  - DoD R&E Strat Guidance Docs
  - R&E-related solicitations, events
- **Most current Technology Interchange Meetings**
- **IR&D Secure Portal**
- **Independent Research & Development (IR&D) Secure Portal**
  - Share IR&D projects with S&T/R&D and acquisition personnel

CCMD Classified Reading Room

- **Physical location/secured room** located @ **DTIC** in Fort Belvoir, VA
- For access to **restricted capability gap needs of the CCMDs**, apply at **www.dtic.mil.**
  - Active Security Clearance of secret or higher & U.S. citizenship required
  - Limited to Industry/Government/ DoD
  - Min. of 10-business days processing
  - CCMDs approve access to their respective classified needs

International Agreements Database (IADB)

- **Leading role in Pentagon's efforts to leverage global research**
- **Search 4000** proposed, existing, and passed **DoD International Agreements**
- **Critical international S&T knowledge** needed to prepare critical materials for engagements with **Allied and Partner Nations**
- **Efficiencies gained** from **aligning resource efforts** with **international partners** for research and new technologies

Monitor DoD investment priorities and plans; industry news & events; technology trends; Combatant Command (CCMD) capability needs; new partnerships or business opportunities.

www.dtic.mil

Information Analysis Centers (IACs)

- **Cyber Security & Information Systems (CSIAC)**
- **Defense Systems (DSIAC)**
- **Homeland Defense & Security (HDIAC)**

❖ Collect technical info / create technical reports

❖ 4 hours FREE research & tech assess

❖ The Information Analysis Centers (IAC) provide access to R&D contract vehicles to perform research & analysis at any magnitude (from a few thousand to hundreds of millions of dollars) across the range of DoD R&D interests at a low rate of 1.2% (FY18). See the IAC website for more details: http://iac.dtic.mil/

❖ DTIC / IAC Field Advisor Program

Collaborative Sites

DTIC's R&E Gateway on NIPRnet and SIPRnet provides shared workspaces for collaboration, information-sharing and professional networking.

- **DoDTechSpace**
- **DoDTechipedia**

Why Submit to DTIC?

➢ Cost Savings

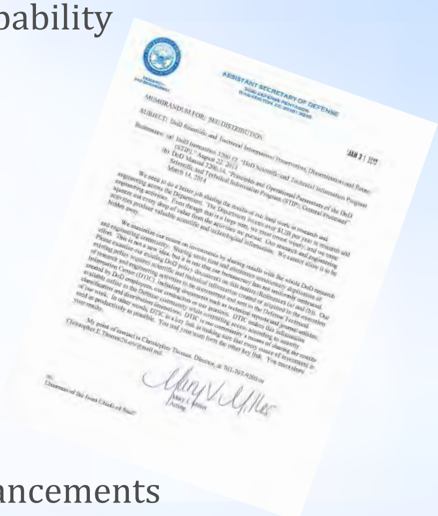
- ✓ Reduce costs, leverage results, eliminate duplication, save time & money for DoD-funded projects

➢ Preservation

- ✓ Enduring availability to S&T knowledge = enduring potential for future innovative capability

➢ Access

- ✓ 24/7 availability to largest body of S&T and R&E knowledge in DoD
- ✓ Facilitate sharing, while safeguarding national security, through a multi-level secure system for controlled dissemination


ASSISTANT SECRETARY OF DEFENSE

MEMORANDUM FOR: SEE DISTRIBUTION

➢ Visibility

- ✓ Reports and Journal Articles are available to DoD colleagues enabling sharing and transferring of STINFO in pursuit of future capabilities
- ✓ Leveraged research can result in innovative work leading to future technological advancements
- ✓ Facilitate intellectual property management of federally funded public domain and government purpose rights works = transparency for taxpayers, visibility for researchers—more readers, higher citation impact

➢ Compliance

- ✓ DoDI, DoDM, DoD Directive, DTM, WH and OSD(AT&L) Memorandums

Capability for the Warfighter; now and for the future

Journal of DoD Research & Engineering

- ➢ Journal of DoD Research & Engineering:
- ✓ Semi-annual publication
- ✓ Published at the classified/controlled unclassified level
- ✓ Fully supported by Ms. Mary Miller and the office of the ASD(R&E)

- ➢ Researchers, scientists, and engineers working in our labs on limited & classified projects have little opportunity for peer reviewed status of their work

- ➢ This DTIC published journal provides a protected venue for the DoD S&T community to share their work

- ➢ Looking for support from the Communities of Interest, S&T Deputies, and Defense Labs:
- ✓ Articles from our researchers, scientists, and engineers
- ✓ SMEs who can provide peer review support
- ✓ Senior leaders interested in Advisory Board opportunities

https://www.dodtechipedia.mil/dodwiki/x/DgCeEQ

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United States Transportation Command (USTRANSCOM) Challenges & Opportunities

Mr. Lou Bernstein, TCJ5-GC

Research, Development, Test & Evaluation (RDT&E) Program Director

22 March 2018

Distribution Statement A: Approved for Public Release

Overview

- USTRANSCOM 101
- RDT&E Program Overview/Process
- Technology Focus Areas/Challenges
- Overview of Select Current Initiatives

Mission

DPO

USTRANSCOM DISTRIBUTION PROCESS OWNER

SDDC

MSC

AMC

JTRU

JECC

USTRANSCOM Provides Full-Spectrum Global Mobility Solutions & Related Enabling Capabilities for Supported Customers' Requirements in Peace and War

The Global Distribution Network

USTRANSCOM Assets/Team

RDT&E Program Foundation

Program Element (PE) ($M) – Air Force	FY18	FY19	FY20	FY21	FY22	FY23
Deployment & Distribution (PE0604776F)	26.22	28.35	28.94	29.44	30.05	30.60

- **As the Joint Deployment & Distribution Coordinator, USTRANSCOM actively pursues collaborative partnerships to:**
  - Rapidly integrate deployment and distribution capability enhancements to improve Joint Deployment & Distribution Enterprise (JDDE) logistics effectiveness & efficiency
  - Provide tangible cost savings/avoidances
- **Goals:**
  - Develop and deploy joint, relevant technologies to improve Warfighter support while reducing costs
  - Improve precision, reliability, visibility and efficiency of the DOD supply chain
  - Assure superior strategic, operational and tactical mobility support

~$523M Services/Agency/OSD leveraged; **90.8%** Transition Rate (DOD metric is 30%)

DOD Levels of RDT&E Budget Activity (BA)

- Basic Research (BA1): Systematic study directed toward a greater understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products
- Applied Research (BA2): Systematic study to gain knowledge necessary to determine the means by which a recognized and specific need may be met
- Advanced Technology Development (BA3): Includes all efforts that have moved into the development and integration of hardware for field experiments and tests
- **Demonstration and Validation (BA4): Includes all efforts to evaluate integrated technologies in a realistic operating environment to assess performance or cost reduction potential of the advanced technology**
- Engineering and Manufacturing Development (BA5): Includes projects in engineering and manufacturing development for Service use which have not received approval for full rate production
- RDT&E Management Support (BA6): Includes R&D efforts directed toward support of installation operations required for general R&D use. This includes test ranges; military construction; maintenance support of laboratories; operations and maintenance of test aircraft and ships; and studies and analysis in support of a R&D program
- Operational System Development (BA7): Includes projects in support of development acquisition programs or upgrades still in engineering and manufacturing development. These projects have received Defense Acquisition Board or other approval for production or for which production funds have been included in the DOD budget

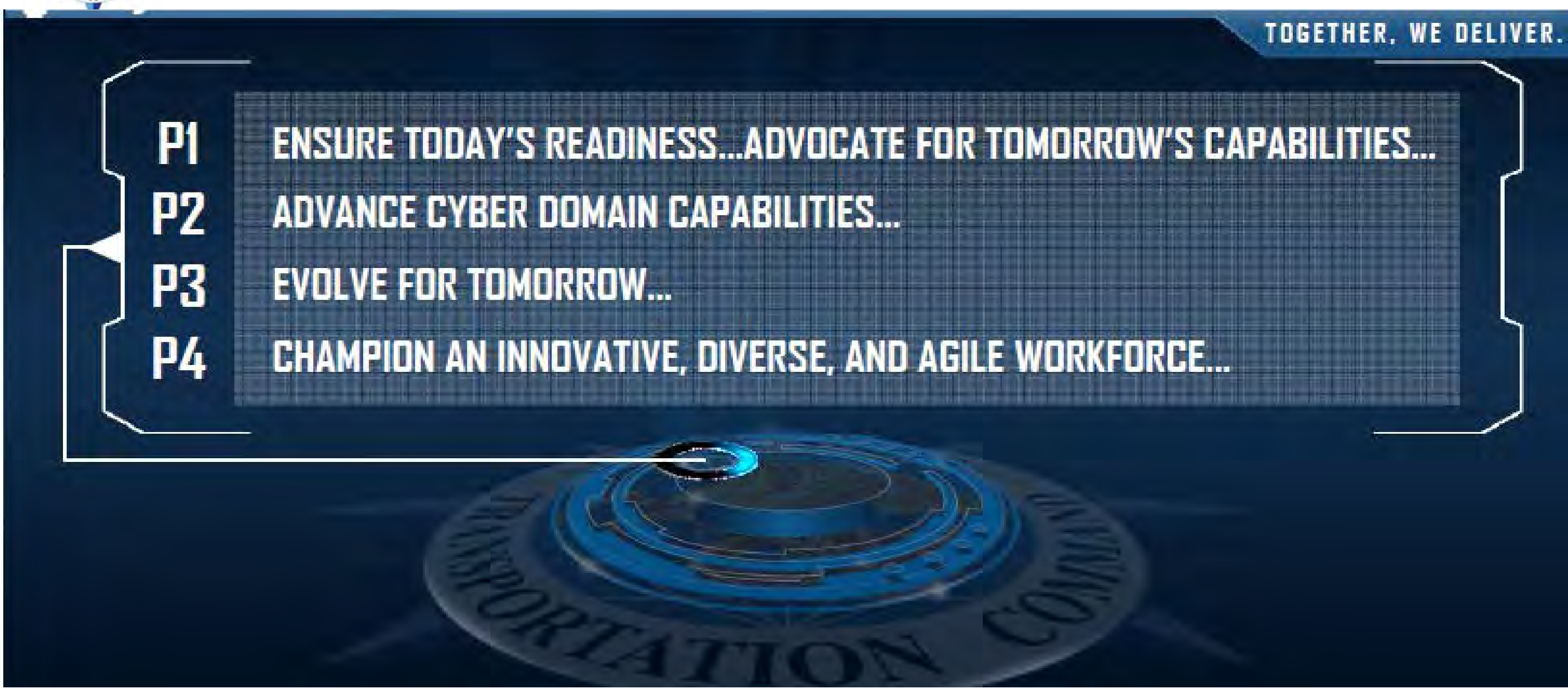
USTRANSCOM Budget Line Shifted from DLA to USAF in FY17

Technology Readiness Levels (TRL)

USTC RDT&E Program Focus

- TRL 1: Basic principles observed and reported
- TRL 2: Technology concept/application formulated
- TRL 3: Analytical or experimental proof of concept
- TRL 4: Component(s) validated in normal lab environment
- TRL 5: Component(s) validated in realistic lab environment
- TRL 6: System or subsystem prototype in relevant environment
- TRL 7: System prototype demonstration in operational environment
- TRL 8: Actual system qualified through developmental T&E
- TRL 9: Actual system proven through operational T&E

Commander's Priorities



JDDE Enduring Challenges

FY 20 Focus Areas

- **Cyber and Electronic Security**
- **Big Data**
- **End-to-End Visibility**
- **Sea Basing Technologies/Logistics-Over-The-Shore**
- **Delivery Technologies**
- **Rapid Distribution Technologies**
- **Rapidly Establish Points of Debarkation**
- **Distribution Planning and Forecasting**
- **Predictive Forecasting**
- **Secure Collaboration with Commercial Partners**
- **Cloud Computing**
- **Electronic Data Interchange**
- **Resilient Communications**
- **Transportation Node Optimization**
- **Modeling**
- **Supply Chain Sustainment Simulation Tools**
- **Adaptive Planning and Execution**
- **Interoperable, Multi-modal Patient Movement**

- Knowledge Management
- Automatic Identification Technology
- Risk Assessment
- Process Management and Business Rules
- Information Science and Technology
- Distributed Global Mobility C2
- Information Visualization
- Cross-Domain Information Exchange & Collaboration
- Joint Retail Inventory Interoperability
- Human System Interface
- Fuel Efficiency
- Advanced Mobility Aircraft
- Mobility Aircraft
- Convoy Security
- Aircraft Survivability
- Force Protection
- Autonomous Approach and Landing Guidance
- Opportune Landing Site Identification
- Standardized Intermodal Containers/Pallets

FY20 New Start Solicitation Process Timeline

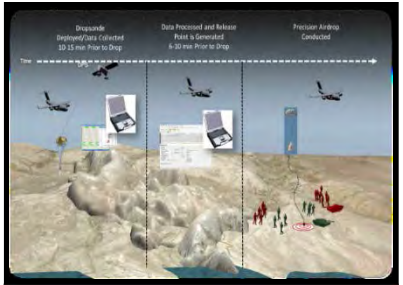
- Revised Operational/Technical Challenges
  - ✓ 27 Oct 17 - 17 Jan 18: Changes submitted by JDDE Community
  - ✓ 24 Jan – 20 Feb: Reviews by multiple boards
  - ✓ 26 Feb: Commander USTRANSCOM approved
- ✓ 1 Mar: FY20 Solicitation Released (http://www.transcom.mil/cmd/associated/rdte/)
- 30 Mar: Phase I White Papers Due
- 2-27 Apr: Phase I Evaluation Period
- 30 Apr: Phase II Selection Notification
- 29 Jun: Phase II Proposals Due
- 2 Jul – 14 Aug: Phase II Evaluation Period
- 28 Aug – 30 Sep: Vet Draft FY20 New Start Investment Plan via multiple boards
- 16 Oct: TRANSCOM Oversight Council (★★) FY20 Investment Plan Review
- 31 Oct: TRANSCOM Corporate Board (★★★★) FY20 Plan Approval
- 31 Oct: Notification of Final Selection

Partners & Collaboration

Select Current Initiatives

Autonomous Aerial Insertion and Resupply into Dense, Urban, Complex Terrain

Autonomously insert sensors, munitions, unmanned ground vehicles & supplies into an urban environment



Dropsonde Optimization

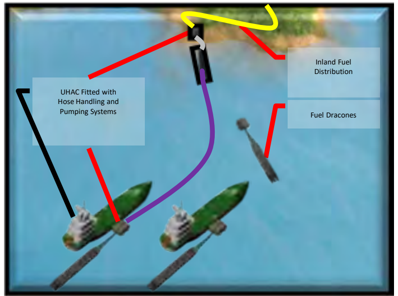
Pursue single pass airdrop capability to enhance delivery aircraft/crew safety

Preamble Initial Look Leading to Accelerated Results/Port Improvement via Exigent Repair

Rapid repair capability to fix a damaged pier

Mini-Robotic Dredge

Expeditionary dredging capability to support improved access to the shore



Expeditionary End-to-End Fueling Concept

Modular pumping system to address over-the-shore & inland distribution needs and inform future Service Programs of Record

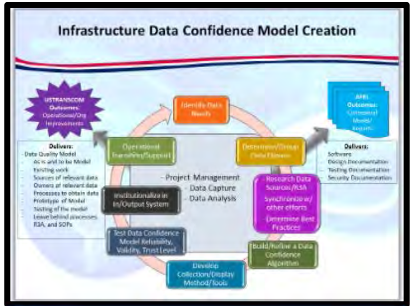
Current Initiatives

Strategies for Enterprise Metadata Management

Implementation strategies for enterprise-wide metadata management

Sprint to Big Data/Data Lakes

Explore repository for structured & unstructured data that preserves data fidelity for real time analysis



Infrastructure Information Confidence Model with Automation

Info collaboration process provides a confidence assessment

Analytics Driven Command Decision Support

Enhance organizational decision making by providing a holistic methodology

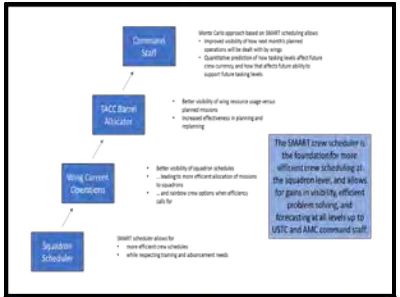
End-to-End (E2E) Distribution Modeling

Enhance E2E modeling/analysis to optimize force projection, distribution and redeployment

FY18 New Starts

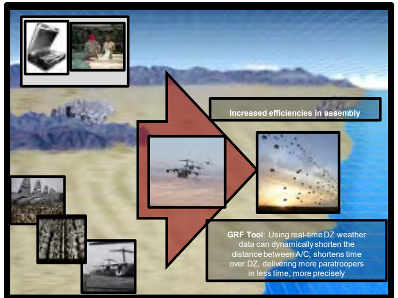
Autonomous Drone Delivery from Airdrop Systems

Develop air-droppable Unmanned Aerial System (UAS) capability



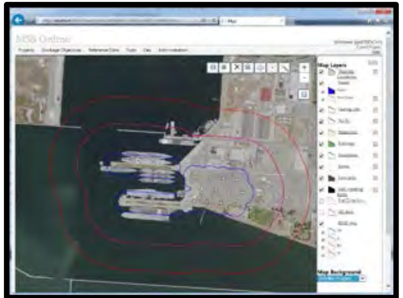
Synchronizing Mobility Allocations and Resources for Transportation

Squadron scheduling/allocation/collaboration crew utilization forecasting tool



Advanced Planning for Global Response Force

Analytical/visual tools to provide joint warfighting planners the ability to plan missions



Web Based Seaport Explosive Safety Planning

Develop an ammunition storage and explosive safety application

RDT&E Info (http://www.transcom.mil/cmd/associated/rdte/)

USTRANSCOM
United States Transportation Command

Enterprise Readiness Center | Doing Business with USTRANSCOM | Moving Passengers and Cargo | Defense Transportation Regulations

Incoming Personnel | Command Information | Associated Websites | Freedom Of Information Act | Customer Feedback

Research Development Test & Evaluation

The USTRANSCOM Research Development Test & Evaluation program explores innovative joint technologies that address Distribution Process Owner (DPO) and Defense Transportation System (DTS) capability gaps.

Our History

On 16 September 2003, the Secretary of Defense designated United States Transportation Command (USTRANSCOM) as the Department of Defense (DOD) Distribution Process Owner (DPO), responsible for the overall efficiency and interoperability of distribution-related activities supporting the deployment, sustainment, and redeployment of forces conducting the full range of military operations. The paramount goal of the DPO Science and Technology program is to enhance support to USTRANSCOM's customers in peace and war through exploration of transformational distribution technologies. The S&T program fosters development of new bodies of knowledge on distribution, then enables evaluation and integration of the resulting transformational approaches.

As the DOD's DPO, USTRANSCOM's business enterprise stretches from the point at which warfighting materiels have been procured to their point of use in a theater of operations--anywhere in the world. This "global supply chain" requires close synchronization between operational planners and the materiel, personnel, and facilities that support the warfighting customer. Often the system must respond with only a few hours' notice. For capital assets like aircraft and tanks, the supply chain also has a retrograde requirement--to return items for employment in future operations. Movement and sustainment of personnel are also missions USTRANSCOM executes.

USTRANSCOM's mission is unique in the fact that it does not direct all the organizations and agencies that accomplish the missions of mobilization, deployment, sustainment, employment, and redeployment. Rather, as an orchestrator, USTRANSCOM must collaborate rapidly, with many partners, to ensure the supply chain operates effectively and efficiently.

In recognition of the vastly complex business of DOD distribution, USTRANSCOM received its first increment of Research, Development, Test and Evaluation (RDT&E) funds in fiscal year 2006 to

Navigation

- RDT&E Home
- Ongoing Projects
- References
- Capabilities
- FY19 Project Solicitation (Government Only)
- Related Links
- Program Training
- Frequently Asked Questions

Backups

JDDE Challenge Descriptions

- **Cyber and Electronic Security:** USTRANSCOM and its components must be able to defend its information, detect and mitigate cyber and electronic threats against mobility platforms, networks, and C2 systems to continue uninterrupted operations. This requires a platform independent capability to secure deployment/distribution information resident in or traversing low assurance info networks/environments. This includes anomaly detection and predictive analysis techniques/tools (e.g. artificial intelligence (AI), machine learning (ML) & cognitive computing (CC)) to dynamically assess future threats, attack vectors, and attacker intent and anticipate actions before they happen (i.e., the capability to defeat an attack before it happens, instead of having to react to it as it occurs). Capability must allow for assured, secure and trusted communications protected with Federal Information Processing Standard (FIPS) 140-2 compliant cryptography while also robustly withstanding or adapting to direct electronic attack. Solutions must require minimal management/infrastructure overhead, be able to integrate into existing DOD and commercial information systems, and leverage government-owned/operated capabilities to the maximum extent possible. Capability must enhance government collaboration in its ability to predict, detect, analyze, assimilate, mitigate, and deter cyber and electronic threats.

JDDE Challenge Descriptions

- **Big Data:** USTRANSCOM lacks the ability to provide authoritative data at the Speed of War at the right time and place to drive informed decisions and operational effectiveness. Today's data environment has many independently managed data sources and no common standards, resulting in inconsistent outcomes that drive increased risk to operations and decision making. Ability to manage data as a strategic resource is foundational to USTRANSCOM's transformation to a data driven command and underpins implementation of business reform initiatives such as the implementation of a Transportation Management System. USTRANSCOM requires the definition, evaluation, and proposal of tools and implementation methodologies for Machine Learning (ML) and Artificial Intelligence (AI) solutions to support planning, analysis, operations, logistics, and real-time decision making for the JDDE. Includes but is not limited to advanced big data management; manipulation/integration of large data sets, discovery, predictive/ prescriptive analytics, and deep learning algorithm schema. Solutions must allow transparent access to, data mining of, and knowledge discovery in large, distributed, relational and non-relational databases; and ability to autonomously explore, analyze and identify trends and correlations between elements of large data sets to enhance data analytics and aid decision support, ML, AI, and cognitive computing.

JDDE Challenge Descriptions Continued

- **End-to-End Visibility:** Stakeholders throughout the deployment and distribution process require the ability to determine shipment status (where has it been, where is it now, and what condition is it in) through system access at the beginning of a movement through the various nodes to the final destination/point of need. The availability of this information contributes to inform decision making, confidence in the supply chain, and improve overall performance of the logistics processes. Although much asset visibility data resides in USTRANSCOM's Integrated Data Environment/Global Transportation Network Convergence (IGC) system, challenges remain in the effectiveness and efficiency of data capture, visibility of assets in-theater, and ability to create an enterprise view of the data. USTRANSCOM is interested in partnering with other organizations to provide solutions to overcome challenges relating to the integration of asset visibility data into appropriate business processes and system(s) to include, but are not limited to: advanced cryptology, distributed ledger technologies and artificial intelligence (AI).
- **Sea Basing Technologies/Logistics-Over-The-Shore:** Technologies and enablers to enhance the Joint Force Commander's flexibility to deploy and employ from/through a joint sea base as well as deliver and sustain warfighting capabilities at the point of effect. Enhancements should minimize the need to build up a logistics stockpile ashore and permit the forward positioning of joint forces for immediate employment. This includes autonomous technologies that facilitate the trans-loading and/or transporting of supplies and equipment in a sea base operation within a degraded or austere access environment. Solutions could include stealth capabilities to include under surface solutions, masking or other capabilities to minimize risk to the asset and subsequent delivery operations. Solution should provide protective or defensive capability to ensure asset can deliver its requirements in a hostile environment.

