Defense Advanced Research Projects Agency

Peter Highnam, Ph.D.
Acting Director

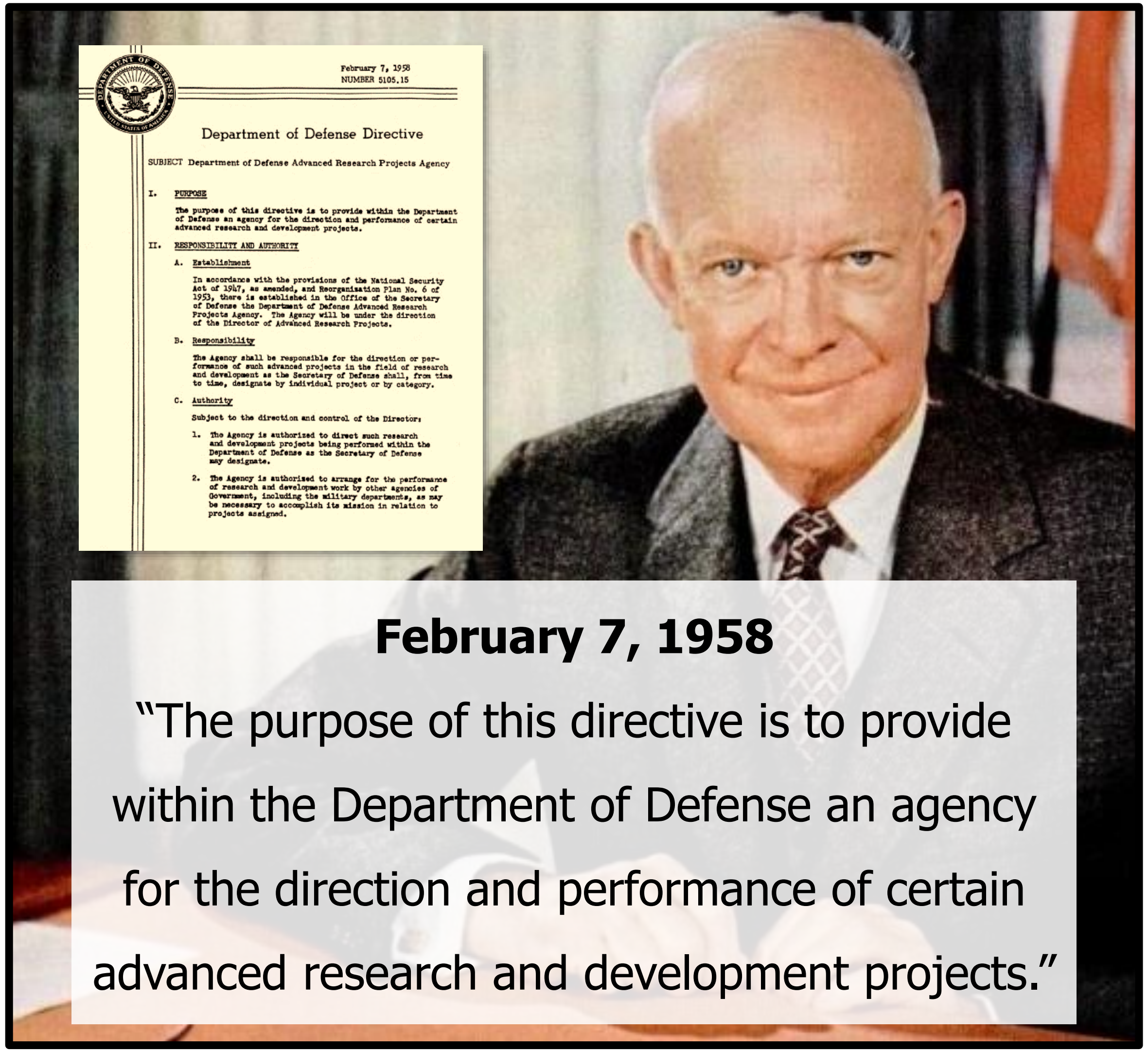
DARPA VPR/VCR Summit

August 25, 2020

Origins

October 4, 1957

Russians beat U.S. to space with Sputnik satellite; U.S. should never again be surprised by technology.



February 7, 1958
NUMBER 5105.15

Department of Defense Directive

SUBJECT Department of Defense Advanced Research Projects Agency

I. PURPOSE

The purpose of this directive is to provide within the Department of Defense an agency for the direction and performance of certain advanced research and development projects.

II. RESPONSIBILITY AND AUTHORITY

A. Establishment

In accordance with the provisions of the National Security Act of 1947, as amended, and Reorganization Plan No. 6 of 1953, there is established in the Office of the Secretary of Defense the Department of Defense Advanced Research Projects Agency. The Agency will be under the direction of the Director of Advanced Research Projects.

B. Responsibility

The Agency shall be responsible for the direction or performance of such advanced projects in the field of research and development as the Secretary of Defense shall, from time to time, designate by individual project or by category.

C. Authority

Subject to the direction and control of the Director:

1. The Agency is authorized to direct such research and development projects being performed within the Department of Defense as the Secretary of Defense may designate.
2. The Agency is authorized to arrange for the performance of research and development work by other agencies of Government, including the military departments, as may be necessary to accomplish its mission in relation to projects assigned.

February 7, 1958

"The purpose of this directive is to provide within the Department of Defense an agency for the direction and performance of certain advanced research and development projects."

Prevent and impose technological surprise

PEOPLE

- Exceptional technologists
- Limited tenure
- Autonomy

PROCESSES

- No in-house labs
- Metrics-based
- Programs have end-dates

CULTURE