JDDE Challenge Descriptions Continued

- **Delivery Technologies:** Seeking innovative solutions, to include autonomous, AI and ML technologies, that provide for the safe, accurate and timely delivery of joint forces and their sustainment within an Anti-Access/Area Denial (A2/AD) environment across a complex, distributed battlefield. This includes the re-supply of forces in austere conditions and in high threat areas, just two of the missions driving the need for more accurate and single-pass precision airdrop. This area applies to technologies to ensure survivability of aircraft and personnel on the ground while delivering cargo to a precise location within a high threat environment.
- **Rapid Distribution Technologies:** Concepts and technologies, to include autonomous, AI and ML, that improve the end-to-end flow of military unit equipment and cargo through ocean ports, aerial ports and intermodal inter-change points, to include autonomous capabilities and motion compensation interface platforms, for use with commercial cargo vessels to enhance cargo throughput of military unit equipment at sea.
- **Rapidly Establish Points of Debarkation:** The JDDE lacks the ability to rapidly assess, establish, and secure points of debarkation in an anti-access/area denial/contested environment to make the Joint force more expeditionary.
- **Distribution Planning and Forecasting:** There is a lack of collaborative distribution planning, based on an understanding of aggregate customer requirements, for optimizing the JDDE. Require solutions, to include AI/ML, that synchronize planning, forecasting and collaboration capabilities to ensure people, processes and assets are in place to execute planned operations.

JDDE Challenge Descriptions Continued

- **Predictive Forecasting**: Seeking solutions, to include AI/ML, to enhance the warfighter's ability to more accurately forecast future logistics requirements. The JDDE lacks the capability to predict maintenance and logistics requirements to enhance operational needs and optimize the supply chain, both forward and reverse flow. Where predictive maintenance/logistics forecasting capabilities exist, they are not linked (machine-to-machine) to distribution and logistics support responses.

- **Secure Collaboration with Commercial Partners:** USTRANSCOM has interest in exploring concepts which minimize risk to passenger and cargo movement data on commercial scheduled or chartered plane, ship, truck, bus, barge, and rail services leaving the Defense Information Systems Network (DISN) and shared with commercial partners. Capability must allow for assured, secure and trusted communications protected with Federal Information Processing Standard (FIPS) 140-2 compliant cryptography. Solutions must require minimal management/infrastructure overhead, be able to integrate into existing DOD and commercial information systems, and leverage government-owned/operated capabilities to the maximum extent possible. Goal is to securely collaborate and share information with commercial partners while ensuring confidentiality, integrity, and availability of U.S. transportation data residing outside of the DISN. Technologies of interest may include, but are not limited to: advanced cryptology, distributed ledger technologies and artificial intelligence (AI).

JDDE Challenge Descriptions Continued

- **Cloud Computing:** Explore, demonstrate and prototype a modern cloud computing environment which supports migration of multiple applications from current DOD environments. Goal is to show the utility of a vendor agnostic cloud computing environment which demonstrates the value of open architectures, modern tools and services while adhering to appropriate DOD Computer Network Defense Service Provider (CNDSP) security methodologies. Prototype environment must demonstrate and support these key areas of interest: business intelligence, analytics, rapid prototyping, performance dashboards, continuous development and testing, and containerization.
- **Electronic Data Interchange:** Today USTRANSCOM and its components use electronic data interchange (EDI) to communicate with its industry partners. EDI continues to evolve/mature to meet requirements. The move towards a service-oriented architecture provides additional opportunities for EDI that did not exist previously. There is a need to assess the current state of how EDI is being used and then evaluate opportunities, to include AI/ML, for future enhancement.
- **Resilient Communications:** The JDDE needs technical solutions that address resilient and secure communications and networks, information infrastructure protection, and engineered systems. The objectives of the research are to provide secure, resilient, and assured communications over both wired and wireless networks to include highly mobile networks.
- **Transportation Node Optimization:** Warfighters need a single integrated view of force movement and sustainment planning requirements to provide a continuous and optimal balancing of total demand and capacity from plan inception to mission completion. Looking for technologies, to include AI/ML, to provide desired capability.

JDDE Challenge Descriptions Continued

- **Modeling:** Budget uncertainty and the evolving global mobility environment drive the need to modify our business processes, equipment and infrastructure. Currently USTRANSCOM is limited in its ability to weigh alternative courses of action and/or measure the effectiveness of the proposed changes. USTRANSCOM requires modeling & decision support tools to transform systems, programs and initiatives to ensure operational efficiency.
- **Supply Chain Sustainment Simulation Tools:** Joint simulation tools are poorly equipped to integrate sustainment flow modeling at the strategic and operational levels (wholesale and Service-level retail). Little capability exists to do unconstrained "what-if" supply scenarios without manual effort.
- **Adaptive Planning and Execution:** The planning community requires trained personnel, well defined processes and the essential technologies, including AI/ML, to ensure DOD's ability to rapidly develop, assess, adapt and execute plans in a dynamic environment.
- **Interoperable, Multi-modal Patient Movement (MM-PM):** Future contingency operations may result in significantly larger numbers of seriously injured casualties in denied areas, where PM requirements cannot be met exclusively with strategic airlift platforms and USAF Aeromedical Evacuation personnel and equipment. As a result, PM activities may be delayed, take place over longer distances, and require use of different transportation platforms and en route care capabilities than currently employed. USTRANSCOM needs viable solutions to provide MM-PM (air-, sea-, and ground-based) through the continuum of care to the CONUS support base under a variety of operational conditions (contested, permissive, cyber-degraded environments, etc.)

JDDE Challenge Descriptions Continued

- **Knowledge Management:** The operational and technical requirements of an effective near real-time global transportation network cannot be achieved through the application of legacy data-centric software design and development principles. Such a network calls for a degree of interoperability and a level of collaborative decision-support that is not available in any existing industry or government software environment of comparable scale. USTRANSCOM is looking to create an information-centric knowledge management layer on top of a data-centric Corporate Data Environment meta database layer.
- **Automatic Identification Technology (AIT):** AIT and automated information systems (AIS) are two of the basic building blocks in DOD's effort to provide timely asset visibility in the logistics pipeline, whether in-storage, in-transit, in-process or in-theater. AIT is used by a business AIS to capture the identity of materiel or packaging at each layer of consolidation to improve logistics processes. AIT also contributes to the track-and-trace capability within the Department's supply and distribution operations. USTRANSCOM is interested in partnering with other organizations in solutions, to include AI/ML, that improve logistics processes in a resource-constraint budget environment.
- **Risk Assessment:** There is a lack of available real-time risk assessment information for commanders and deploying units to rapidly determine acceptable levels of risk while en route to final destinations or to an intermediate staging locations. Interested in technologies, to include AI/ML, to address this gap.

JDDE Challenge Descriptions Continued

- **Process Management and Business Rules:** Joint process descriptions and business rules either do not exist or are unclear for many key deployment and distribution processes. A lack of well-defined, integrated process descriptions causes shipment delays, wastes resources, and undermines efforts to streamline the supply chain. The lack of business rules creates organizational and communication breakdown and precipitates a lack of control. Additionally individuals spend large amounts of time combing through mountains of data, often stored in silo enclaves, to assemble pertinent information for decision-makers.
- **Information Science and Technology:** This area involves the maturing of technologies that support state-of-the-art capabilities for the Warfighter in the analysis, assimilation, and dissemination of real and simulated digitized battlespace information. Interests include, but are not limited to: artificial intelligence (AI), machine learning (ML), cognitive computing (CC), distributed ledgers, advanced cryptology, course of action analysis, transportation planning and feasibility, embedded training, optimization and resource allocation solutions, collaborative technologies for distributed work environments, and data visualization. (removed – intelligent software agents (ISA)).

JDDE Challenge Descriptions Continued

- **Distributed Global Mobility C2:** C2 is the heart of successful military endeavors. For global mobility, C2 must be seamless regardless of theater of operation and/or customer being supported. This includes technologies that allow distributed C2 with mobile platforms (whether on land, sea or in the air) as well as technologies, including AI/ML, that provide the capability to replicate large databases, in a synchronized fashion, across a globally distributed network. In addition, these enclaves must be capable of working "off-line," then seamlessly rejoining the global network following combat or contingency degradation. Additionally, a capability that can plan, allocate and integrate logistics resources effectively and quickly on a global scale in support of the operational needs of the combatant commanders.
- **Information Visualization:** The Warfighter requires an integrated geo-referenced digital image map and dashboard view of logistics and transportation land, sea, air, and waterway operational information with drill-down capability into specific details such as capacity, capability and readiness of equipment, personnel, built and natural infrastructure and other assets at current or potential operating locations. Both mission planners and operators require this dual-faceted visualization of mission information to ensure diminished risk to warfighters and the mission.
- **Cross-Domain Information Exchange & Collaboration:** The Command requires a secure means to transition information across multiple classification domains to enable process improvements and reduce system requirements. This includes interaction/interoperability with military/civilian partners which has grown in importance and immediacy with the shift in focus toward home basing and homeland defense posturing. Closer interoperability between non-traditional actors is key to preparing and responding to threats in a truly global manner.

JDDE Challenge Descriptions Continued

- **Joint Retail Inventory Interoperability:** DOD cannot optimize customer requirements as it does not provide inventory interoperability across all Services and theaters. Information and material exchange across the DOD is inhibited by disparity of systems and insufficient interfaces. Inventory status and shipment information cannot be optimized due to lack of connectivity between the various components in supply chain.
- **Human System Interface:** Poor HSI is a major contributor to data integrity problems in business systems supporting the Defense Transportation System. There is a need for intuitive HIS (e.g. artificial intelligence (AI), machine learning (ML) and cognitive computing (CC) technologies) that reduces cognitive workload and lowers data entry errors for planners/port operators. Edit checks and suggested data correction alerts connected to DOD data dictionaries are needed to improve HSI input.
- **Fuel Efficiency:** Mobility assets are the largest consumers of fuel within DOD. Seeking technologies that reduce the dependence and/or consumption of fossil fuels while maintaining or improving speed, flexibility, range, and responsiveness in contested environments.
- **Advanced Mobility Aircraft:** Next generation mobility and air refueling aircraft to provide intra-theater maneuvers. This includes leveraging technologies used for hybrid and unmanned aircraft as well as next generation information, surveillance, and reconnaissance platforms. Advanced mobility aircraft capabilities will include future platforms that have more efficient airframes and engines, improved Command and Control (C2) and defensive systems capabilities, human integration and training, and have greater range, speed, payload, offload and access.

JDDE Challenge Descriptions Continued

- **Mobility Aircraft:** This challenge addresses anti-access concerns, ergonomically designed crew stations to reduce aircrew workload, assured global line of sight/beyond line of sight secure airborne voice and data communications to enable dynamic mission re-tasking while enhancing aircrew situational awareness, and modular concepts that allow for multiple configurations/missions with same/like airframe. Additionally, aging airlift and aerial refueling fleet present a need for technologies that increase the reliability of aircraft systems and structures to include electronic control systems and more reliable avionics packages that will increase aircraft availability and airlift capacity.
- **Convoy Security:** The Theater Commander requires a variety of available lift asset options at his disposal to optimize distribution and best mitigate risks depending on Mission, Enemy, Terrain and Weather, Troops and Support Available, Time Available and Civil Considerations. There is limited ability to provide support for multiple, small, widely-dispersed detachments. Additional efforts in RDT&E in Counter-small Unmanned Aerial Systems (C-sUAS) are needed to help provide security for ground convoy security.
- **Aircraft Survivability:** USTRANSCOM seeks advanced capabilities to increase aircraft survivability, self defense, and enhance aircrew situational awareness (SA). Affordable, open system technologies are needed to detect and counter the full range of surface-to-air and air-to-air threats, navigate in contested environments, fuse onboard and off-board data for aircrew SA, and counter directed energy threats to aircrew and sensors. Additional efforts in RDT&E for C-sUAS are needed to help provide A/C survivability during landing and departures in both CONUS, OCONUS and expeditionary locations.

JDDE Challenge Descriptions Continued

- **Force Protection:** Terrorism and asymmetric warfare pose an ever-present threat to our Nation's strategic mobility assets and their embarked cargo, equipment and personnel. This broad area of interest supports proposals to counter these types of threats. Of particular interest is the application of technology to create virtual borders at the point of loading, decontamination of transportation assets, and enhance seaborne and air cargo container standards. Screen cargo for smuggled goods as well as explosive, chemical, and biological threats. Technology interests are in those systems with stand-off, hand-held, robotic and/or unmanned vehicle inspection/detection capabilities (both on land and in the water) as well as fixed detectors to allow for the identification of potential threats before endangering personnel and/or resources. Interests include technologies that, when applied, detect access attempts and can be monitored for intrusion. Additional efforts in RDT&E for C-sUAS are needed to help provide A/C security while on the flight line and in hangers in both CONUS, OCONUS and expeditionary locations.
- **Autonomous Approach and Landing Guidance:** All-weather and lights-out taxi, take-off and landing capability, leveraging multiple technologies to include AI/ML for mobility aircraft operations from prepared and unprepared fields. Operations may require taxi, takeoff, and landing for aircraft under inclement weather conditions without assistance from navigation guidance systems that are commonly available at most U.S. airports.
- **Opportune Landing Site Identification:** All-weather airfield independence capability, leveraging various technologies to include AI/ML, focused on mobility aircraft to determine the security of a landing site for arrival and throughput operations without use of a pre-coordinated survey or on-site, ground party analysis.

JDDE Challenge Descriptions Continued

- **Standardized Intermodal Containers/Pallets:** Systems, including those that leverage AI/ML, that can be used by automated aircraft/ship loading/unloading systems, to include those designed to automatically scan standardized containers and pallets as they are on-loaded/off-loaded. Initiatives must be designed to increase cargo throughput by eliminating the requirement to handle cargo multiple times during shipping, reduce the requirement for multiple Materials Handling Equipment (MHE) systems, reduce need for additional ground personnel throughout the en route system, minimize the requirement to reposition MHE to support deployment/distribution, address pallet construction (current capabilities do not tie to shipments pallet break down, holding, frustration clearance, and costs), and improve the flexibility to be rapidly embarked on multiple expeditionary platforms.

DoD Research and Engineering Enterprise

19th Annual National Defense Industrial Association Science & Emerging Technology Conference

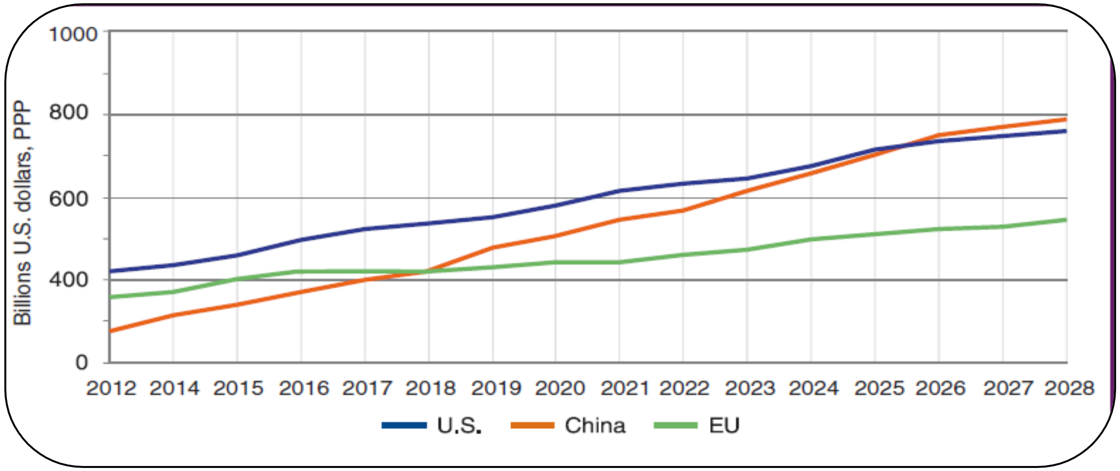
March 20, 2018

Mary J. Miller
Performing the Duties of Assistant Secretary of Defense for Research and Engineering

What Drives Us…

Threats Exist Across All Domains

- **Adversaries are moving to next generation capabilities across all domains: Air, Land, Maritime, Space, & Cyber**
- **Advanced materials, ranges, speed, and lethality seen across Russian and Chinese platforms – approaching/at parity**
- **Increased power projection**
  - We are now on-par or outranged by Russian and Chinese rocket and artillery capabilities
  - Russia and China continue to develop and modernize their extensive nuclear forces and long range precision-guided conventional weapons systems
- **China and Russia can hold U.S. and allied positions at risk**
  - Amplifying capabilities to detect, track, and target threats in varying conditions, larger volumes, and at greater distances, extend China's integrated air defense systems



"China's 2017 (R&D) growth is basically twice the percentage change and twice the dollar amount of change as the growth forecast for the U.S.'s 2017 R&D spending"

- 2017 GLOBAL R&D FUNDING FORECAST WINTER 2017
Industrial Research Institute, R&D Magazine

What we are doing about it…

Secretary of Defense Focus Areas

- Strengthen military readiness by increasing ***lethality*** of the force

- Strengthen our ***alliances*** and collaborate with allies whenever and wherever possible

- ***Reform*** the Department of Defense through budget discipline and increased accountability

"When it comes to security, no one goes their own way in this world alone. Security is always best when provided by a team."
– Secretary Mattis, Munich Security Conference, February 2017

National Defense Strategy

- Sec Mattis unveiled the first National Defense Strategy in 10 years
- First comprehensive review in a decade and first major policy document of the Trump administration
- Sec Mattis' intent is "to pursue urgent change on a significant scale"
- US military is refocusing on fighting other nations rather than terrorist groups
  - Means buying new equipment and embracing innovations so they reach the battlefield faster
  - Erosion of US Military advantage vis-à-vis China and Russia, if unaddressed, could ultimately undermine our ability to deter aggression

"America must be the world's dominant technological powerhouse of the 21st century."
– President Trump, speech on National Security, Sept. 7, 2016

Need to Modernize

- The U.S. is now challenged to strike any adversary at will
- Equal access to emerging technologies, such as autonomy, artificial intelligence and synthetic biology, will disrupt future conflicts
- The U.S. still possesses the best military, however our adversaries' deliberate actions mandate change in what we buy and how we operate
- We must develop new lethal capabilities and accelerate the pace in which we get that capability to the warfighter




To Modernize, We Must Regularize Mission-Focus Thinking

Modernization seeks to **win the enduring competition** of military superiority

BUILD ON THREE STRENGTHS

investing in our differentiators:

JOINTNESS

Fighting together towards a common goal

incentivize investment for interoperability

EMPOWER AT THE EDGE

Warfighter autonomy and mission command

decentralized execution across workforce and in garrison, supported by systems.

ALLIES AND PARTNERS

Leverage geography, assets, and capabilities of allies and partners to fight stronger together

A forethought across DOTMLPF

&

EXECUTE THREE PIVOTS

shifts in emphasis:

DOMINANCE TO LETHALITY

From all-domain supremacy to fighting through adversity and ability to target and prosecute red before they act

resilient kill chains over invulnerable systems

PREDICTABILITY TO SURPRISE

From polishing proven practices to expanding & continuously refreshing playbook of employment concepts & technologies

heterogeneity over uniformity

DELIBERATE INERTIA TO CONTINUOUS SPEED

From a steady pace seeking major advances to rapid block upgrades & capability enhancements

agility & adaptability over performance

driving towards a **mission-focused department**

Path to Modernization

- Establish a unifying goal within the Department – Networked Adaptive Multi-Domain Joint Battle
- Establish a deliberate set of resources for concepts that will be competitively selected to help achieve this goal
- Move to a mission-focused, portfolio managed schema, vice individual platform approach
- Focus on both new capabilities and operational constructs

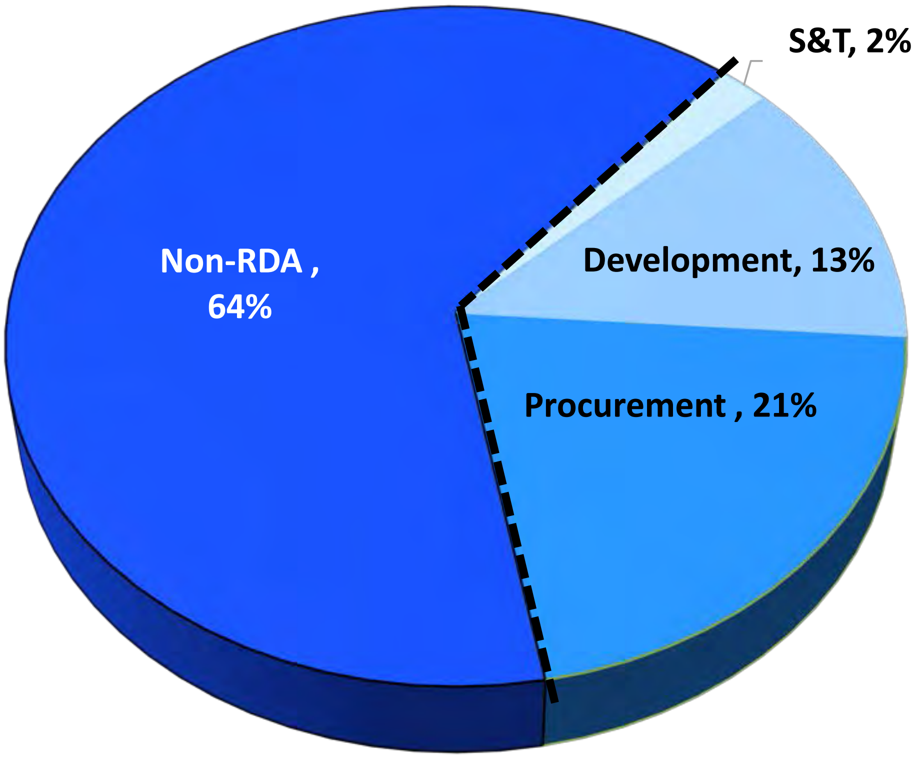
Networked Multi-Domain Joint Battle

Accelerate getting capability to the Warfighter

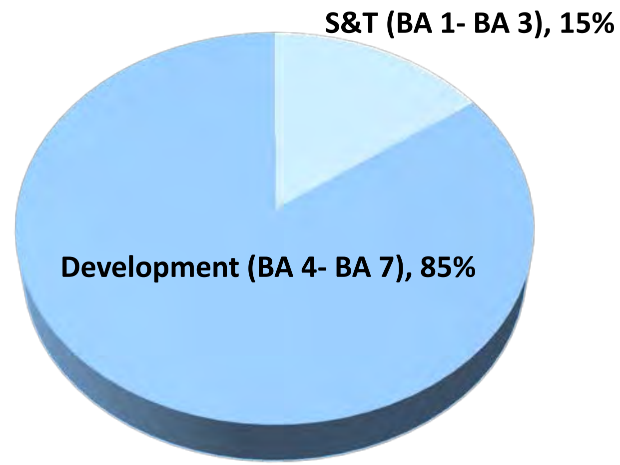
DoD Budget Status

PBR 2019 DoD S&T Funding In Perspective

DoD TOA (Base Only) = $617B



RDT&E (S&T + Development + T&E)



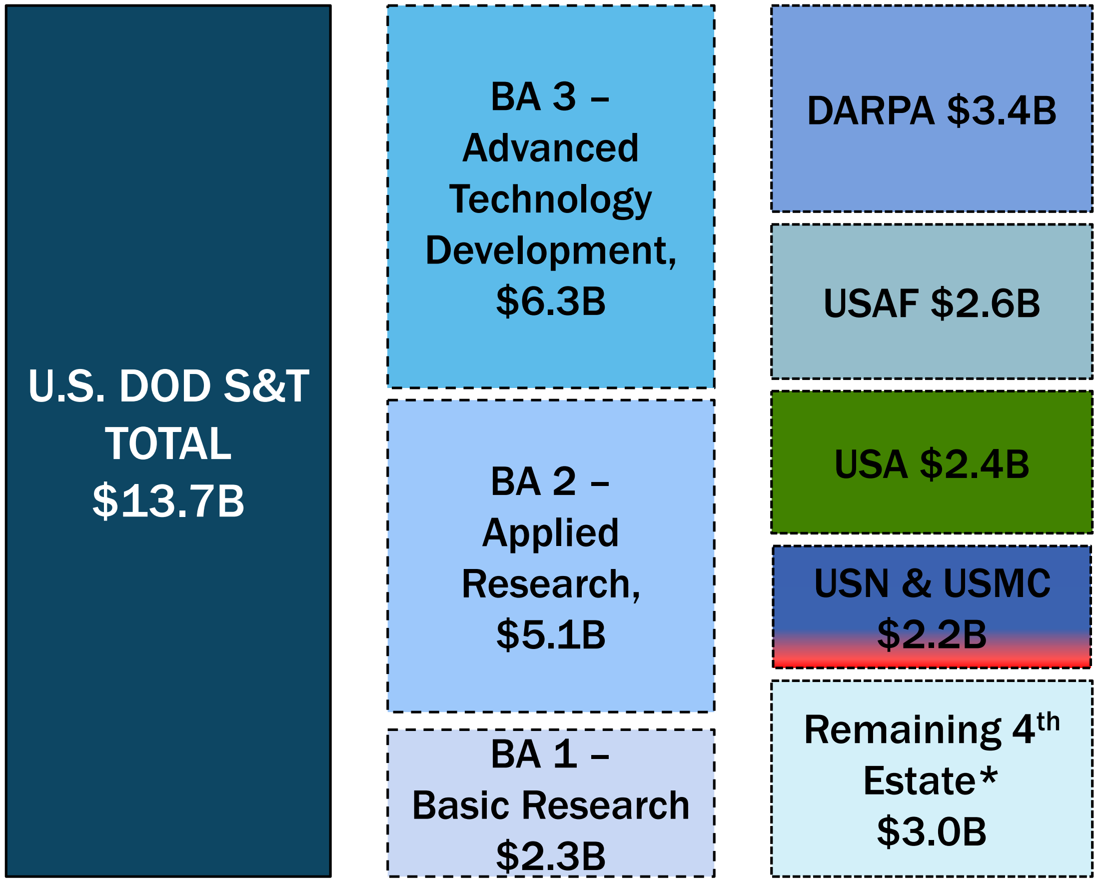
PBR19	FY19 ($B)
Non-RDA	**394.4**
RDA	**222.6**
Procurement	131.6
RDT&E	91.0
S&T (BA1-BA3)	*12.7*
Development BA4-BA7)	*77.4*

Note:

- ***Dollars reflect Base Only, no OCO***
- ***Non-RDA = Force Structure and Operational Readiness***
- ***BA = Budget Activity***
- ***S&T = Science and Technology***

U.S. DoD PB 2019 S&T Request

Technology Development Budget

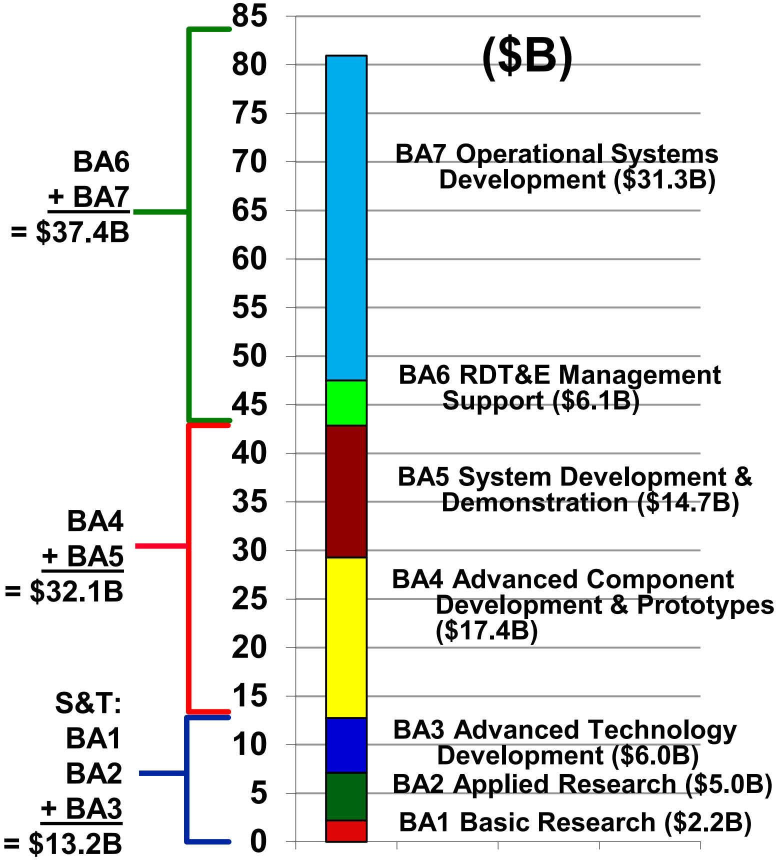


***NOTES:**

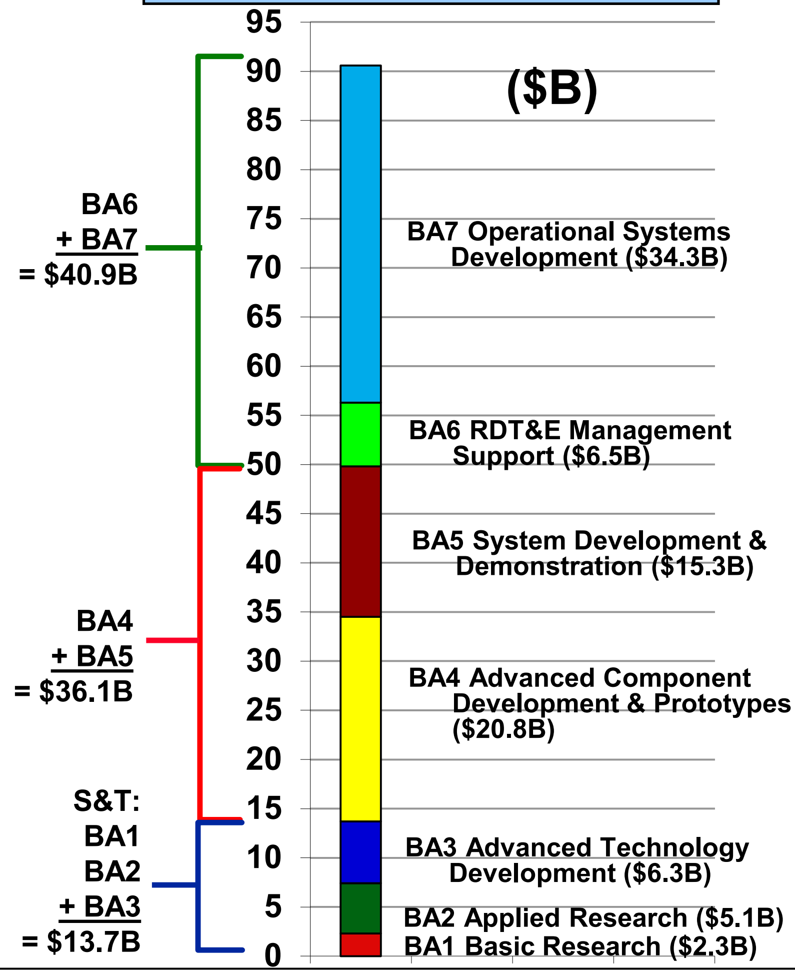
4th Estate includes Chem Bio, DTRA, OSD, USSOCOM, and other DA.

DoD PBR18 & PBR19 RDT&E – Budget Request Comparison

PBR18 FY18 RDT&E = $ 82.7B
(Budget Activities 1-7)



PBR19 FY19 RDT&E = $ 90.6B
(Budget Activities 1-7)



Technology Base (BA1 + BA2) = $7.1B

S&T is 15.9% of RDT&E;
RDT&E is 14.4% of DOD Topline (Base only)

- in Then Year Dollars -

Technology Base (BA1 + BA2) = $7.4B

S&T is 15.1% of RDT&E;
RDT&E is 15.1% of DOD Topline (Base only)

Who are the players???

Leveraging the Entire R&E Ecosystem

Engaging with all partners to ensure technological superiority…

Win today's fight

Design and acquire for the next fight

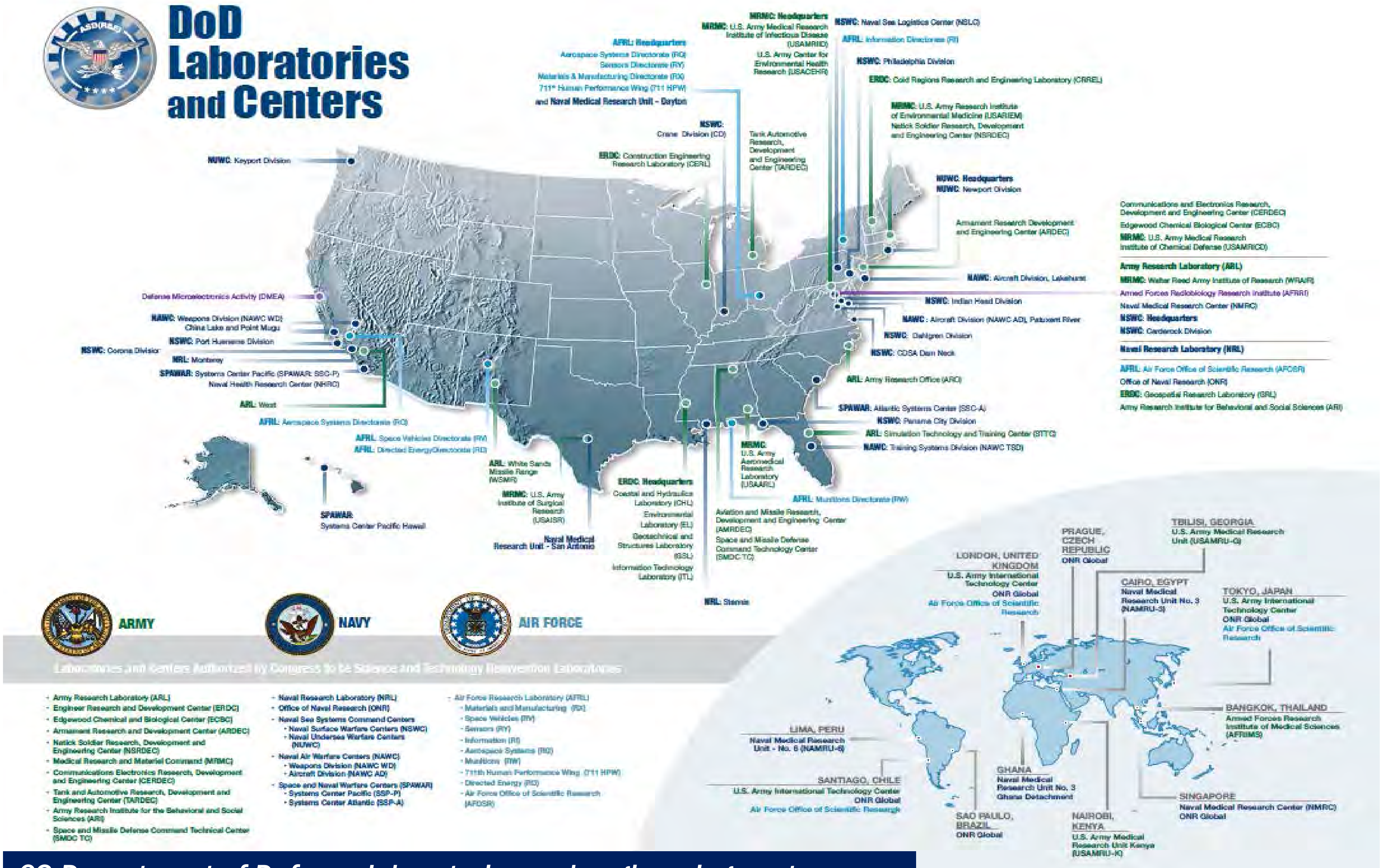
Global Partners

Academia & Industry Partners

Federally Funded R&D Centers (FFRDCs) & University Affiliated Research Centers (UARCs)

DoD Labs, Engineering & Warfare Centers

Force acceleration of science and engineering – driving ideas to capability



63 Department of Defense laboratories and engineering centers provide expertise and insight to enhance our warfighter's capability .

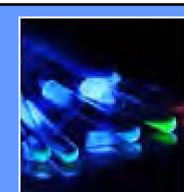
U.S. Communities of Interest

CoIs lead the innovation and the acceleration of advanced concepts and prototypes across three main focus areas:

Mission Focus
Capabilities enabled by advanced technologies & systems

Counter-Improvised Explosive Devices (IED)

Counter-Weapons of Mass Destruction (WMD)



Biomedical (ASBREM*)

Systems / Capability Focus
Multiple technologies are integrated into complex systems to achieve mission impact

Human Systems

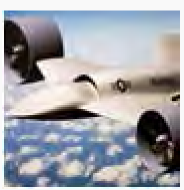
Sensors

Space

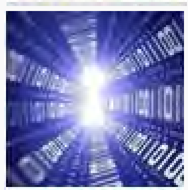
Ground and Sea Platforms

Electronic Warfare

Weapon Technologies

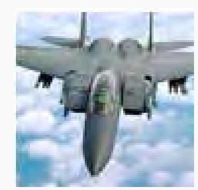


Autonomy



Cyber

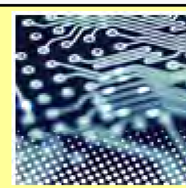
Command, Control, Communication, Computers and Intelligence (C4I)



Air Platforms

Technology Focus
Technology goals with multiple applications

Energy and Power Technologies



Advanced Electronics

Materials and Manufacturing Processes

Alumni CoIs: Engineered Resilient Systems

***ASBREM: Armed Services Biomedical Research Evaluation and Management**

DoD S&T Enterprise Strategy

Continuously Refine our Strategic Thinking and Planning

“Where we are going and who we will be”

Mission

Vision

Strategic Plan

“Where we are and who we are now”

“How we get there”

- Refine our Mission, Strategic Plan, and Vision for Technical and Enterprise Priorities

- Continuous look at the Technology, Focus Areas, CoIs, and Partnering

Are we addressing the right problems?

DoD S&T Enterprise Strategic Vision: One Enterprise

- Mitigate challenges by **strengthening the DoD S&T Enterprise's focus, policies and processes** to unleash the full potential and ingenuity of our S&T workforce
- Anticipate the future S&T environment and **transform the S&T Enterprise toward efficient cross functional practices** that will boost innovation, lower barriers to technology transition, and accelerate response to warfighters
- The new ***DoD S&T Enterprise Strategy*** **provides strategic directions** and initiatives to support the One Enterprise vision
- The focus is in three areas:
  - Addressing new S&T priorities
  - People and culture
  - Supporting business practices and operations

The DoD S&T Enterprise will operate as One Enterprise to deliver responsive, relevant, lethal and affordable technical solutions to deter or defeat known and emerging threats to U.S. national security

Capability Gaps

Opportunities for Collaboration

INPUT FACTORS

- **Threats**
- **Planning**
  - LRRDPP
- **Hard Problems**
  - A2/AD
- **Tech Trends**
  - Globalization
- **Affordability**

Speed

Situational Awareness

Survivability/ Protection

Training Fidelity

Range

Weight/ Mobility

Lethality

Ability to Communicate

LRRDPP – Long-Range Research & Development Planning Program
A2/AD – Anti-Access/Area Denial

Research and Development
— On-going Activities—

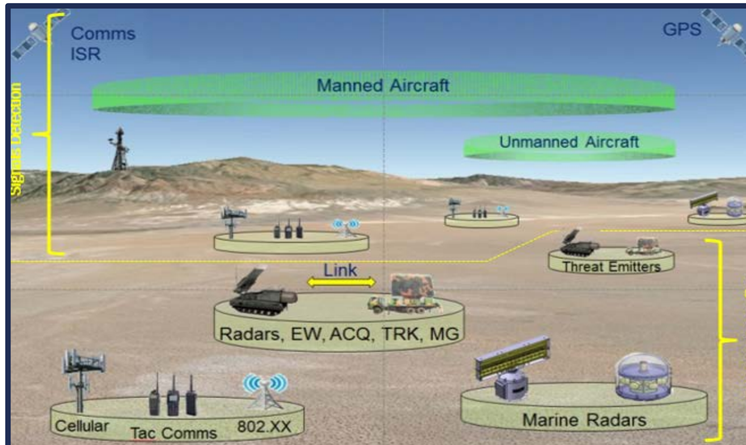
- Autonomy & Robotics
- **Artificial Intelligence** / Man-Machine Interface
- Micro-electronics
- **Hypersonics**
- Directed Energy
- Manufacturing
- Electronic Warfare
- Cyber
- **Advanced Computing**
- Novel Engineered Materials
- Precision Sensing: Time, Space, Gravity, Electromagnetism
- **Emerging Biosciences**
  - Synthetic Biology
- Understanding Human and Social Behavior
- Human Performance

Rapid technological change includes developments in advanced computing, big data analytics, artificial intelligence, autonomy…directed energy, and hypersonics – the very technologies that ensure we will be able to fight and win the wars of the future.“

– Secretary of Defense Mattis, HASC Posture Hearing, June 12, 2017

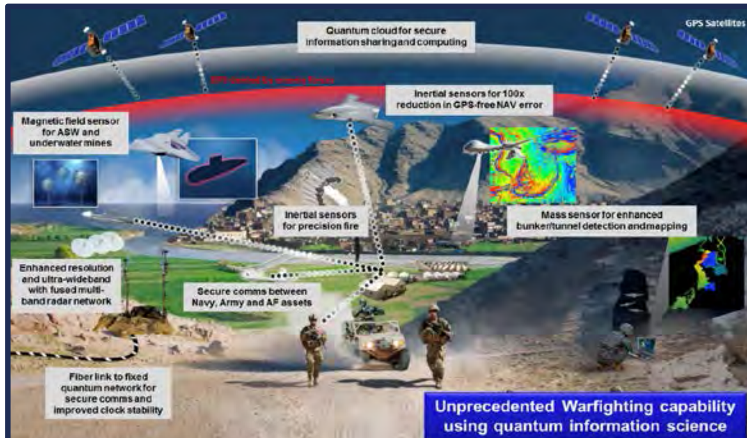
Enhancing Capabilities

Prototyping



Experimentation

New Approaches; Problems, Environments



Cross-Service Research

People and Culture

- **Retain** and continue to **build** our talented R&E workforce
- **Attract** the **best** and **brightest** to **national security service and eliminate barriers** to service
- Bolster programs such as the *S*cience, *M*athematics, *A*nd *R*esearch for *T*ransformation **(SMART)** Scholarship for Service Program
- **Increase recognition** of unique and relevant technical work and **innovative thinking**
- **Leverage all** sources of **talent – internal, industry, academia**

USD(R&E) Organization…

1 Aug 2018
Congressional Report

USD(R&E)
Proposed Organization

- Sets and advances technology /innovation agenda for DOD to dominate battlespace

Under Secretary of Defense (Research and Engineering)

Defense Science Board

MDA

Strategic Intel Analysis Cell

- Kill Chain Analysis (US and threat)
- Red-Teaming and Vulnerability Analysis (Technology/Concepts)
- Global Technology Tracking
- Technology Forecasting

Assistant Secretary of Defense (Research & Technology)

- Strategic Technology Objectives and Investment Strategy
- Foundational Research and Innovative Approaches for Warfighting Challenges
- Affordable & Assured Technology Development
- Global Technology Outreach and Leverage (academic/commercial/ government/international)
- Laboratory Infrastructure and Workforce Policy

DASD (Research &Technology Investment)

DASD (Laboratories and Personnel)

DARPA

Assistant Secretary of Defense (Advanced Capabilities)

- Developmental Prototyping
- Experimentation / Concept Development
- Joint Enduring Operational Needs (JEON) & CCMD Support
- Developmental Planning and Mission Engineering Analysis (assured integration of capability)
- Acquisition Program Support
- Open Architecture / Cyber Security Policy & Standards
- Non-traditional Rapid Acquisition Pathways

DASD (Mission Engineering & Integration)

DASD (Prototyping & Experimentation)

Strategic Capabilities Office (SCO)

DIUx

USD(R&E) Tenets

What has changed as we stand up the USD(R&E)?

- USD(R&E) will **operate with a Mission Focus**
  - Move from Service oversight focus to CCMD enabling focus
  - Assess capability gaps/needs by mission, vice system or Service
  - Resource integrated prototyping/experimentation activities (leveraging Service efforts) with outcomes focused on mission effectiveness
  - Engage CCMDs/operators in mission analysis/experimentation to develop new CONOPs
- USD(R&E) will **set the Technical Direction for the Department**, not just recommend
- USD(R&E) **will utilize intelligence products, technology forecasting and analysis to inform decisions** on investment, prototyping, experimentation and emerging capabilities and concepts of operation
- USD will **focus on driving effectiveness and affordability** by addressing drivers in acquisition, testing and sustainment into the system design phase – setting and adhering to open architectures and interface standards while implementing good systems engineering/cyber resiliency practices
- USD(R&E) will pilot new acquisition pathways to speed capability to the Warfighter

USD(R&E) will establish and embrace a collaborative culture focused on providing effective and affordable capability to the Warfighter

Opportunities

Industry Support

There are opportunities for industry to provide valuable support to an array of technical and operational challenges across the Department.

- **Improve** communication, coordination, and **research and development** in **artificial intelligence, hypersonics, advanced computing, synthetic biology,** and other emerging technologies.
- **Establish** known degree of assurance that **devices, networks, and cyber-dependent functions** perform as expected, **despite attack** or error
- **Reduce size, weight, and power** across all sensor modalities while **preserving sensor capability** and sensitivity
- Provide **delivery, maneuvering, and recovery of payloads to and from space**
- **Deliver** materials, processing, and fabrication **techniques** that significantly change the **manufacturing cost curve**

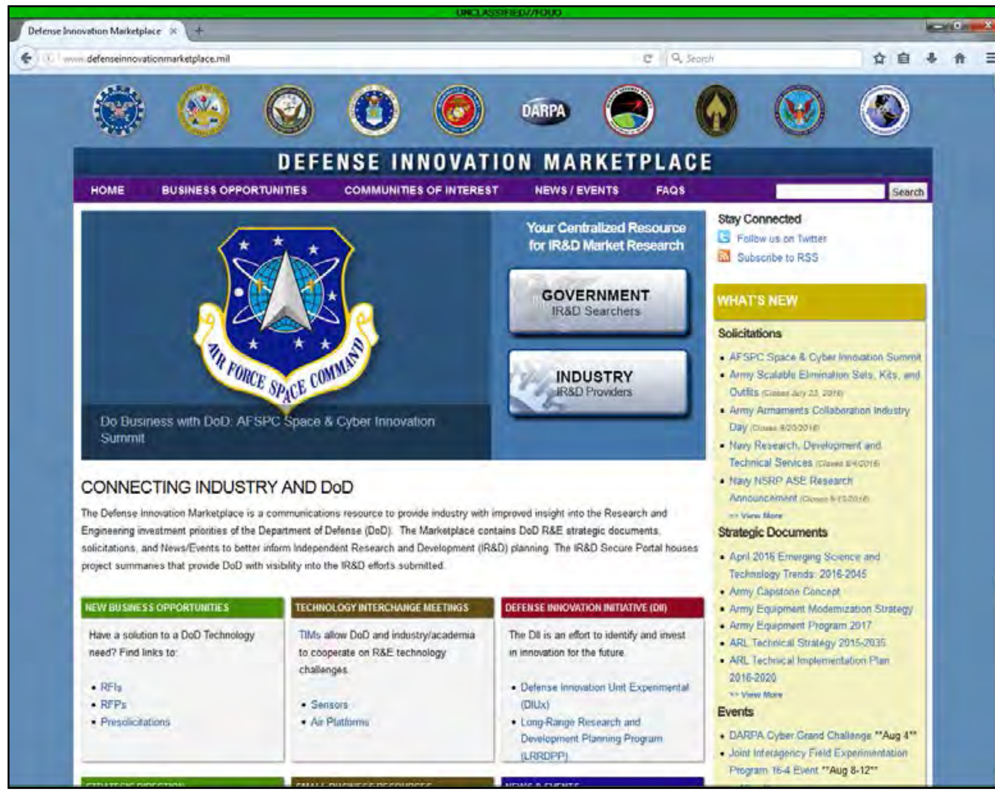
The opportunities mentioned above are not an exhaustive list, but a representative sample of some areas where industry can play a key role.

DoD Innovation Marketplace

The Marketplace addresses the Department's need for increased collaboration with industrial base partners and small businesses.

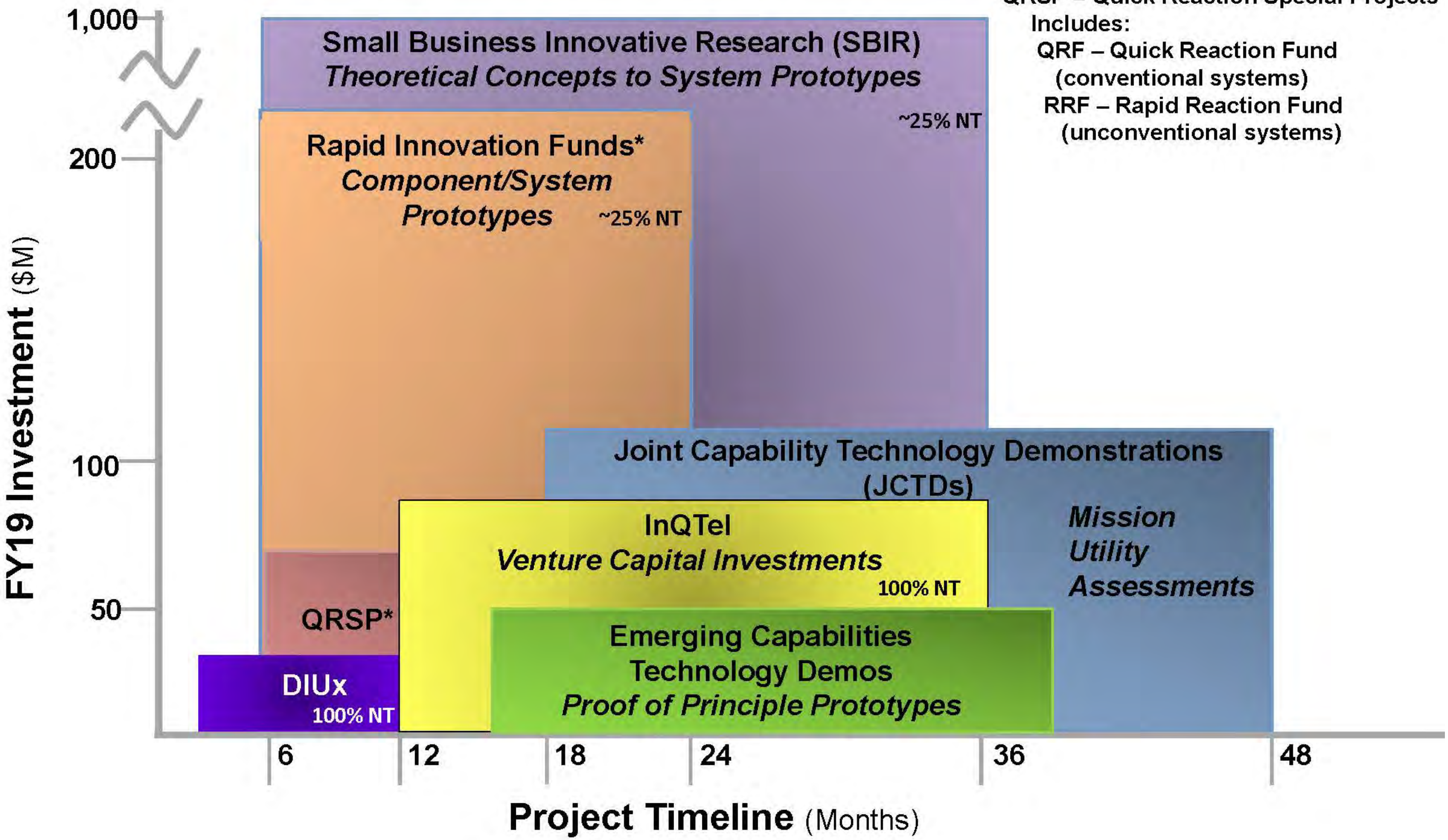
What can be found at the site?

- **New Business Opportunities**
  - Request for Information/Proposals Presolicitations
  - Broad Agency Announcements
  - Rapid Innovation Fund
- **Small Business Resources**
  - Small Business Innovation Research (SBIR)
  - Mentor-Protégé
- **Acquisition Instruments**
  - Other Transaction Authority (OTA)
  - Consortiums (e.g., STEM R&D)
- **Technology Interchange Meetings**
  - Sensors, Air Platforms, etc.



Defense Innovation Marketplace, the one-stop-shop for connecting Industry to DoD.

Non-Traditional Prototyping Outreach



* QRSP = Quick Reaction Special Projects
Includes:
QRF – Quick Reaction Fund (conventional systems)
RRF – Rapid Reaction Fund (unconventional systems)

NT = Non-traditional

Maintaining Technology Superiority

- The U.S. military has long relied on ***high quality people, technological superiority, innovative operational*** and ***organizational constructs***, and our ***unmatched ability to fight*** as a ***Joint Force***
- We are addressing the erosion of technological superiority by identifying and investing in ***innovative technologies and processes***
- We are pushing the envelope with ***innovative*** and ***cutting edge research***
- Beyond technical innovation, we are pursuing ***new practices*** and ***organizational structures*** to ensure future U.S. technical dominance
- From ***basic research*** to ***advanced capabilities***, the DoD R&E enterprise provides the ***technological foundations*** that ensures our military of the future remains the ***most capable in the world***

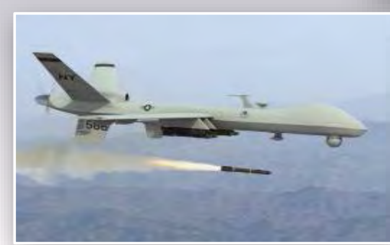
DoD R&E Enterprise: Solving Problems Today – Designing Solutions for Tomorrow

DoD R&E Enterprise
Solving Problems Today – Designing Solutions for Tomorrow







DoD Research and Engineering Enterprise
https://www.acq.osd.mil/chieftechnologist/

Defense Innovation Marketplace
http://www.defenseinnovationmarketplace.mil

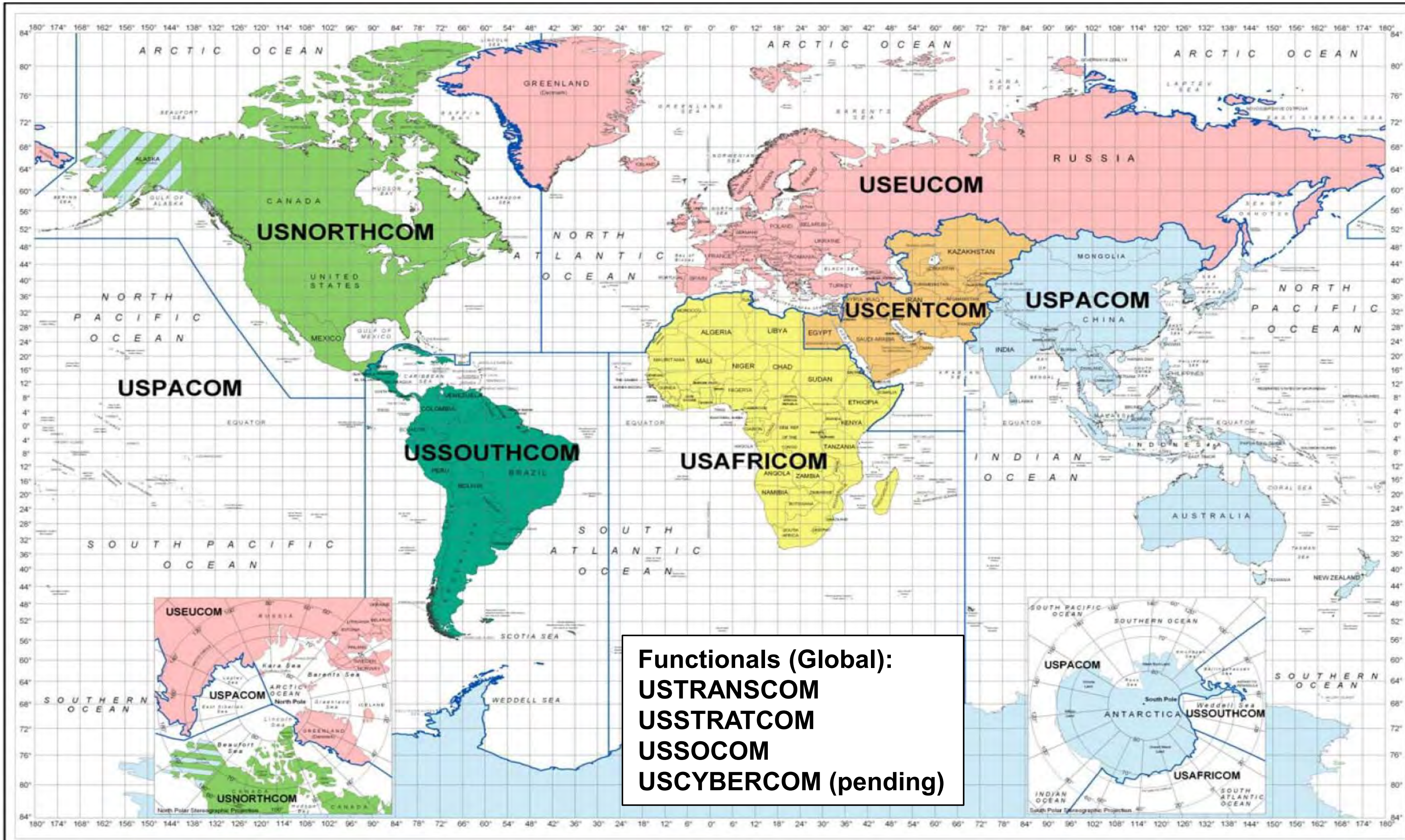
Twitter
@DoDInnovation

US Central Command Technology Development

DISTRIBUTION STATEMENT A: Approved for public release

THE WARFIGHTER

People Like Me – Geos & Functionals



Functionals (Global):
USTRANSCOM
USSTRATCOM
USSOCOM
USCYBERCOM (pending)

CENTCOM - Area of Responsibility

Complex
- 20 Countries, 4.5 million square miles
- 1.1 Million square miles of ocean
- 531 Million people, 16 major ethnic groups
- 7 Major languages, hundreds of dialects
- 4 Major religions

Global Economic Impact
- Arabian Gulf produces ~ 31% of world crude oil
- Region exports ~ 26% of global LNG supply
- 3 x Strategic Choke Points
  - Appx 40% internationally traded oil transits Strait of Hormuz
  - 21% of LNG goes through Strait of Hormuz

Evolving Landscape

- U.S. maintaining presence in Iraq and Afghanistan
- U.S. priorities shifting
- Instability continues across the AOR
- Foreign fighter flow continues across porous borders
- Russian / Iranian involvement
- Yemen activity and support to regional partners
- Counter-Piracy mission continues
- Several splinter terrorist groups emerging
- Refugee / Displaced Persons movement
  - As a result of conflict; seeking a better life
  - Potential natural/manmade disaster

USCENTCOM S&T Charter

Conduct ***discovery***, ***research***, ***analysis***, and ***sponsor development*** of new and emerging ***technologies*** and ***concepts*** which have the ***potential to provide solutions*** to Headquarters and Component validated Joint needs.

Review USCENTCOM and Component ***plans, operations***, programs, policies and activities for areas where ***technology/new technique*** will improve efficiency and effectiveness.

Integrate across USCENTCOM headquarters and Component staffs for transformational, integrating, and experimentation activities.

U.S. Central Command Tech Focus

- We focus on the **JOINT** solution that has the potential to satisfy a **JOINT validated** need
- Separate from the many technology needs of our customer(s) those technology challenges which:
  - *Do not have a readily available solution*
  - For high-impact needs there is *insufficient activity pursuing a solution*
- Seek out game-changing technologies which our customer(s) don't know they need

How I Find New Technologies

I go to people's Homes, Garages, Basements, Conventions, Technology Events (NOT DoD), Conventions, Labs, Incubators, and more
-Have even found technologies in the basement of a Synagogue, NOT just in DC or Silicon Valley, Started TTDs in 2010

Work with DTIC and DTIC Field Advisors. I WILL GO ANYWHERE TO FIND TECHNOLOGY FOR THE WARFIGHTER!!!

Events in 2018 - at no cost except airfare, hotel and meals...NO CONFERENCE FEES and all put on for the Warfighter, First Responders, and other Governmental agencies like the CIA, FBI and more...the only cost for any participant is a lunch fee. As many presenters cannot afford the cost.

1. TTD New York City, Brooklyn, Ms. Bev Corwin. Feel free to contact Bev at technologytransferdays@gmail.com Mobile: 347-908-7098, Skype: bevcorwin I am attaching her Flyer 30 Apr-4 May & 7-11 May, 2018

2. National Innovation Summit, TTD Huntsville, AL. POC Mr. Terry Griffin -256-975-1285, 17-20 July, 2018

3. TTD Columbus, OH Lisa Delp, C: 614-460-9688 - August Dates -TBD

4. Encountering Innovation Wichita, Kansas Alan Badgley, 316-978-6624, 8-12 October, 2018

5. TTD Tempe, AZ Wes, November Dates -TBD

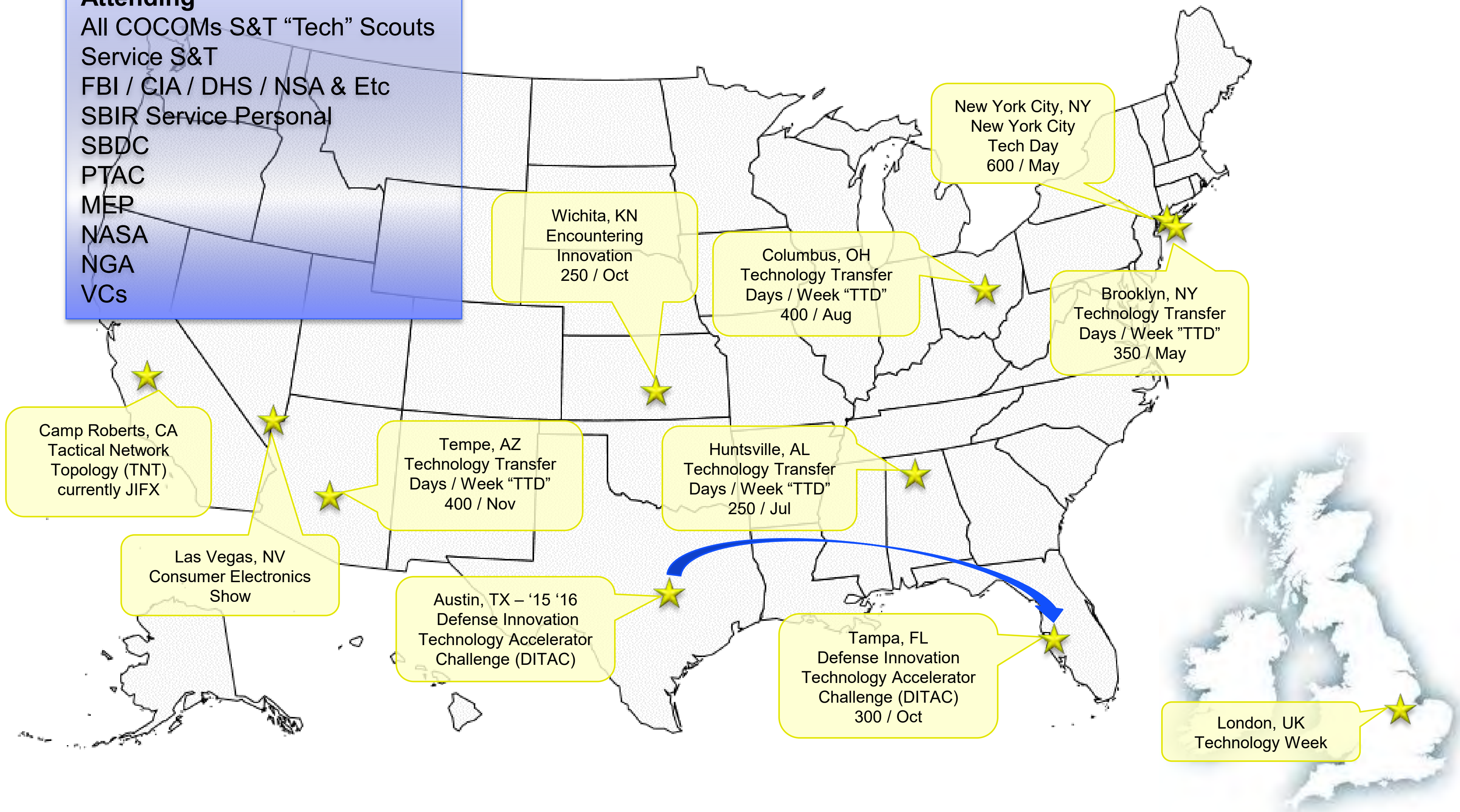
Also what we did not talk about during the week long events:
1. When morning Group of presenters is briefing the afternoon Group or presenters will be meeting with:
a. SBDC people, SBIR (monies), State PTACS, DTIC-FA's, and VENTURE Capitalists!
b. In the afternoon session vice-versa

Possible TTDs being added in 2019
1. Texas, Austin
2. Kansas,
3. Missouri (possibly)
4. Florida (possibly)

FIND a New Technology…I "SOCIALIZE" it with the COCOMs, SERVICES, SERVICE LABS, DHS/FBI/CIA/DOS/WHO/USAID & More

USCENTCOM
Science and Technology Outreach

Attending
All COCOMs S&T “Tech” Scouts
Service S&T
FBI / CIA / DHS / NSA & Etc
SBIR Service Personal
SBDC
PTAC
MEP
NASA
NGA
VCs



Some technology areas we "pursue":

- **Detection of CBRNE at tactically significant distances; with emphasis on a little "e"**
- **Pre-shot counter-sniper, counter-mortar, counter-RPG technologies; with emphasis on automated systems**
- **Technologies which enable the transfer of information more securely, more quickly, to a wider set of users, to include the warfighter when it makes sense, with less bandwidth and dedicated support resources, e.g.:**
  - **Multi-level Security over single architectures**
  - **Bandwidth compression / reduction techniques**
  - **Data to Decision [data=>info=>knowledge=>understanding=>wisdom]**
- **Through automation, remote action, new and novel techniques & technologies which reduce risk and / or stress on the force and / or improve the efficiency and effectiveness of our action(s)**
- **Technologies which allow for greater persistence over the battlespace with fewer platforms; employing improved sensor technology providing greater fidelity of information**

Thematic areas of concern

(not in priority order)

- A2AD solutions
- Detect / Defeat:
  - IED initiators / initiator systems
  - Buried / concealed IEDs
  - Production and assembly of IEDs
- HME production standoff detection
- Culvert access denial / alerting
- Persistence in surveillance
- Biometrics (Identity dominance for FP/access)
- Non-lethal vehicle / vessel stop
- Reduce stress on the force:
  - Force Protection requirements
  - Increased automation
- Anti-swarm lethal / non-lethal
- Enable Partner Support
- Predictive analysis techniques
- Tunnel detection / defeat
- Holding all targets at risk
- Messaging / counter-Messaging
- Mine Warfare (offensive/defensive)
- IAMD overmatch solutions
- C4ISR systems:
  - Processing, exploitation & dissemination
  - Multi-level security
  - Cross domain solutions
  - Information access to tactical edge via MIL Comms, Cellular & WiFi
- Tagging, Tracking, and Locating (TTL)
- Denying non-state actors state-like functions
- Energy & Power efficiencies
- Scalable non-lethal / lethal effects
  - Directed Energy
  - Kinetics
- True SA for Blue … Fused Red
- Sustaining the force – reduced size, weight, amount, and retrograde
- Any sensor any shooter
- Cyber Warfare Defense
- Detect, track, defeat UAS (Grp 1&2)

COMBATANT COMMAND (CCMD)
CLASSIFIED READING ROOM

A complimentary and one-of-a-kind, access-controlled room
Exclusively located within the U.S. Department of Defense's Defense Technical Information Center Headquarters

Overview:

Admission is restricted to cleared industry/government/DoD personnel with potential technology solutions to meet the mission requirements of the CCMDs.

The access-controlled room features two workstations for viewing sensitive CCMD capability needs.

User Benefits:

Gain invaluable insights on the top priorities and current capability demands of the CCMDs.

The requirements provided by participating CCMDs are current—within six (6) months.

Access Requirements:

Authorized industry/government/DoD personnel must submit an application to visit the CCMD Classified Reading Room located within the DTIC Headquarters in Fort Belvoir, Virginia.

Applicants must have an active security clearance of SECRET or higher and be a U.S. citizen.

Application Process:

- Download and complete the application form at http://www.dtic.mil/dtic/pdf/ccmd_visit_application_form.pdf
- Applications must be received 10 business days in advance of desired appointment date
- DTIC will verify applicant's security access
- CCMDs will review and approve applicant's request to view their respective classified capability needs
- DTIC will notify applicant and coordinate the visit appointment
- Appointments can be made for Tuesdays, Wednesdays and Thursdays only

Learn more and download the application form at:

http://www.dtic.mil/dtic/services/research.html#readingroom

For other products and services offered by DTIC, visit:

http://www.DTIC.mil

Questions?

Email: dtic.belvoir.pm.mbx.ReadingRoom@mail.mil

Support Challenging Technology Needs
of Current and Future Warfighters

DEFENSE TECHNICAL INFORMATION CENTER
8725 John J. Kingman Road, Fort Belvoir, VA 22060
1-800-CAL-DTIC (1-800-225-3842)
http://www.DTIC.mil

DTIC Classified Reading Room Access

- **Request access via email to:**

dtic.belvoir.pm.mbx.ReadingRoom@mail.mil

With the following info:

  - **Full name (First, Middle, Last)**
  - **Company**
  - **Subject matter of focus interest**
  - **Requested visit date and am/pm preference**
  - **Full signature in pen (not digital or electronic)**

  [DTIC prepares form at right and sends to requestor]

- **Requestors must:**
  - **Be US Citizens**
  - **Possess a Secret or higher active security clearance**
  - **Make request at least ten (10) days prior to desired visit date – walk-ins will not be approved**
  - **Visit DTIC HQ FT Belvoir, VA to access the info**
- **DTIC verifies clearance & notifies COCOM**
- **COCOM reviews and certifies need-to-know**

COMBATANT COMMAND CLASSIFIED READING ROOM
VISIT APPLICATION

Visit applications for the Combatant Command Classified Reading Room can be mailed, emailed or faxed to the Defense Technical Information Center (DTIC). Applications must be received a minimum of 10 business days in advance of your desired appointment date. Contact DTIC at 703.767.8274 or visit www.DTIC.mil for more information.

Email: dtic.belvoir.pm.mbx.readingroom@mail.mil **Fax:** 703.767.8228

Mail To: Defense Technical Information Center – ATTN: DTIC-UR, 8725 John J. Kingman Road, Fort Belvoir, VA 22060

VISITOR INFORMATION:

Name*(printed)* Last First Middle

Business/Organization Name

Number and Street or Route and Box Number City State Zip

Email address Contact Phone Ext

Desired Appointment Date (Tues, Wed, Thurs Only) (MM/DD/YYYY) Time: ○ 0900-1200 ○ 1300-1600

SUBJECT MATTER FOCUS OF INTEREST

VISITOR'S SECURITY OFFICER INFORMATION

Name*(printed)* Last First Middle

Email Contact Phone Ext

Security Management Office (SMO) Code

☐ I certify that the information given is true and does not contain misleading statements.

Visitor's Signature Date (MM/DD/YYYY)

Print Form Clear Form

DTIC - Apr 2016

How you can help - Propose a solution

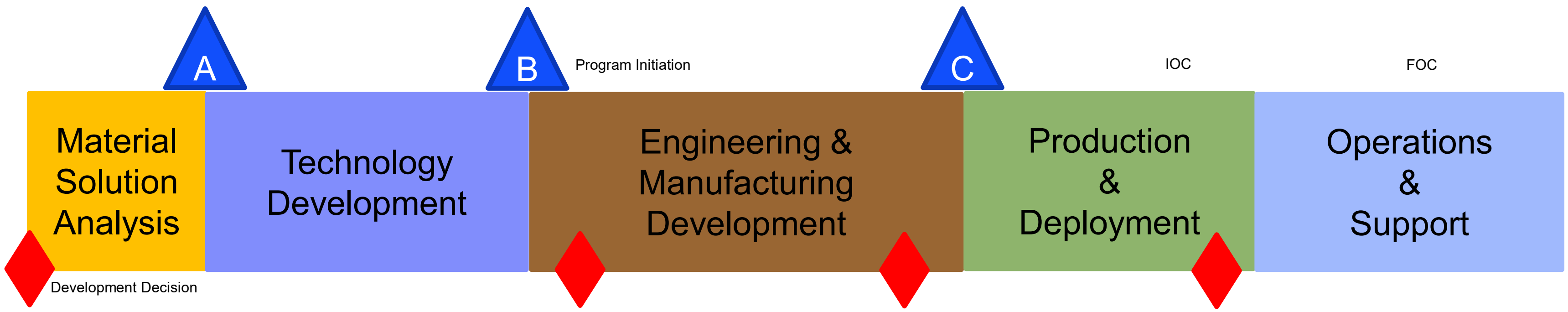
Tell me:

- What are you trying to do?
    - Articulate your objectives using absolutely no jargon
- Who should care?
- How is it accomplished today?
- What are the limits of the current practice?
- What is new in your approach?
- Why do you think you will be successful?
    - How do you define / measure success?
    - What is your strategy to get there?
- How long will it take and at what cost?
- What are the risks?
- What is your risk reduction / mitigation strategy?
- What are the payoffs / return on investment?

For Technology Developers … Some Points to Consider

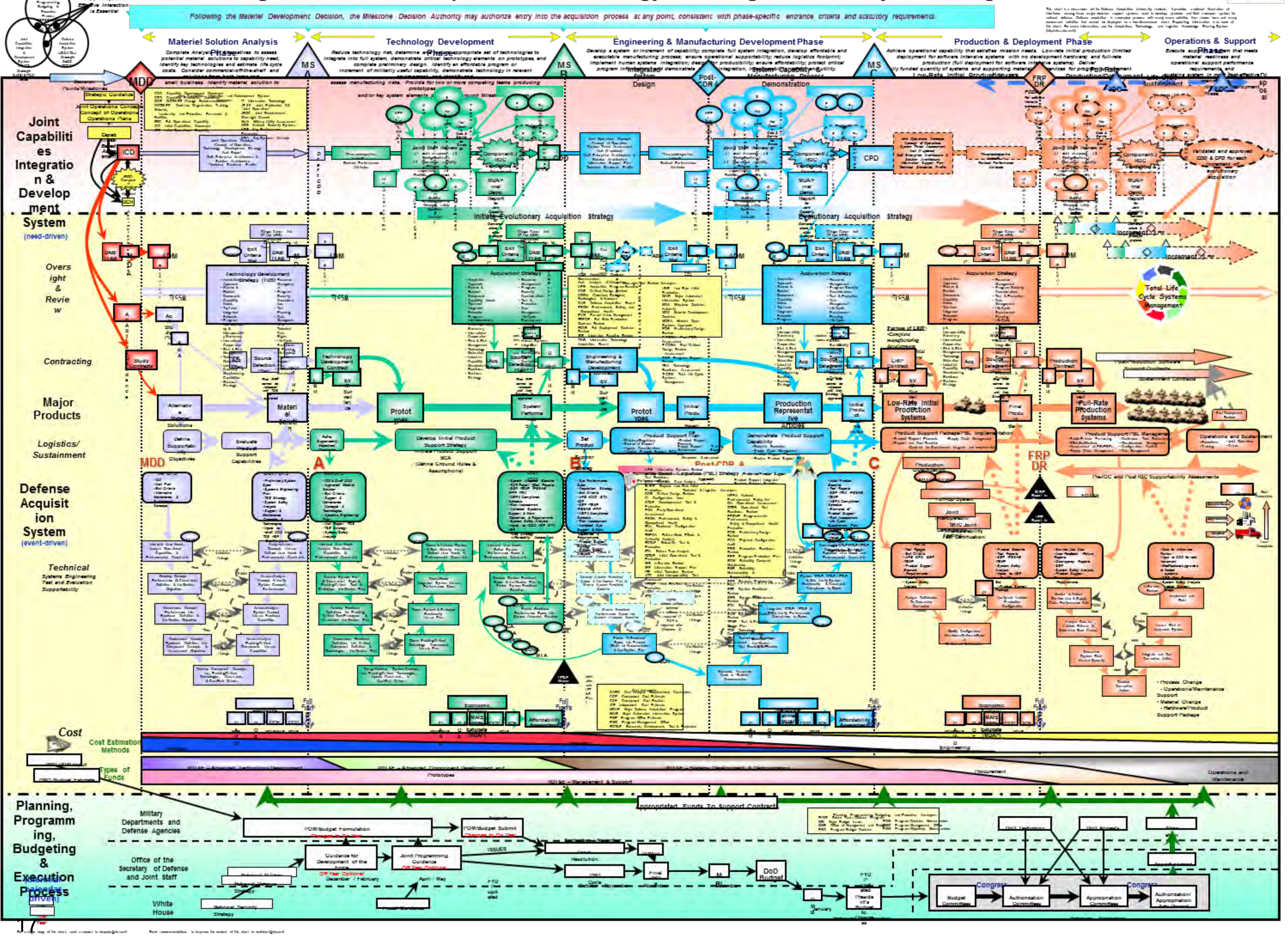
- **Seek to understand how your solution fits in the overall DoD system of systems**
  - **Integrate with legacy systems vice replace them**
  - **Open architectures receive higher interest / support**
- **Consider partnering with others to bring a 'greater' solution to the table - system best-of-breed vice at the component level**
- **Determine impact to Service programs of record (PORs)**
  - **Training**
  - **Initial fielding**
  - **Sustainment**
- **Substantiate your position with data**
  - **Testing**
  - **Cost-benefit analysis**

Simplified DoD Acquisition Process



Version 5.3.4 1 June 2009

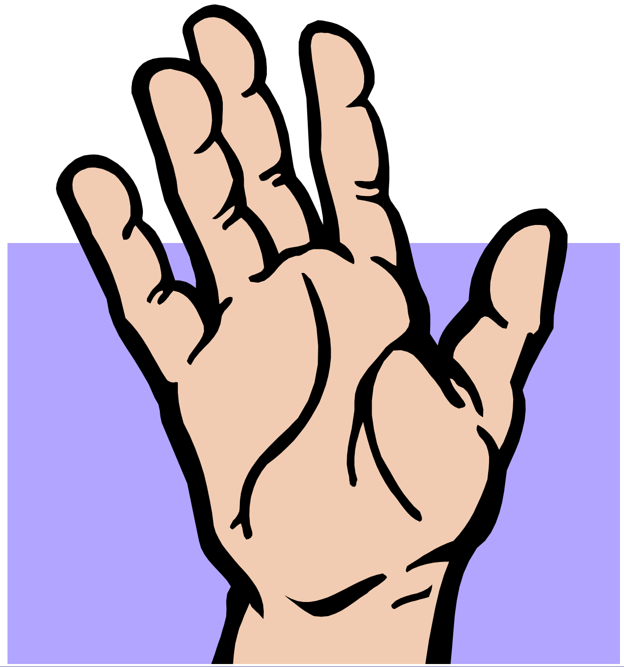
Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management



Points of Contact

[We've gone to DEE!]

• Marty Drake Science Advisor	813-529-8055	martin.a.drake.civ@mail.mil
• Lt Col Milko Padilla, USAF Deputy Division Chief	813-529-8057	milko.r.padilla.mil@mail.mil
• Tom Smith Technology Development	813-529-8107	thomas.r.smith4.civ@mail.mil
• Eric Follstad Transformation & Concepts	813-529-8106	eric.a.follstad.civ@mail.mil
• Dan Calderala Experimentation	813-529-8105	dan.g.calderala.civ@mail.mil
• Brett Scharringhausen Discovery	813-529-8103	brett.t.scharringhausen.civ@mail.mil
• USMC Augmentee Quick Reaction	813-529-8109	varies - call



Raise your Hand


U.S. Central Command
7115 S Boundary Blvd
MacDill AFB, FL 22651-5101
[Your Name Here]
Honorary Deputy Science Advisor
Contact Info
Blah, Blah, Blah

SPECIAL OPERATIONS FORCES ACQUISITION, TECHNOLOGY, & LOGISTICS

Win • Transform • People

Howard Strahan *Deputy Director, Science and Technology*

SCIENCE & TECHNOLOGY Overview

SOF AT&L

SOF AT&L

MISSION

Provide rapid and focused acquisition, technology, and logistics to Special Operations Forces.

VISION

Trusted Experts

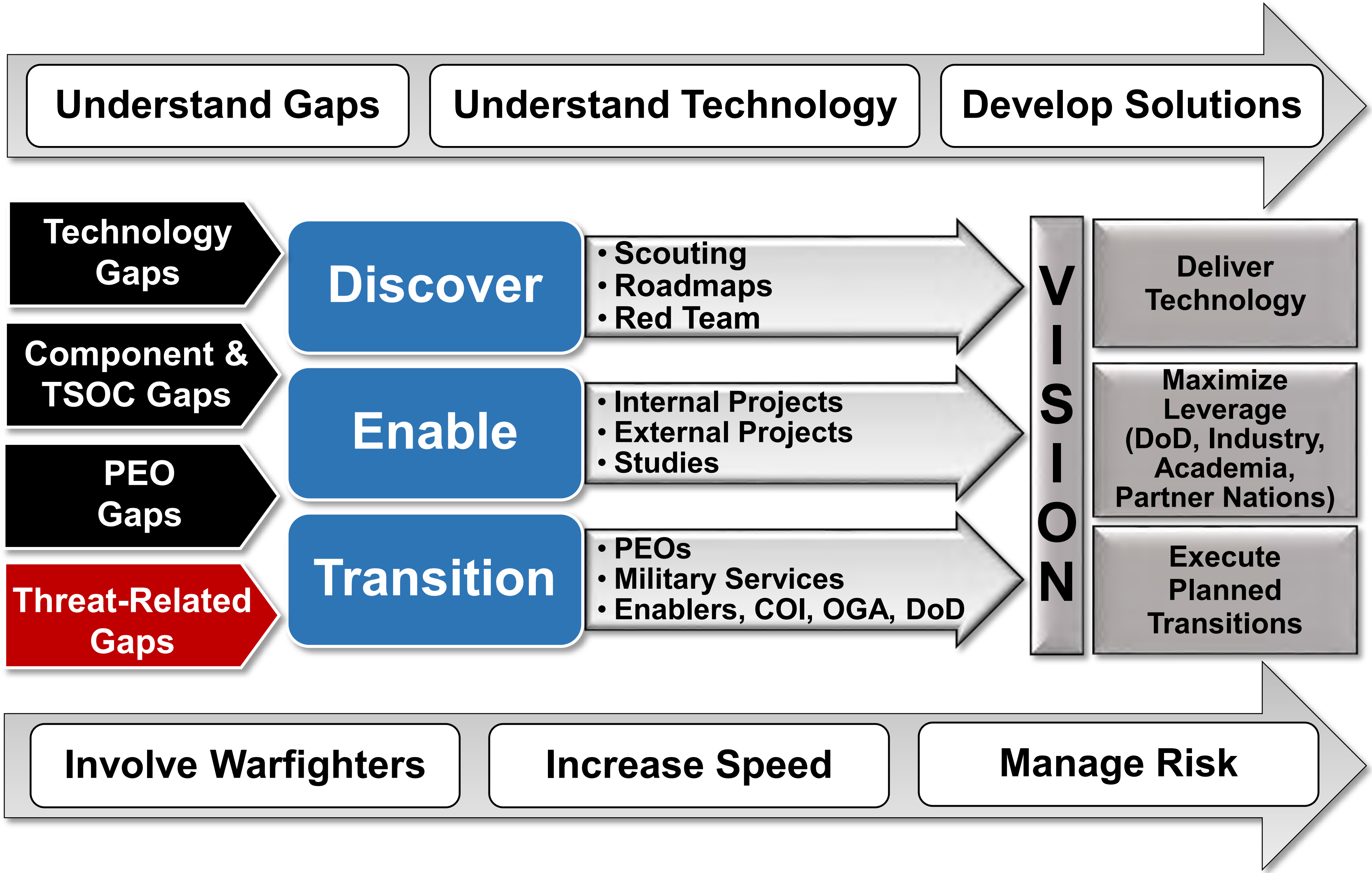
PRINCIPLES

Deliver capability to user expeditiously; exploit proven techniques and methods; keep Warfighters involved throughout process; take risk and manage it!

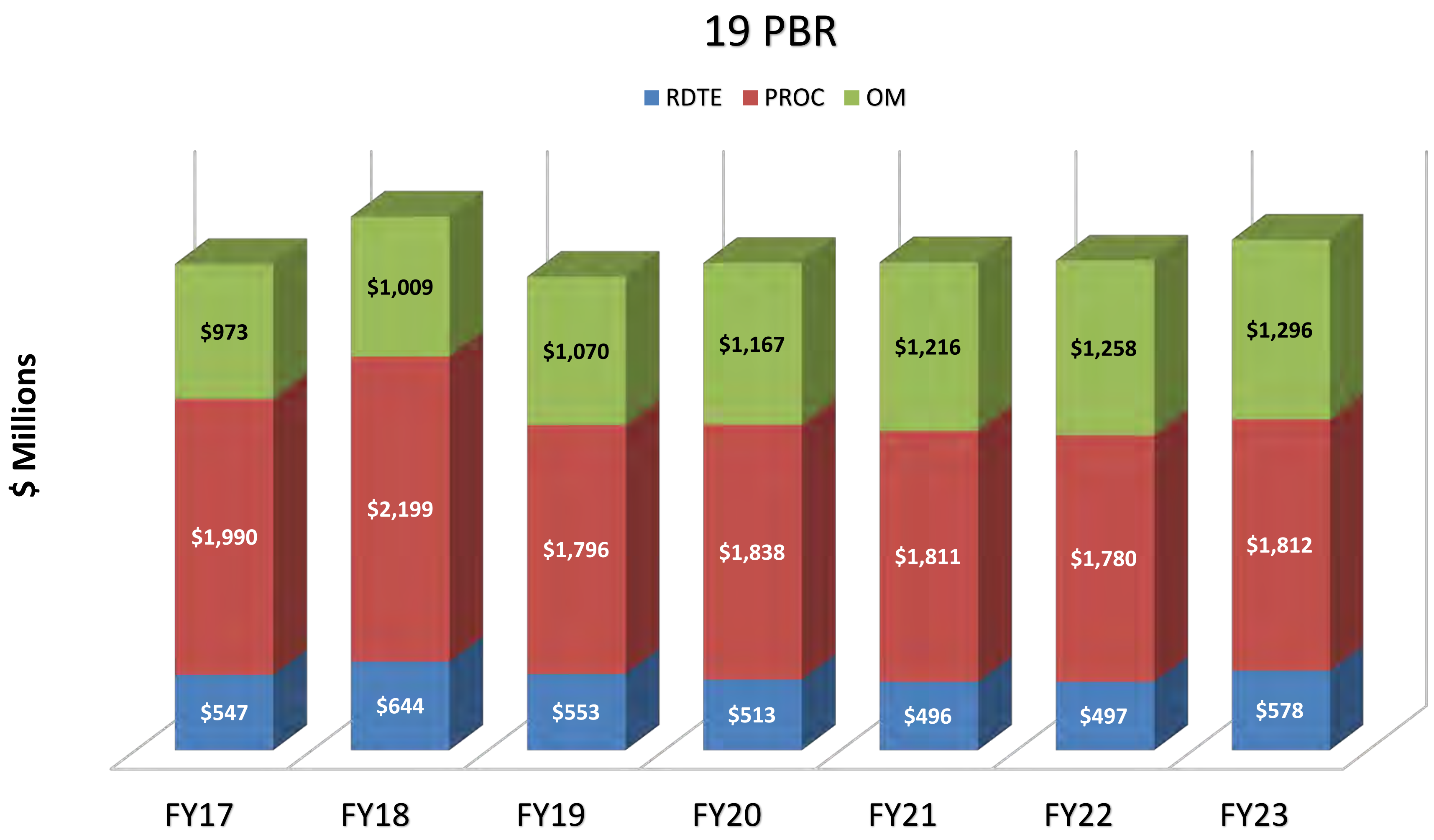
SOF AT&L-ST Vision

Discover, Enable, and Transition technologies to provide an asymmetric advantage for Special Operations Forces

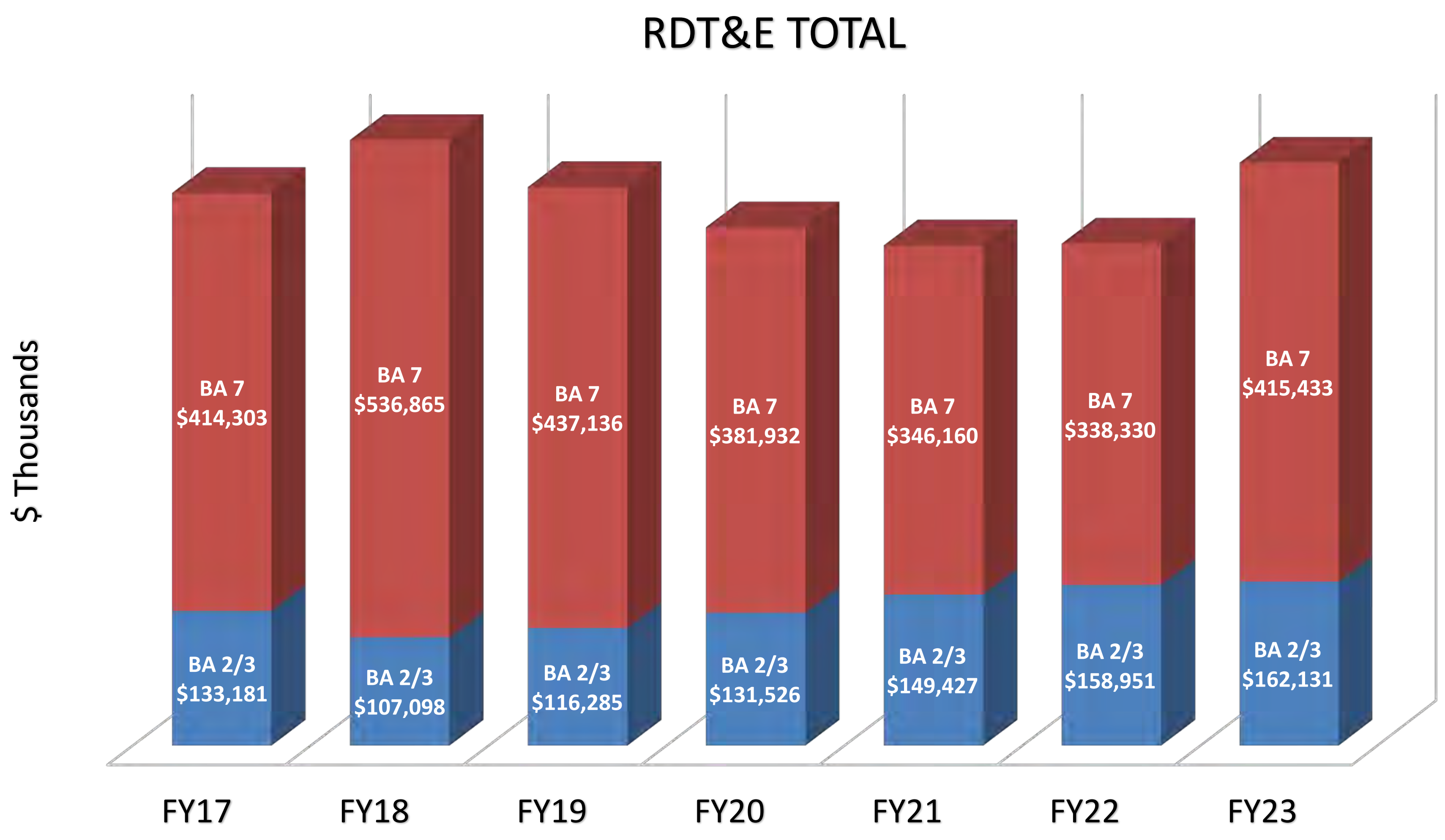
S&T Execution Overview



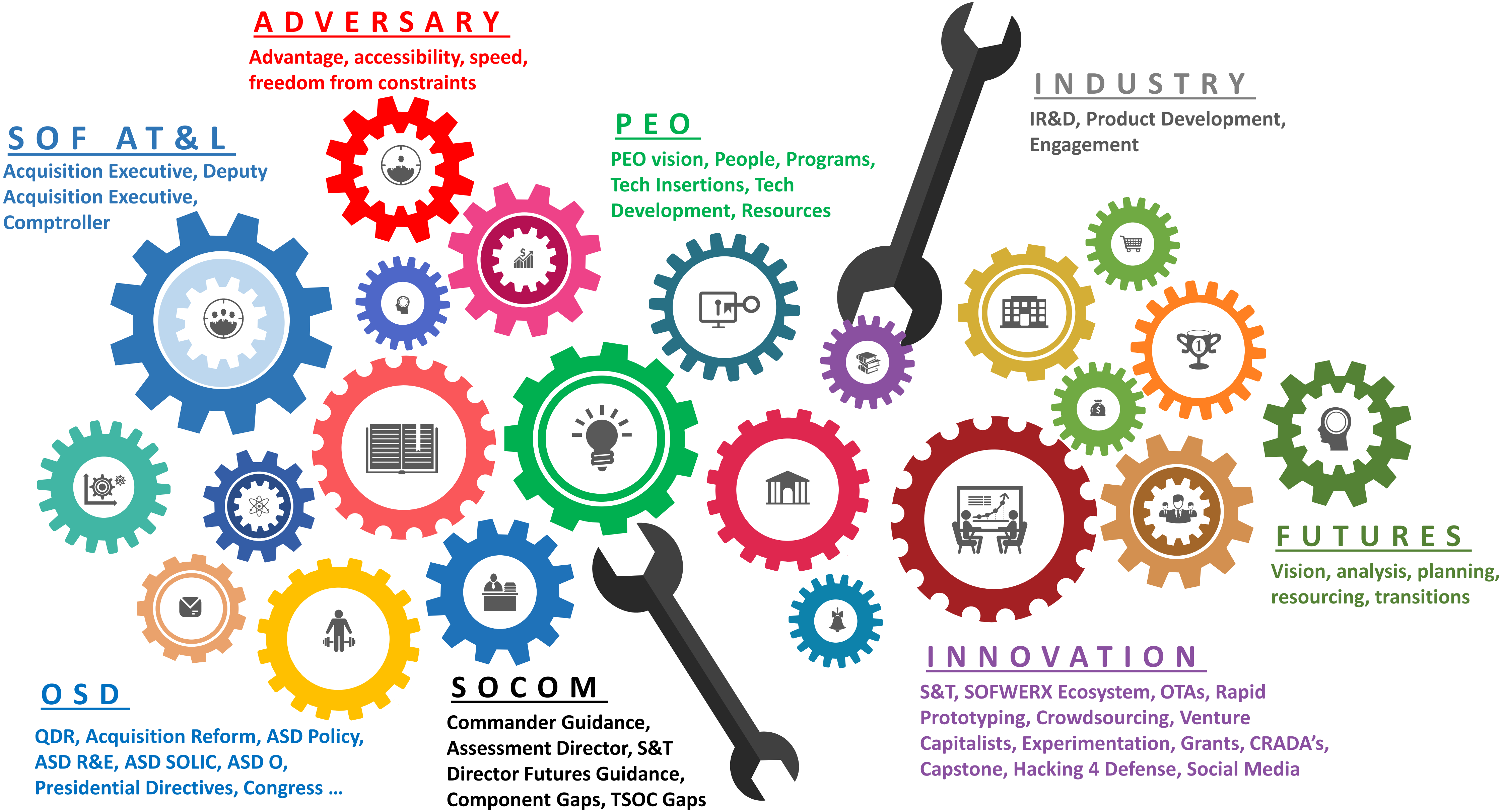
S&T MFP-11 Funding



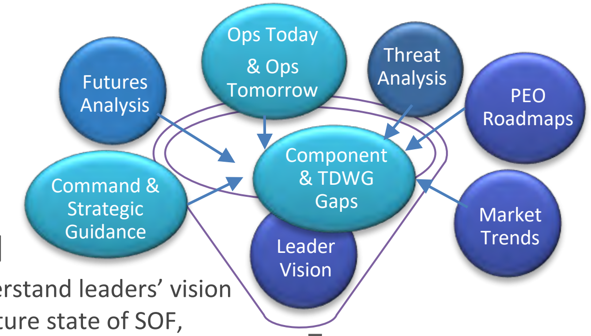
S&T MFP-11 Funding



S&T Portfolio Challenge



S&T Portfolio Process

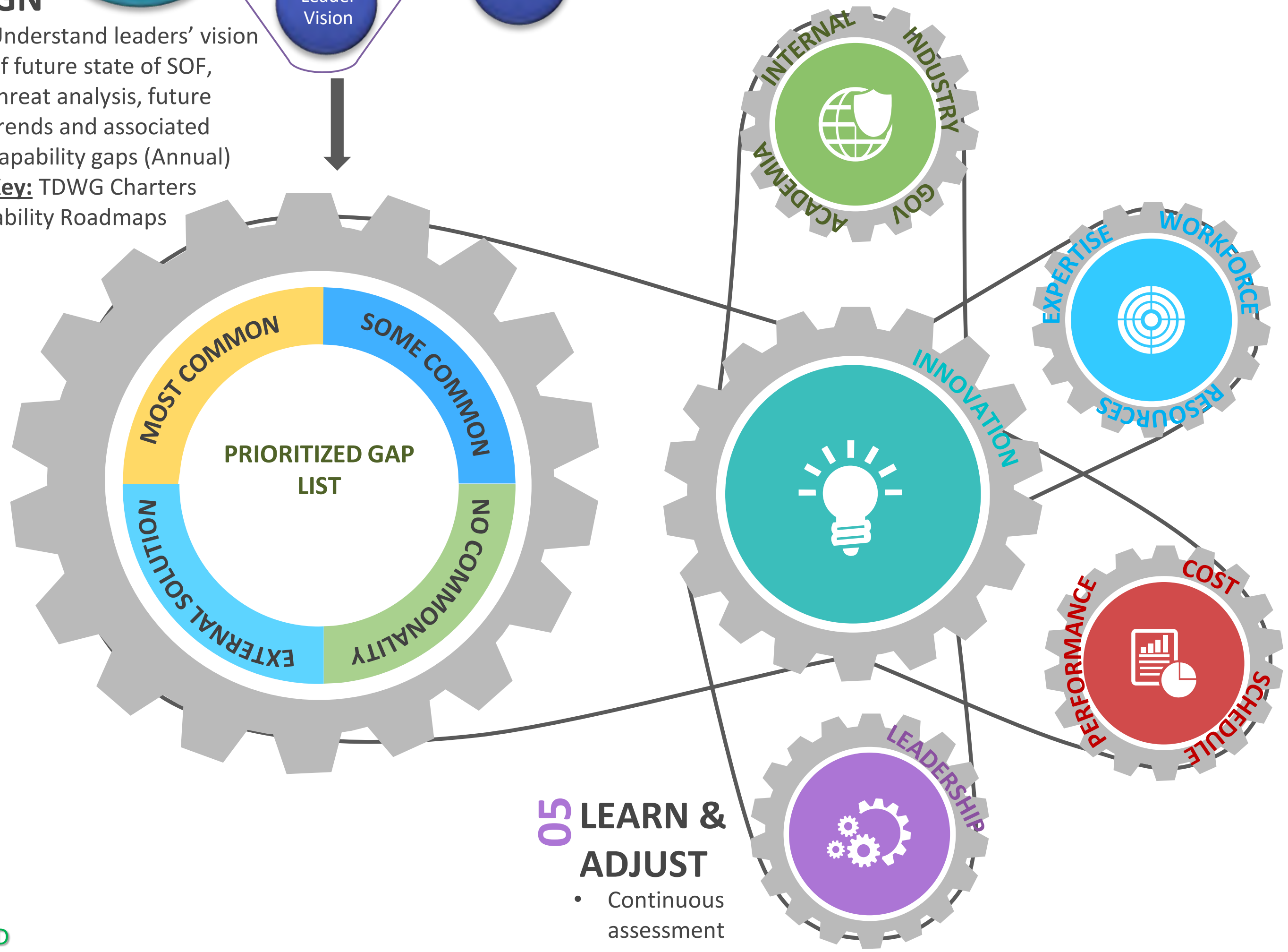


01 ALIGN

- Understand leaders' vision of future state of SOF, threat analysis, future trends and associated capability gaps (Annual)
- **Key:** TDWG Charters
  Capability Roadmaps

02 COMMUNICATE

- Message the vision and explain the process to obtain buy-in
- Solicit input
- **Key:** Engagement & Marketing Strategy
  Virtual Industry Day and Podcast
  Market RFI



03 COMMIT

- Execution paths
- Assign resources
- **Key:** Project alignment matrix
  Spend plan
  TDWG FY Battle Rhythm
  (for workload balancing)

04 EXECUTE

- Implement and actively manage
- **Key:** Quarterly portfolio review
  15-min weekly status

05 LEARN & ADJUST

- Continuous assessment

EXPLORE: Primarily specialized capabilities that emerging technology completely enables or provides a revolutionary impact. Concept development recommended prior to substantial development. (SOFWERX, Capstone, Land Grants, UARCs, Crowdsource, Prize challenges)

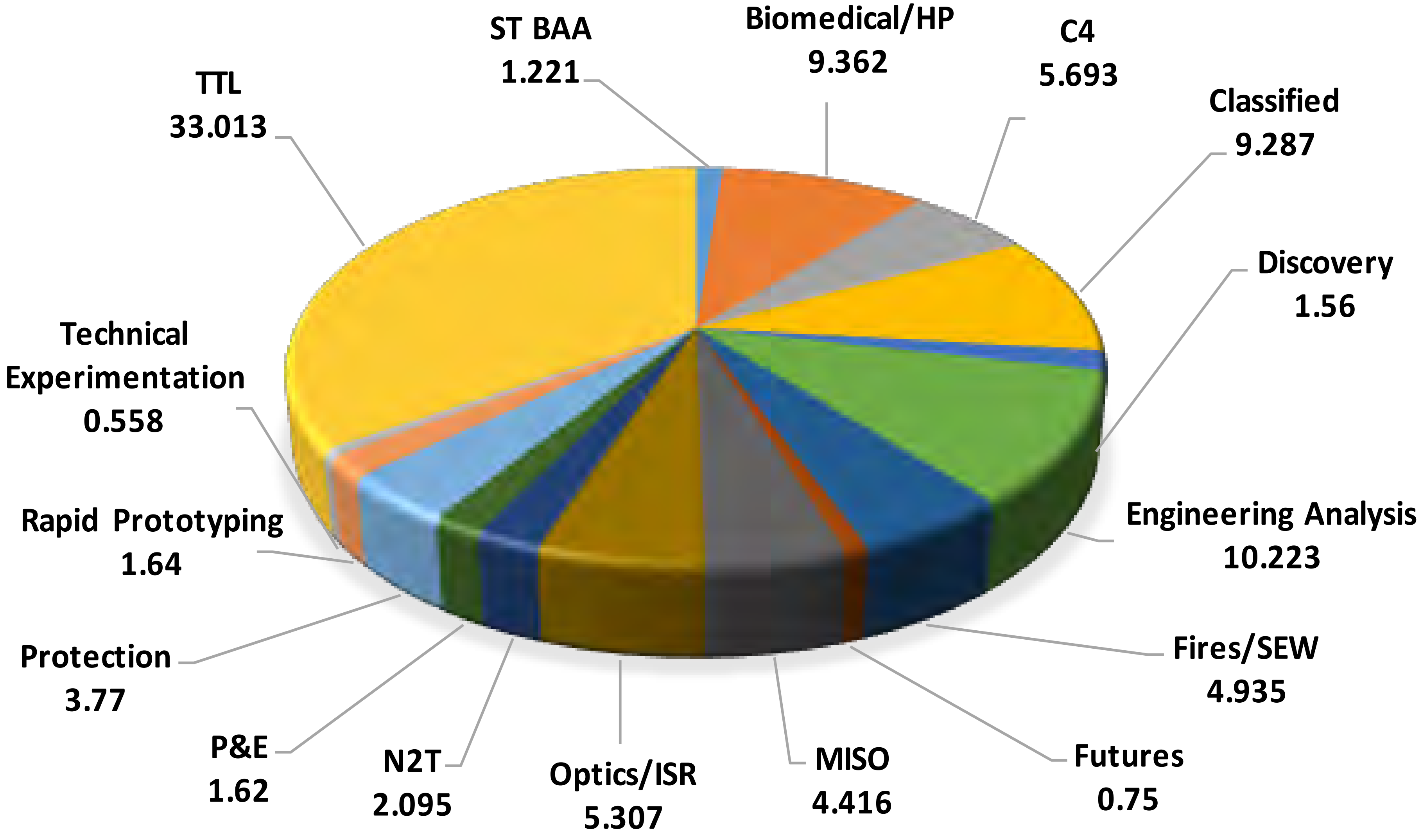
LEAD: Areas that support critical SOF capabilities and have insufficient external emphasis to assure Future SOF asymmetric advantage without SOF S&T participation. (BAA, SBIR, Cost-Share, Engineering Analysis, SOFWERX, Prize Challenges, Capstone, Land Grands, UARCs)

COLLABORATE: Team, actively participate, and invest with other organizations, membership on IPTs, impose technical standards.

INFLUENCE: No financial investment but sharing of specifications, some representation or peer review. Potential endorsement of external activities. (CRADAs)

MONITOR: Completely passive approach but keeping informed on progress; nominate areas for increased participation.

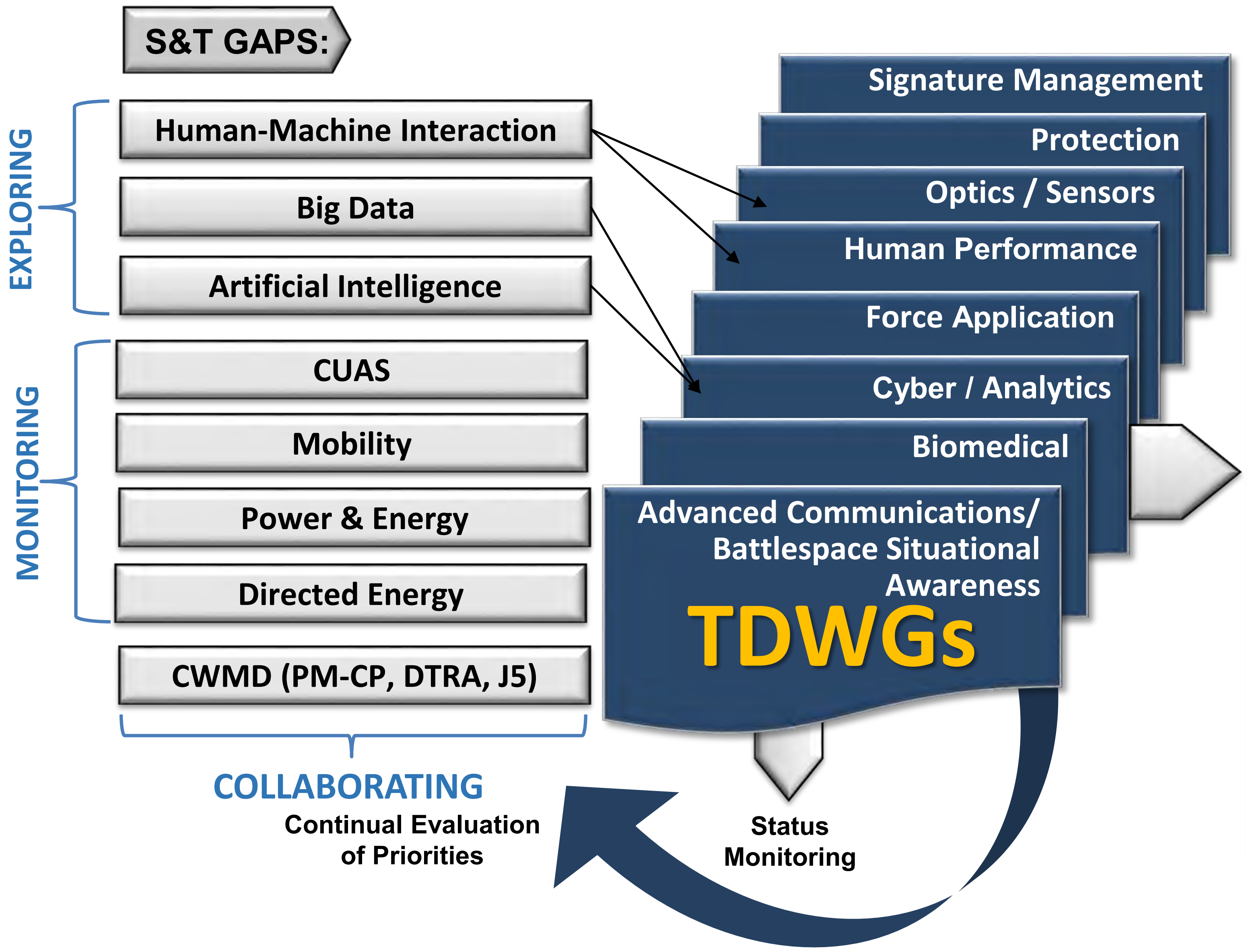
S&T FY18 S&T Spend Plan



S&T Major Drivers/Activities

- Integrating science & technology (S&T) efforts across the SOF enterprise. Ensuring that capability gaps are aligned with technology enablers and developers, ongoing efforts are integrated with transition partners, additional innovation that is required to address S&T gaps is identified, and disruptive technology solutions are assessed for their impact and potential benefit to the SOF mission set.
- Linking S&T Strategy to Rapid Prototyping Series (RAPS) events and executing actionable technology development efforts that support USSOCOM Program Executive Office (PEO) POM Technology Insertion Roadmaps (TIR) high priority needs
- Maintaining execution of tactical SOF S&T capability interests and resources
  - SOF S&T funds
  - Leverage Service/DoD efforts
  - Leverage Non-Traditional Avenues

S&T Portfolio Analysis



Technology Development Working Group (TDWG) Leads

- Cohesive understanding of respective Near-, Mid- and Far-Term technology areas
- Create, facilitate and maintain working relationships with users, tech developers, transition partners, co-development partners (Labs, Services, etc..)
- Use efficient communication methodologies to convey information and ensure transparency
- Develop expertise
- Cost, Schedule and Performance

Directorate of Science and Technology

BIOMEDICAL / HUMAN PERFORMANCE

Human Performance

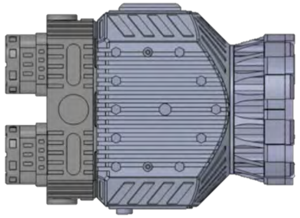
FORCE APPLICATION

Small Unit Dominance CBA

ADVANCED COMMUNICATIONS

PNT in Contested Environments (PACE)

OPTICS / SENSORS



1080P Color Night Vision

PROTECTION

Variable Transmission Laser Protection Eyewear

CYBER / ANALYTICS

Artificial Intelligence/ Machine Learning

TACTICAL ASSAULT LIGHT OPERATOR SUIT (TALOS)

Integrated Advanced VAS/ Exoskeleton

TECHNICAL EXPERIMENTATION (TE)

TE Themed Experiments

EMERGING CAPABILITIES & PROTOTYPING

JCTDs

SMALL BUSINESS INNOVATION RESEARCH (SBIR)

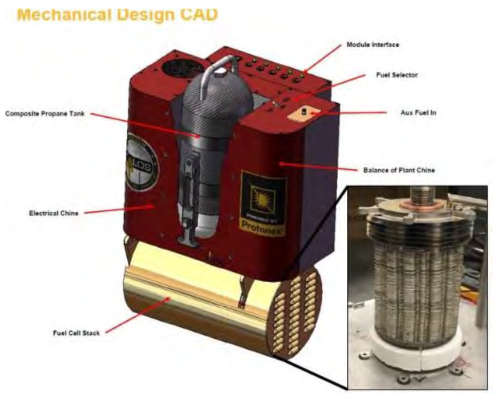
TALOS – Thermal Management & Sensing Baselayer

SOF S&T Needs

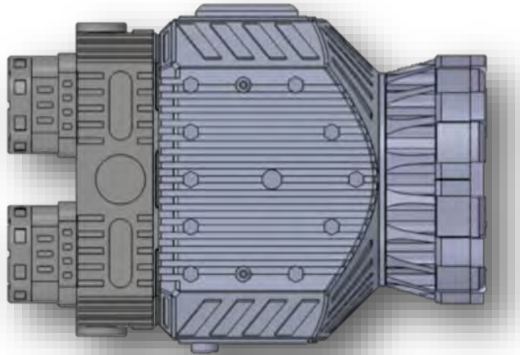
- Comprehensive Signature Management for personnel & platforms
- Unmatched ballistic protection through advanced armor/novel materials
- Capabilities to sufficiently execute Countering Weapons of Mass Destruction (CWMD)
- Enhanced Human Performance
- Far-Forward Combat Casualty Care (CCC)
- First pass accuracy and lethality
- SOF Small Unit Dominance (SOFSUD)*
- Precision Guided Munitions (PGM)/Scalable Effects Weapons (SEW)
- Counter-Terrorism (CT)/Tagging, Tracking, & Locating (TTL) technologies
- C4 revolutionary capabilities
- Optical electronics, Infrared (IR), & Lasers
- Anti-Access/Area Denial (A2/AD)
- Battlespace awareness
- Intelligence, Surveillance,
  & Reconnaissance (ISR)
- Cyber/Social media analysis tools
- Leap ahead Power & Energy (P&E) systems
- Biometrics/Sensitive Site Exploitation (SSE)
- Military Information Support Operations (MISO)

Special Operations Technology Development (SOTD)

Biomedical R&D



TALOS Solid Oxide Fuel Cell
Power & Energy



Optics/ISR – 1080P Color
Night Vision

C4 – Immersive Training
Technology

Protection –Variable Transmission
Laser Protection Eyewear (VTLPE)

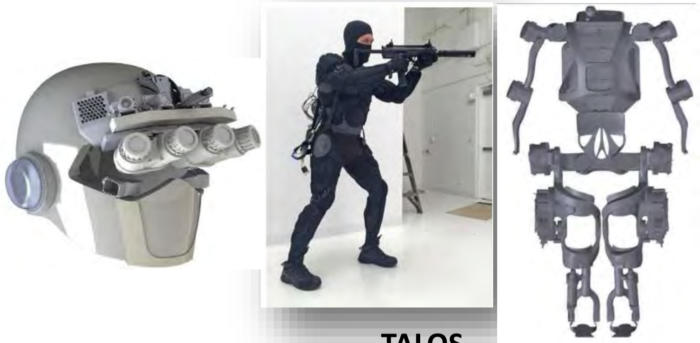
Appropriation

- RDT&E: PE 1160401BB, SOF Technology Development, Project S100

Special Operations Special Technology (SOST)

Technical Experimentation (TE)

PNT Application in Contested Environments (PACE)

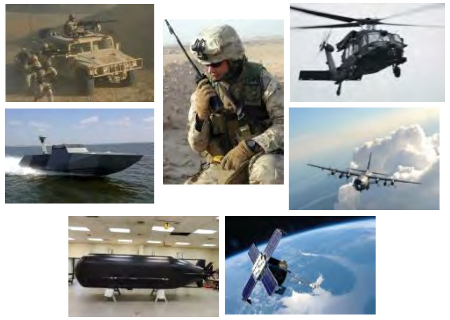


TALOS
Integrated Advanced Visual Augmentation System (VAS), Thermal Management & Sensing Baselayer and Exoskeleton

Human Performance (HP)

SOF Small Unit Dominance Capability Based Assessment (SOFSUD)

VULCAN Application



Engineering Analysis (EA)

Appropriation

- RDT&E: PE 1160402BB, SOF Advanced Technology Development, Projects S200/SF101

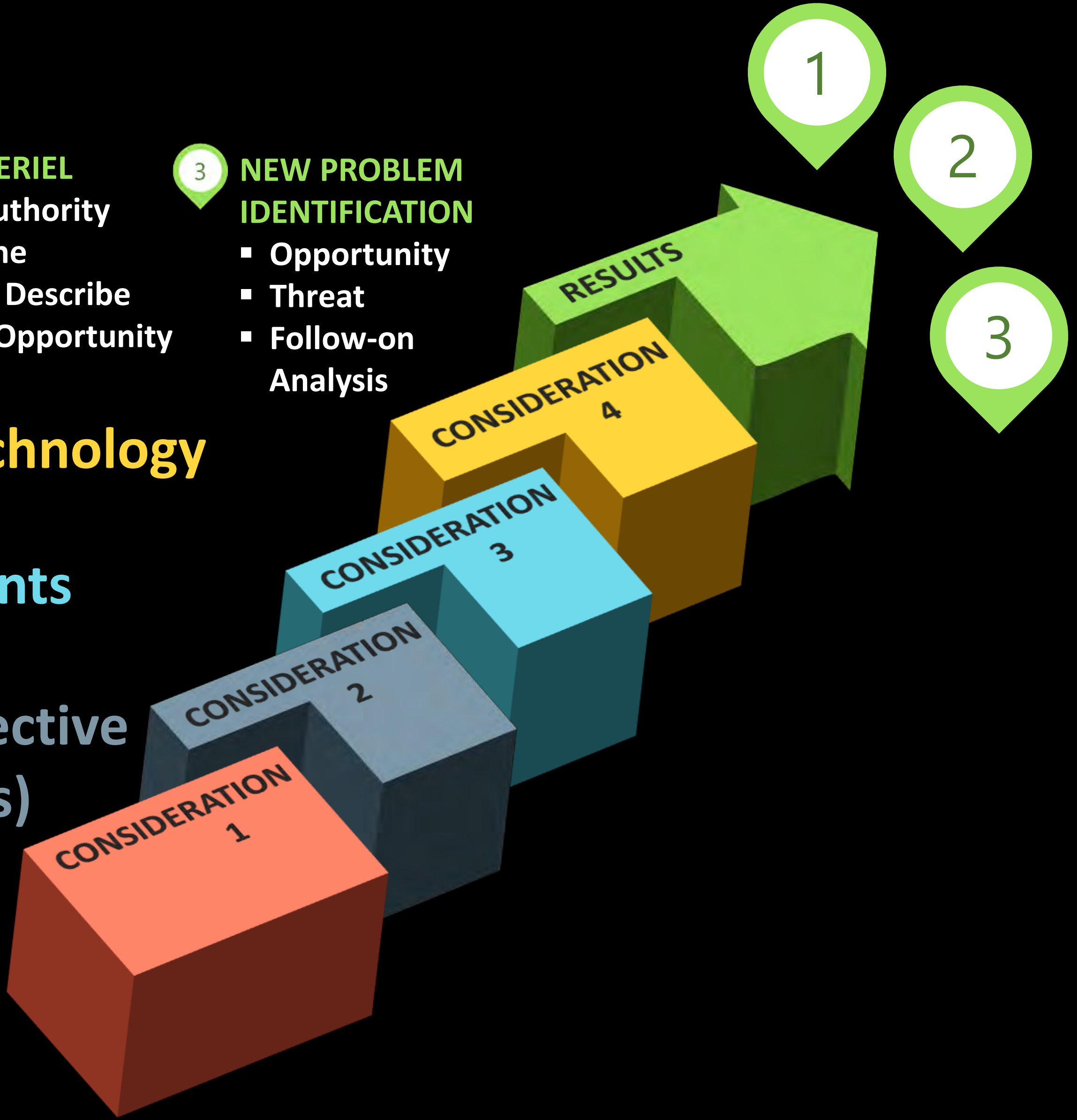
S&T Futures Process

A FOUNDATIONAL PROCESS that is FLEXIBLE/ADAPTABLE and PROVIDES A FRAMEWORK

ITERATIONS are MISSION/OBJECTIVE FOCUSED and ENABLE BRAINSTORMING/IDEATION

S&T Futures Process

- **Results**
  - 1 MATERIEL APPROACHES
    - Leap Ahead
    - Asymmetric
    - Divergent
  - 2 NON-MATERIEL
    - Policy, Authority & Doctrine
    - Assess & Describe Impact/Opportunity
  - 3 NEW PROBLEM IDENTIFICATION
    - Opportunity
    - Threat
    - Follow-on Analysis
- **Rapidly Changing Technology**
- **Changing Environments**
- **Varying Mission Objective (Measures of Success)**
- **Changing Strategic Conditions**



S&T Innovation Foundry Events

INAUGURAL INNOVATION FOUNDRY EVENT TOOK PLACE IN OCTOBER 2017

INCORPORATED DESIGN THINKING
LEVERAGED DIVERSE PARTICIPANTS

USING 2 SOF MISSION SCENARIOS, IDENTIFIED 24 FUTURES CONCEPTS and ASSOCIATED SUB-CONCEPTS/KEY TECHNOLOGIES WITH THE POTENTIAL TO REVOLUTIONIZE SOF MISSIONS 10-15 YEARS IN THE FUTURE

SOF "Hard" Problems

- **SOF SMALL UNIT DOMINANCE**
  - Integrated Operator
- **MISSION ASSURED COMMUNICATIONS**
  - Cyber
  - Contested Environment
  - Austere/Remote Operating Location
- **COMPREHENSIVE SIGNATURE MANAGEMENT**

SOF Hard Problems

USSOCOM

SCIENCE AND TECHNOLOGY - PREPARING FOR THE FUTURE 2020-2030

SPECIAL OPERATIONS COMMAND WANTS YOUR HELP SOLVING THEIR HARD PROBLEMS

United States Special Operations Command's Science and Technology (S&T) Directorate has developed three Special Operations Forces (SOF) Hard Problems that are of critical importance to SOF missions. They are: **Small Unit Dominance**, **Mission Assured Communications**, and **Signature Management**. The three SOF Hard Problems are available for download at: https://www.socom.mil/SOF-ATL/Pages/SOF-Hard-Problems.aspx.

If you think you've got a solution that can help USSOCOM's S&T Directorate solve some or all of the SOF Hard Problems please reply via their Hard Problems mailbox also located on that same website. Please feel free to distribute this information to interested parties that could provide potential solutions to these S&T SOF "Hard Problems."

SOF Small Unit Dominance

MISSIONS
- Direct Action
- Hostage Rescue and Recovery
- Counterterrorism
- Countering Weapons of Mass Destruction
- Counterinsurgency

COMMUNICATIONS
Big Problem #2

SITUATIONAL AWARENESS

DISMOUNTED

OPERATOR

INFORMATION MANAGEMENT
- Fusing
- Display

SENSORS
- PNT
- Optical
- Infrared
- RF

PROTECTION

TACTICAL
- Armor
- Jammers

HOLISTIC
- Medical
- Human Performance

LETHALITY
– SCALABLE
- Effect
- Size
- Range

MOBILITY
- Dismounted
- Ground Transit
- Insertion

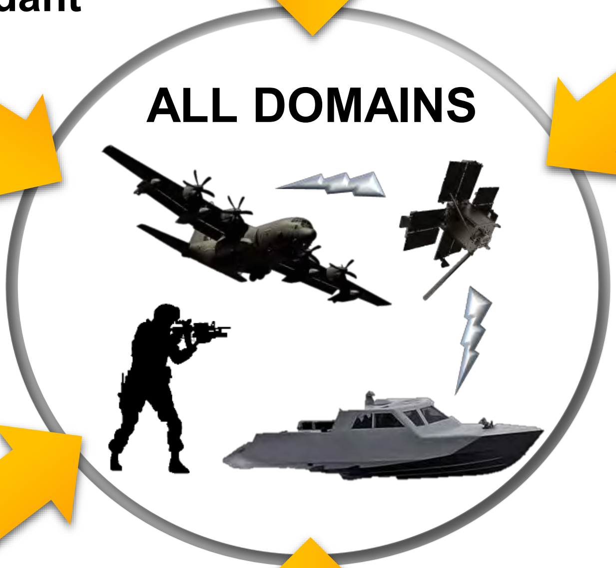
Adversary Impact
- Capability / Threat
- Task / Purpose
- Intelligence

Non-Materiel Enablers / Constraints
- Doctrine
- Training
- Policy / Authority
- Task / Purpose

SOF Mission Assured Communications

GLOBAL NETWORK
- Interoperable, Adaptive Networks
- Infinitely Scalable
- Resilient, Robust, & Redundant
- Big Data Analytics

INFORMATION MANAGEMENT
- Increased Capacity & Efficiency
- Reduce Cognitive Workload
- Multiple Transport Methods



DEFEND THE NETWORK
- Cyber Hacks
- Denied Environments

EXPEDITIONARY COMMS
- Remote Locations
- Highly Contested
- Device Agnostic
- Low Signature

Adversary Impact
- Capability / Threat
- Task / Purpose
- Intelligence

Non-Materiel Enablers / Constraints
- Doctrine
- Training
- Policy / Authority
- Task / Purpose

S&T Engagement Tools

S&T ACTIVITY	OPPORTUNITY	ENGAGEMENT
SOF Innovation Foundry Events POC: Shawn Martin 813-825-4578, shawn.martin@socom.mil	• S&T has developed an S&T Futures Process • S&T conducts "Innovation Foundry" events to enable SOF's ability to accomplish their missions 10-15 years in the future	• S&T plans to conduct 1-2 SOF Innovation Foundry Events per Fiscal Year • Innovation Foundry events will provide opportunities for attending and injecting disruptive technology solutions for SOF
Small Business Innovation Research (SBIR)/ Small Business Technology Transfer (STTR) POC: Mr. Anthony Aldrich 813-826-9150, anthony.aldrich@socom.mil	• S&T manages SOCOM's SBIR/STTR programs • Stimulates innovation for small businesses • 3 Phases, Phase I is a Study ($150K), Phase II Prototype ($1.5M), Phase III Commercialization	• https://www.socom.mil/SOF-ATL/Pages/sbir.aspx • USSOCOM participates in three SBIR/STTR Topics Call per year (April, August, and December timeframes)
Technical Experimentation (TE) Events POC: Mr. Dan Bernard 813-826-9917, dan.bernard@socom.mil	• Conducts 3 US-based events every fiscal year each with different theme(s) • Industry opportunity to engage and demonstrate technology/concepts and get direct feedback from SOF Operators/Acquisition Professionals	• Normally 1 TE Event/QTR, TE Request for Information (RFI) posted on FBO.gov for each TE Event • Go to https://www.socom.mil/SOF-ATL/Pages/technical-experimentation.aspx
Cooperative Research & Development Agreements (CRADA) POC: Mr. Howard Strahan 813-826-1267, howard.strahan@socom.mil	• SOCOM employs Overarching and Specific (Traditional) CRADAs • Legal agreement to provide general and specific access to USSOCOM needs	• Allows for the formulation and execution of Individual Work Plans (IWP) between the Collaborator – PEO/Directorate within SOF AT&L
Broad Agency Announcements (BAA) POC: Mrs. Damian Guinn 813-826-7416, damian.guinn@socom.mil	• SOCOM S&T Directorate/PEOs develop and post BAAs to FBO.gov that provide Areas of Interest (AOI) to Industry and other External Organizations	• S&T BAA once per year in April • TALOS BAA once per year in January • Biomedical BAA once per year in February through US Army
Vulcan POC: Mr. Howard Strahan 813-826-1267, howard.strahan@socom.mil	• Web-based platform that enables anyone to quickly describe technology and upload supporting documentation to a secure, shared, searchable, central database	• Vulcan supports evaluation/ assessment/scoring of submitted technologies, and sharing of results • Go to www.vulcan-sof.com and register
Technology & Industry Liaison Office (TILO) POC: Mrs. Shelvin Watts 813-826-1269, shelvin.watts@socom.mil	• Conduit for the SOF AT&L Enterprise • Matches your company's product/service/capability to the appropriate personnel within the command and schedules discussions or demos	• Go to https://www.socom.mil/SOF-ATL/Pages/submit-your-idea.aspx for information and link to USSOCOM Areas of Interest and for the TILO Submitting Your Idea Form

Acquisition Agility: SOFWERX

New Processes

Rapid Prototyping

ThunderDrone Rapid Prototyping Event: Warfighter Council

Collaboration Events

LTATV Industry Collaboration

OpenWerx Challenges

Prize Challenges

Industry Fellows

HARRIS
KOPIS MOBILE
INDUSTRY COMMUNITY UNIVERSITY
BATTELLE
L3
Raytheon
e.C.
ULTRALIFE
NORTHROP GRUMMAN

Academic Interns

Additive Manufacturing
3-D Printing Training

New Products

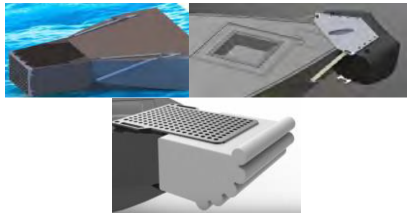
MedRZR- Litter Carrying

Interceptor & Scalable Drones

C4 Communications Suite for LTATV

Mobility C4

Combatant Craft Bow Bumpers



New Networks

ECOSYSTEM

Small Business
Academia
Futurists
Citizen Scientists
400+ Hacker/Maker

New Ideas

Single Man Flying Machines

USSOCOM CRADAs

OVERARCHING CRADA

- Formulated to provide general access to USSOCOM gaps/needs to foster collaboration – must be consistent with missions of organization
- Allows for the formulation and execution of Individual Work Plans (IWP) between the Collaborator – PEO/Directorate within SOF AT&L
- Collaborator may request meetings with appropriate personnel to discuss IWP development – through the SOF AT&L Technical POC
- SOF AT&L Acquisition Executive signed – company coordination and acceptance – generally 30 days

SPECIFIC (TRADITIONAL) CRADA

- Formulated to provide a collaboration on a specific technology
- Follows USSOCOM Directive 70-1 Appendix Q procedures
- Standard Template
- Specifically between collaborator and single PEO/Directorate
- Writing and staffing is generally 90 to 120 days

Vulcan-Technology Scouting Application

- **Web-based platform that enables anyone to quickly describe technology and upload supporting documentation to a secure, shared, searchable, central database**
  - Information is entered into a "Scout Card"
  - Scout Cards can be easily disseminated across the SOF enterprise to individuals or teams
  - Enables everyone in SOF to be a Tech Scout
- **Government users can remotely "poke" the organization or individual who originally entered the data to provide updates/respond to comments**
- **Vulcan supports evaluation/assessment/scoring of submitted technologies, and sharing of results**
- **Each time a Scout Card is interacted with it has an associated timeline showing technology maturation across events**

Go to www.vulcan-sof.com and register

Vulcan provides an <u>exponential</u> increase in efficiency and effectiveness over existing business processes for gathering, disseminating, searching, assessing and <u>acting on</u> technology related information.

Technical Experimentation (TE)

- **18-2, 26-30 March 2018 at Camp Atterbury-Muscatatuck Center for Complex Operations, IN**
  - Experimentation Focus: Long Range Facial Recognition and Chemical Attribution, Neuro-Cognitive Enhancements, and Optics
- **TE 18-3, 17-21 July 2018 at Fort A.P. Hill, VA**
  - Experimentation Focus: C4, Cyber, ISR, Mobility, and Small Unmanned Aerial Systems (SUAS)
- **Public Link:** http://www.socom.mil/SOF-ATL/Pages/technical-experimentation.aspx
- **Linked in© Group: SOCOM Technical Experimentation**

Our Blueprint

Set **unreasonable** expectations

Execute an **elastic** business definition

A **cause,** not a business

Embrace and listen to **new voices**

Enable a market for **innovation**

Exploit low-risk experimentation

Create and exercise the **network**

USSOCOM acquisition ... light, agile, lethal: a pathfinder for DoD acquisition reform:
USSOCOM leads the way by focusing on modifying organization culture rather than processes - GLENDA H. SCHEINER

LEADING THE REVOLUTION - GARY HAMEL

Adapt or Die

QUESTIONS?

BACKUP

S&T Medical Technology Success

Uncontrolled hemorrhage is the leading cause of preventable combat-related deaths. The vast majority of these deaths occur in the field before the injured can be transported to a treatment facility. Early control of hemorrhage remains the most effective strategy for treating combat casualties.

1998

Hemostatic Agents in Uncontrolled Hemorrhage – Proof of Concept Studies. (USSOCOM S&T Projects)

2003

Hemostatic Dressing Device and Protocol – 2500+ delivered to SOF

2005

HemCon Bandage (Chitosin) to Special Operations Forces

Department of Air Force/SGO CENTCOM CENTAF Selection of Hemostatic Agent for New Individual First Aid Kits (HemCon, QuikClot)

2007

SOF Tactical Combat Casualty Care Kits (CDD)


UNITED STATES SPECIAL OPERATIONS COMMAND
OFFICE OF THE DEPUTY COMMANDER

MEMORANDUM FOR

DIRECTOR, CENTER FOR SPECIAL OPERATIONS, HEADQUARTERS, UNITED STATES SPECIAL OPERATIONS COMMAND, 7701 TAMPA POINT BOULEVARD, MACDILL AFB, FL 33621-5323

DIRECTOR, CENTER FOR ACQUISITION AND LOGISTICS, HEADQUARTERS, UNITED STATES SPECIAL OPERATIONS COMMAND, 7701 TAMPA POINT BOULEVARD, MACDILL AFB, FL 33621-5323

SUBJECT: Capability Development Document for Tactical Combat Casualty Care Kit

1. In accordance with the recommendations of the Special Operations Command Requirements Evaluation Board (SOCREB), the subject Capability Development Document (CDD) is approved and is formally transitioned to the Special Operations Acquisition Executive for action.

2. Approval of this document does not constitute program funding. This requirement must compete in accordance with United States Special Operations Command Directive 71-4 and with all other valid requirements.

3. The designated lead for this multicomponent CDD is the United States Special Operations Command Surgeon (SOCS-SG).

4. Designated distribution is "A" and "C", distribution authorized to DOD and U.S. DOD contractors only (critical technology). Other requests shall be referred to Headquarters, United States Special Operations Command.

5. The USSOCOM POC is LTC Gary Cross, SORR-J8-RS, DSN 299-9340.

ERIC T. OLSON
Vice Admiral, U.S. Navy
Deputy Commander

CF:
SOCS-SG

United States Transportation Command (USTRANSCOM) Challenges & Opportunities

Mr. Lou Bernstein, TCJ5-GC

Research, Development, Test & Evaluation (RDT&E) Program Director

22 March 2018

Distribution Statement A: Approved for Public Release

Overview

- USTRANSCOM 101
- RDT&E Program Overview/Process
- Technology Focus Areas/Challenges
- Overview of Select Current Initiatives

Mission

DPO
USTRANSCOM DISTRIBUTION PROCESS OWNER

SDDC

JECC

MSC

JTRU

AMC

USTRANSCOM Provides Full-Spectrum Global Mobility Solutions & Related Enabling Capabilities for Supported Customers' Requirements in Peace and War

The Global Distribution Network

USTRANSCOM Assets/Team

RDT&E Program Foundation

Program Element (PE) ($M) – Air Force	FY18	FY19	FY20	FY21	FY22	FY23
Deployment & Distribution (PE0604776F)	26.22	28.35	28.94	29.44	30.05	30.60

- **As the Joint Deployment & Distribution Coordinator, USTRANSCOM actively pursues collaborative partnerships to:**
  - Rapidly integrate deployment and distribution capability enhancements to improve Joint Deployment & Distribution Enterprise (JDDE) logistics effectiveness & efficiency
  - Provide tangible cost savings/avoidances
- **Goals:**
  - Develop and deploy joint, relevant technologies to improve Warfighter support while reducing costs
  - Improve precision, reliability, visibility and efficiency of the DOD supply chain
  - Assure superior strategic, operational and tactical mobility support

~$523M Services/Agency/OSD leveraged; **90.8%** Transition Rate (DOD metric is 30%)

DOD Levels of RDT&E Budget Activity (BA)

- Basic Research (BA1): Systematic study directed toward a greater understanding of the fundamental aspects of phenomena and/or observable facts without specific applications toward processes or products
- Applied Research (BA2): Systematic study to gain knowledge necessary to determine the means by which a recognized and specific need may be met
- Advanced Technology Development (BA3): Includes all efforts that have moved into the development and integration of hardware for field experiments and tests
- **Demonstration and Validation (BA4): Includes all efforts to evaluate integrated technologies in a realistic operating environment to assess performance or cost reduction potential of the advanced technology**
- Engineering and Manufacturing Development (BA5): Includes projects in engineering and manufacturing development for Service use which have not received approval for full rate production
- RDT&E Management Support (BA6): Includes R&D efforts directed toward support of installation operations required for general R&D use. This includes test ranges; military construction; maintenance support of laboratories; operations and maintenance of test aircraft and ships; and studies and analysis in support of a R&D program
- Operational System Development (BA7): Includes projects in support of development acquisition programs or upgrades still in engineering and manufacturing development. These projects have received Defense Acquisition Board or other approval for production or for which production funds have been included in the DOD budget

USTRANSCOM Budget Line Shifted from DLA to USAF in FY17

Technology Readiness Levels (TRL)

USTC RDT&E Program Focus

- TRL 1: Basic principles observed and reported
- TRL 2: Technology concept/application formulated
- TRL 3: Analytical or experimental proof of concept
- TRL 4: Component(s) validated in normal lab environment
- TRL 5: Component(s) validated in realistic lab environment
- TRL 6: System or subsystem prototype in relevant environment
- TRL 7: System prototype demonstration in operational environment
- TRL 8: Actual system qualified through developmental T&E
- TRL 9: Actual system proven through operational T&E

Commander's Priorities

JDDE Enduring Challenges

FY 20 Focus Areas

- Cyber and Electronic Security
- Big Data
- End-to-End Visibility
- Sea Basing Technologies/Logistics-Over-The-Shore
- Delivery Technologies
- Rapid Distribution Technologies
- Rapidly Establish Points of Debarkation
- Distribution Planning and Forecasting
- Predictive Forecasting
- Secure Collaboration with Commercial Partners
- Cloud Computing
- Electronic Data Interchange
- Resilient Communications
- Transportation Node Optimization
- Modeling
- Supply Chain Sustainment Simulation Tools
- Adaptive Planning and Execution
- Interoperable, Multi-modal Patient Movement

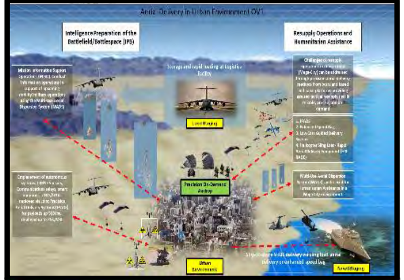
- Knowledge Management
- Automatic Identification Technology
- Risk Assessment
- Process Management and Business Rules
- Information Science and Technology
- Distributed Global Mobility C2
- Information Visualization
- Cross-Domain Information Exchange & Collaboration
- Joint Retail Inventory Interoperability
- Human System Interface
- Fuel Efficiency
- Advanced Mobility Aircraft
- Mobility Aircraft
- Convoy Security
- Aircraft Survivability
- Force Protection
- Autonomous Approach and Landing Guidance
- Opportune Landing Site Identification
- Standardized Intermodal Containers/Pallets

FY20 New Start Solicitation Process Timeline

- Revised Operational/Technical Challenges
  - ✓ 27 Oct 17 - 17 Jan 18: Changes submitted by JDDE Community
  - ✓ 24 Jan – 20 Feb: Reviews by multiple boards
  - ✓ 26 Feb: Commander USTRANSCOM approved
- ✓ 1 Mar: FY20 Solicitation Released (http://www.transcom.mil/cmd/associated/rdte/)
- 30 Mar: Phase I White Papers Due
- 2-27 Apr: Phase I Evaluation Period
- 30 Apr: Phase II Selection Notification
- 29 Jun: Phase II Proposals Due
- 2 Jul – 14 Aug: Phase II Evaluation Period
- 28 Aug – 30 Sep: Vet Draft FY20 New Start Investment Plan via multiple boards
- 16 Oct: TRANSCOM Oversight Council (★★) FY20 Investment Plan Review
- 31 Oct: TRANSCOM Corporate Board (★★★★) FY20 Plan Approval
- 31 Oct: Notification of Final Selection

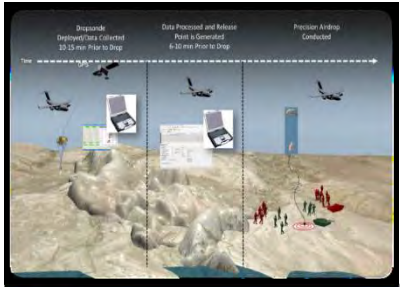
Partners & Collaboration

Select Current Initiatives



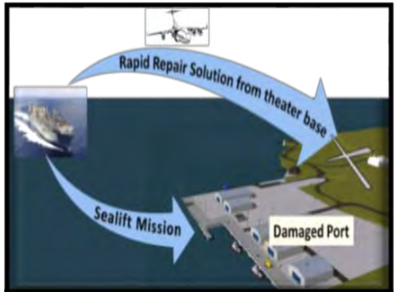
Autonomous Aerial Insertion and Resupply into Dense, Urban, Complex Terrain

Autonomously insert sensors, munitions, unmanned ground vehicles & supplies into an urban environment



Dropsonde Optimization

Pursue single pass airdrop capability to enhance delivery aircraft/crew safety

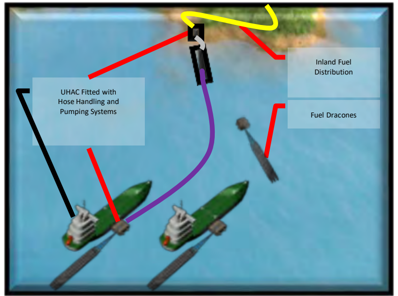


Preamble Initial Look Leading to Accelerated Results/Port Improvement via Exigent Repair

Rapid repair capability to fix a damaged pier

Mini-Robotic Dredge

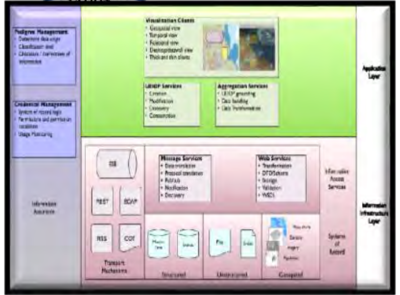
Expeditionary dredging capability to support improved access to the shore



Expeditionary End-to-End Fueling Concept

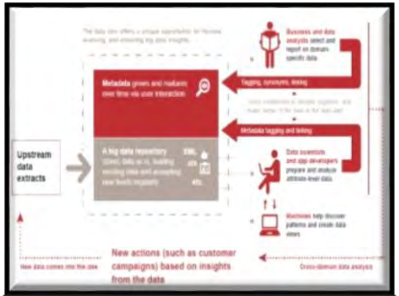
Modular pumping system to address over-the-shore & inland distribution needs and inform future Service Programs of Record

Current Initiatives



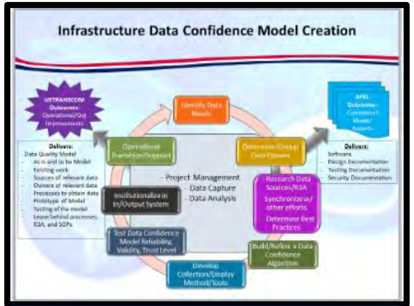
Strategies for Enterprise Metadata Management

Implementation strategies for enterprise-wide metadata management



Sprint to Big Data/Data Lakes

Explore repository for structured & unstructured data that preserves data fidelity for real time analysis



Infrastructure Information Confidence Model with Automation

Info collaboration process provides a confidence assessment

Analytics Driven Command Decision Support

Enhance organizational decision making by providing a holistic methodology

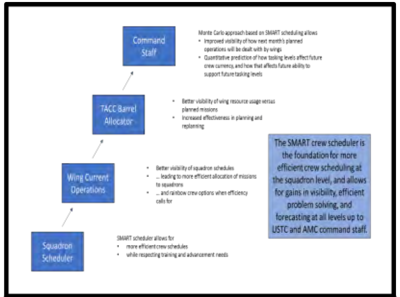
End-to-End (E2E) Distribution Modeling

Enhance E2E modeling/analysis to optimize force projection, distribution and redeployment

FY18 New Starts

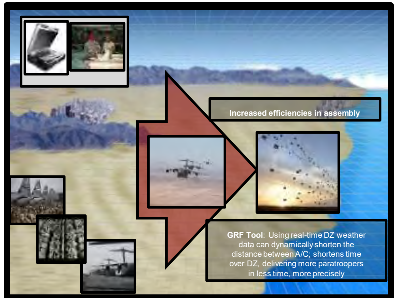
Autonomous Drone Delivery from Airdrop Systems

Develop air-droppable Unmanned Aerial System (UAS) capability



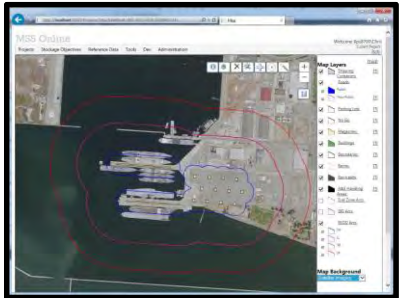
Synchronizing Mobility Allocations and Resources for Transportation

Squadron scheduling/allocation/collaboration crew utilization forecasting tool



Advanced Planning for Global Response Force

Analytical/visual tools to provide joint warfighting planners the ability to plan missions



Web Based Seaport Explosive Safety Planning

Develop an ammunition storage and explosive safety application

RDT&E Info (http://www.transcom.mil/cmd/associated/rdte/)

USTRANSCOM
United States Transportation Command

Enterprise Readiness Center | Doing Business with USTRANSCOM | Moving Passengers and Cargo | Defense Transportation Regulations

Incoming Personnel | Command Information | Associated Websites | Freedom Of Information Act | Customer Feedback

Research Development Test & Evaluation

The USTRANSCOM Research Development Test & Evaluation program explores innovative joint technologies that address Distribution Process Owner (DPO) and Defense Transportation System (DTS) capability gaps.

Our History

On 16 September 2003, the Secretary of Defense designated United States Transportation Command (USTRANSCOM) as the Department of Defense (DOD) Distribution Process Owner (DPO), responsible for the overall efficiency and interoperability of distribution-related activities supporting the deployment, sustainment, and redeployment of forces conducting the full range of military operations. The paramount goal of the DPO Science and Technology program is to enhance support to USTRANSCOM's customers in peace and war through exploration of transformational distribution technologies. The S&T program fosters development of new bodies of knowledge on distribution, then enables evaluation and integration of the resulting transformational approaches.

As the DOD's DPO, USTRANSCOM's business enterprise stretches from the point at which warfighting materiels have been procured to their point of use in a theater of operations--anywhere in the world. This "global supply chain" requires close synchronization between operational planners and the materiel, personnel, and facilities that support the warfighting customer. Often the system must respond with only a few hours' notice. For capital assets like aircraft and tanks, the supply chain also has a retrograde requirement--to return items for employment in future operations. Movement and sustainment of personnel are also missions USTRANSCOM executes.

USTRANSCOM's mission is unique in the fact that it does not direct all the organizations and agencies that accomplish the missions of mobilization, deployment, sustainment, employment, and redeployment. Rather, as an orchestrator, USTRANSCOM must collaborate rapidly, with many partners, to ensure the supply chain operates effectively and efficiently.

In recognition of the vastly complex business of DOD distribution, USTRANSCOM received its first increment of Research, Development, Test and Evaluation (RDT&E) funds in fiscal year 2006 to

Navigation

- RDT&E Home
- Ongoing Projects
- References
- Capabilities
- FY19 Project Solicitation (Government Only)
- Related Links
- Program Training
- Frequently Asked Questions

Backups

JDDE Challenge Descriptions

- **Cyber and Electronic Security:** USTRANSCOM and its components must be able to defend its information, detect and mitigate cyber and electronic threats against mobility platforms, networks, and C2 systems to continue uninterrupted operations. This requires a platform independent capability to secure deployment/distribution information resident in or traversing low assurance info networks/environments. This includes anomaly detection and predictive analysis techniques/tools (e.g. artificial intelligence (AI), machine learning (ML) & cognitive computing (CC)) to dynamically assess future threats, attack vectors, and attacker intent and anticipate actions before they happen (i.e., the capability to defeat an attack before it happens, instead of having to react to it as it occurs). Capability must allow for assured, secure and trusted communications protected with Federal Information Processing Standard (FIPS) 140-2 compliant cryptography while also robustly withstanding or adapting to direct electronic attack. Solutions must require minimal management/infrastructure overhead, be able to integrate into existing DOD and commercial information systems, and leverage government-owned/operated capabilities to the maximum extent possible. Capability must enhance government collaboration in its ability to predict, detect, analyze, assimilate, mitigate, and deter cyber and electronic threats.

JDDE Challenge Descriptions

- **Big Data:** USTRANSCOM lacks the ability to provide authoritative data at the Speed of War at the right time and place to drive informed decisions and operational effectiveness. Today's data environment has many independently managed data sources and no common standards, resulting in inconsistent outcomes that drive increased risk to operations and decision making. Ability to manage data as a strategic resource is foundational to USTRANSCOM's transformation to a data driven command and underpins implementation of business reform initiatives such as the implementation of a Transportation Management System. USTRANSCOM requires the definition, evaluation, and proposal of tools and implementation methodologies for Machine Learning (ML) and Artificial Intelligence (AI) solutions to support planning, analysis, operations, logistics, and real-time decision making for the JDDE. Includes but is not limited to advanced big data management; manipulation/integration of large data sets, discovery, predictive/ prescriptive analytics, and deep learning algorithm schema. Solutions must allow transparent access to, data mining of, and knowledge discovery in large, distributed, relational and non-relational databases; and ability to autonomously explore, analyze and identify trends and correlations between elements of large data sets to enhance data analytics and aid decision support, ML, AI, and cognitive computing.

JDDE Challenge Descriptions Continued

- **End-to-End Visibility:** Stakeholders throughout the deployment and distribution process require the ability to determine shipment status (where has it been, where is it now, and what condition is it in) through system access at the beginning of a movement through the various nodes to the final destination/point of need. The availability of this information contributes to inform decision making, confidence in the supply chain, and improve overall performance of the logistics processes. Although much asset visibility data resides in USTRANSCOM's Integrated Data Environment/Global Transportation Network Convergence (IGC) system, challenges remain in the effectiveness and efficiency of data capture, visibility of assets in-theater, and ability to create an enterprise view of the data. USTRANSCOM is interested in partnering with other organizations to provide solutions to overcome challenges relating to the integration of asset visibility data into appropriate business processes and system(s) to include, but are not limited to: advanced cryptology, distributed ledger technologies and artificial intelligence (AI).
- **Sea Basing Technologies/Logistics-Over-The-Shore:** Technologies and enablers to enhance the Joint Force Commander's flexibility to deploy and employ from/through a joint sea base as well as deliver and sustain warfighting capabilities at the point of effect. Enhancements should minimize the need to build up a logistics stockpile ashore and permit the forward positioning of joint forces for immediate employment. This includes autonomous technologies that facilitate the trans-loading and/or transporting of supplies and equipment in a sea base operation within a degraded or austere access environment. Solutions could include stealth capabilities to include under surface solutions, masking or other capabilities to minimize risk to the asset and subsequent delivery operations. Solution should provide protective or defensive capability to ensure asset can deliver its requirements in a hostile environment.

JDDE Challenge Descriptions Continued

- **Delivery Technologies:** Seeking innovative solutions, to include autonomous, AI and ML technologies, that provide for the safe, accurate and timely delivery of joint forces and their sustainment within an Anti-Access/Area Denial (A2/AD) environment across a complex, distributed battlefield. This includes the re-supply of forces in austere conditions and in high threat areas, just two of the missions driving the need for more accurate and single-pass precision airdrop. This area applies to technologies to ensure survivability of aircraft and personnel on the ground while delivering cargo to a precise location within a high threat environment.
- **Rapid Distribution Technologies:** Concepts and technologies, to include autonomous, AI and ML, that improve the end-to-end flow of military unit equipment and cargo through ocean ports, aerial ports and intermodal inter-change points, to include autonomous capabilities and motion compensation interface platforms, for use with commercial cargo vessels to enhance cargo throughput of military unit equipment at sea.
- **Rapidly Establish Points of Debarkation:** The JDDE lacks the ability to rapidly assess, establish, and secure points of debarkation in an anti-access/area denial/contested environment to make the Joint force more expeditionary.
- **Distribution Planning and Forecasting:** There is a lack of collaborative distribution planning, based on an understanding of aggregate customer requirements, for optimizing the JDDE. Require solutions, to include AI/ML, that synchronize planning, forecasting and collaboration capabilities to ensure people, processes and assets are in place to execute planned operations.

JDDE Challenge Descriptions Continued

- **Predictive Forecasting**: Seeking solutions, to include AI/ML, to enhance the warfighter's ability to more accurately forecast future logistics requirements. The JDDE lacks the capability to predict maintenance and logistics requirements to enhance operational needs and optimize the supply chain, both forward and reverse flow. Where predictive maintenance/logistics forecasting capabilities exist, they are not linked (machine-to-machine) to distribution and logistics support responses.

- **Secure Collaboration with Commercial Partners:** USTRANSCOM has interest in exploring concepts which minimize risk to passenger and cargo movement data on commercial scheduled or chartered plane, ship, truck, bus, barge, and rail services leaving the Defense Information Systems Network (DISN) and shared with commercial partners. Capability must allow for assured, secure and trusted communications protected with Federal Information Processing Standard (FIPS) 140-2 compliant cryptography. Solutions must require minimal management/infrastructure overhead, be able to integrate into existing DOD and commercial information systems, and leverage government-owned/operated capabilities to the maximum extent possible. Goal is to securely collaborate and share information with commercial partners while ensuring confidentiality, integrity, and availability of U.S. transportation data residing outside of the DISN. Technologies of interest may include, but are not limited to: advanced cryptology, distributed ledger technologies and artificial intelligence (AI).

JDDE Challenge Descriptions Continued

- **Cloud Computing:** Explore, demonstrate and prototype a modern cloud computing environment which supports migration of multiple applications from current DOD environments. Goal is to show the utility of a vendor agnostic cloud computing environment which demonstrates the value of open architectures, modern tools and services while adhering to appropriate DOD Computer Network Defense Service Provider (CNDSP) security methodologies. Prototype environment must demonstrate and support these key areas of interest: business intelligence, analytics, rapid prototyping, performance dashboards, continuous development and testing, and containerization.
- **Electronic Data Interchange:** Today USTRANSCOM and its components use electronic data interchange (EDI) to communicate with its industry partners. EDI continues to evolve/mature to meet requirements. The move towards a service-oriented architecture provides additional opportunities for EDI that did not exist previously. There is a need to assess the current state of how EDI is being used and then evaluate opportunities, to include AI/ML, for future enhancement.
- **Resilient Communications:** The JDDE needs technical solutions that address resilient and secure communications and networks, information infrastructure protection, and engineered systems. The objectives of the research are to provide secure, resilient, and assured communications over both wired and wireless networks to include highly mobile networks.
- **Transportation Node Optimization:** Warfighters need a single integrated view of force movement and sustainment planning requirements to provide a continuous and optimal balancing of total demand and capacity from plan inception to mission completion. Looking for technologies, to include AI/ML, to provide desired capability.

JDDE Challenge Descriptions Continued

- **Modeling:** Budget uncertainty and the evolving global mobility environment drive the need to modify our business processes, equipment and infrastructure. Currently USTRANSCOM is limited in its ability to weigh alternative courses of action and/or measure the effectiveness of the proposed changes. USTRANSCOM requires modeling & decision support tools to transform systems, programs and initiatives to ensure operational efficiency.
- **Supply Chain Sustainment Simulation Tools:** Joint simulation tools are poorly equipped to integrate sustainment flow modeling at the strategic and operational levels (wholesale and Service-level retail). Little capability exists to do unconstrained "what-if" supply scenarios without manual effort.
- **Adaptive Planning and Execution:** The planning community requires trained personnel, well defined processes and the essential technologies, including AI/ML, to ensure DOD's ability to rapidly develop, assess, adapt and execute plans in a dynamic environment.
- **Interoperable, Multi-modal Patient Movement (MM-PM):** Future contingency operations may result in significantly larger numbers of seriously injured casualties in denied areas, where PM requirements cannot be met exclusively with strategic airlift platforms and USAF Aeromedical Evacuation personnel and equipment. As a result, PM activities may be delayed, take place over longer distances, and require use of different transportation platforms and en route care capabilities than currently employed. USTRANSCOM needs viable solutions to provide MM-PM (air-, sea-, and ground-based) through the continuum of care to the CONUS support base under a variety of operational conditions (contested, permissive, cyber-degraded environments, etc.)

JDDE Challenge Descriptions Continued

- **Knowledge Management:** The operational and technical requirements of an effective near real-time global transportation network cannot be achieved through the application of legacy data-centric software design and development principles. Such a network calls for a degree of interoperability and a level of collaborative decision-support that is not available in any existing industry or government software environment of comparable scale. USTRANSCOM is looking to create an information-centric knowledge management layer on top of a data-centric Corporate Data Environment meta database layer.
- **Automatic Identification Technology (AIT):** AIT and automated information systems (AIS) are two of the basic building blocks in DOD's effort to provide timely asset visibility in the logistics pipeline, whether in-storage, in-transit, in-process or in-theater. AIT is used by a business AIS to capture the identity of materiel or packaging at each layer of consolidation to improve logistics processes. AIT also contributes to the track-and-trace capability within the Department's supply and distribution operations. USTRANSCOM is interested in partnering with other organizations in solutions, to include AI/ML, that improve logistics processes in a resource-constraint budget environment.
- **Risk Assessment:** There is a lack of available real-time risk assessment information for commanders and deploying units to rapidly determine acceptable levels of risk while en route to final destinations or to an intermediate staging locations. Interested in technologies, to include AI/ML, to address this gap.

JDDE Challenge Descriptions Continued

- **Process Management and Business Rules:** Joint process descriptions and business rules either do not exist or are unclear for many key deployment and distribution processes. A lack of well-defined, integrated process descriptions causes shipment delays, wastes resources, and undermines efforts to streamline the supply chain. The lack of business rules creates organizational and communication breakdown and precipitates a lack of control. Additionally individuals spend large amounts of time combing through mountains of data, often stored in silo enclaves, to assemble pertinent information for decision-makers.

- **Information Science and Technology:** This area involves the maturing of technologies that support state-of-the-art capabilities for the Warfighter in the analysis, assimilation, and dissemination of real and simulated digitized battlespace information. Interests include, but are not limited to: artificial intelligence (AI), machine learning (ML), cognitive computing (CC), distributed ledgers, advanced cryptology, course of action analysis, transportation planning and feasibility, embedded training, optimization and resource allocation solutions, collaborative technologies for distributed work environments, and data visualization. (removed – intelligent software agents (ISA)).

JDDE Challenge Descriptions Continued

- **Distributed Global Mobility C2:** C2 is the heart of successful military endeavors. For global mobility, C2 must be seamless regardless of theater of operation and/or customer being supported. This includes technologies that allow distributed C2 with mobile platforms (whether on land, sea or in the air) as well as technologies, including AI/ML, that provide the capability to replicate large databases, in a synchronized fashion, across a globally distributed network. In addition, these enclaves must be capable of working “off-line,” then seamlessly rejoining the global network following combat or contingency degradation. Additionally, a capability that can plan, allocate and integrate logistics resources effectively and quickly on a global scale in support of the operational needs of the combatant commanders.
- **Information Visualization:** The Warfighter requires an integrated geo-referenced digital image map and dashboard view of logistics and transportation land, sea, air, and waterway operational information with drill-down capability into specific details such as capacity, capability and readiness of equipment, personnel, built and natural infrastructure and other assets at current or potential operating locations. Both mission planners and operators require this dual-faceted visualization of mission information to ensure diminished risk to warfighters and the mission.
- **Cross-Domain Information Exchange & Collaboration:** The Command requires a secure means to transition information across multiple classification domains to enable process improvements and reduce system requirements. This includes interaction/interoperability with military/civilian partners which has grown in importance and immediacy with the shift in focus toward home basing and homeland defense posturing. Closer interoperability between non-traditional actors is key to preparing and responding to threats in a truly global manner.

JDDE Challenge Descriptions Continued

- **Joint Retail Inventory Interoperability:** DOD cannot optimize customer requirements as it does not provide inventory interoperability across all Services and theaters. Information and material exchange across the DOD is inhibited by disparity of systems and insufficient interfaces. Inventory status and shipment information cannot be optimized due to lack of connectivity between the various components in supply chain.
- **Human System Interface:** Poor HSI is a major contributor to data integrity problems in business systems supporting the Defense Transportation System. There is a need for intuitive HIS (e.g. artificial intelligence (AI), machine learning (ML) and cognitive computing (CC) technologies) that reduces cognitive workload and lowers data entry errors for planners/port operators. Edit checks and suggested data correction alerts connected to DOD data dictionaries are needed to improve HSI input.
- **Fuel Efficiency:** Mobility assets are the largest consumers of fuel within DOD. Seeking technologies that reduce the dependence and/or consumption of fossil fuels while maintaining or improving speed, flexibility, range, and responsiveness in contested environments.
- **Advanced Mobility Aircraft:** Next generation mobility and air refueling aircraft to provide intra-theater maneuvers. This includes leveraging technologies used for hybrid and unmanned aircraft as well as next generation information, surveillance, and reconnaissance platforms. Advanced mobility aircraft capabilities will include future platforms that have more efficient airframes and engines, improved Command and Control (C2) and defensive systems capabilities, human integration and training, and have greater range, speed, payload, offload and access.

JDDE Challenge Descriptions Continued

- **Mobility Aircraft:** This challenge addresses anti-access concerns, ergonomically designed crew stations to reduce aircrew workload, assured global line of sight/beyond line of sight secure airborne voice and data communications to enable dynamic mission re-tasking while enhancing aircrew situational awareness, and modular concepts that allow for multiple configurations/missions with same/like airframe. Additionally, aging airlift and aerial refueling fleet present a need for technologies that increase the reliability of aircraft systems and structures to include electronic control systems and more reliable avionics packages that will increase aircraft availability and airlift capacity.
- **Convoy Security:** The Theater Commander requires a variety of available lift asset options at his disposal to optimize distribution and best mitigate risks depending on Mission, Enemy, Terrain and Weather, Troops and Support Available, Time Available and Civil Considerations. There is limited ability to provide support for multiple, small, widely-dispersed detachments. Additional efforts in RDT&E in Counter-small Unmanned Aerial Systems (C-sUAS) are needed to help provide security for ground convoy security.

- **Aircraft Survivability:** USTRANSCOM seeks advanced capabilities to increase aircraft survivability, self defense, and enhance aircrew situational awareness (SA). Affordable, open system technologies are needed to detect and counter the full range of surface-to-air and air-to-air threats, navigate in contested environments, fuse onboard and off-board data for aircrew SA, and counter directed energy threats to aircrew and sensors. Additional efforts in RDT&E for C-sUAS are needed to help provide A/C survivability during landing and departures in both CONUS, OCONUS and expeditionary locations.

JDDE Challenge Descriptions Continued

- **Force Protection:** Terrorism and asymmetric warfare pose an ever-present threat to our Nation's strategic mobility assets and their embarked cargo, equipment and personnel. This broad area of interest supports proposals to counter these types of threats. Of particular interest is the application of technology to create virtual borders at the point of loading, decontamination of transportation assets, and enhance seaborne and air cargo container standards. Screen cargo for smuggled goods as well as explosive, chemical, and biological threats. Technology interests are in those systems with stand-off, hand-held, robotic and/or unmanned vehicle inspection/detection capabilities (both on land and in the water) as well as fixed detectors to allow for the identification of potential threats before endangering personnel and/or resources. Interests include technologies that, when applied, detect access attempts and can be monitored for intrusion. Additional efforts in RDT&E for C-sUAS are needed to help provide A/C security while on the flight line and in hangers in both CONUS, OCONUS and expeditionary locations.
- **Autonomous Approach and Landing Guidance:** All-weather and lights-out taxi, take-off and landing capability, leveraging multiple technologies to include AI/ML for mobility aircraft operations from prepared and unprepared fields. Operations may require taxi, takeoff, and landing for aircraft under inclement weather conditions without assistance from navigation guidance systems that are commonly available at most U.S. airports.
- **Opportune Landing Site Identification:** All-weather airfield independence capability, leveraging various technologies to include AI/ML, focused on mobility aircraft to determine the security of a landing site for arrival and throughput operations without use of a pre-coordinated survey or on-site, ground party analysis.

JDDE Challenge Descriptions Continued

- **Standardized Intermodal Containers/Pallets:** Systems, including those that leverage AI/ML, that can be used by automated aircraft/ship loading/unloading systems, to include those designed to automatically scan standardized containers and pallets as they are on-loaded/off-loaded. Initiatives must be designed to increase cargo throughput by eliminating the requirement to handle cargo multiple times during shipping, reduce the requirement for multiple Materials Handling Equipment (MHE) systems, reduce need for additional ground personnel throughout the en route system, minimize the requirement to reposition MHE to support deployment/distribution, address pallet construction (current capabilities do not tie to shipments pallet break down, holding, frustration clearance, and costs), and improve the flexibility to be rapidly embarked on multiple expeditionary platforms.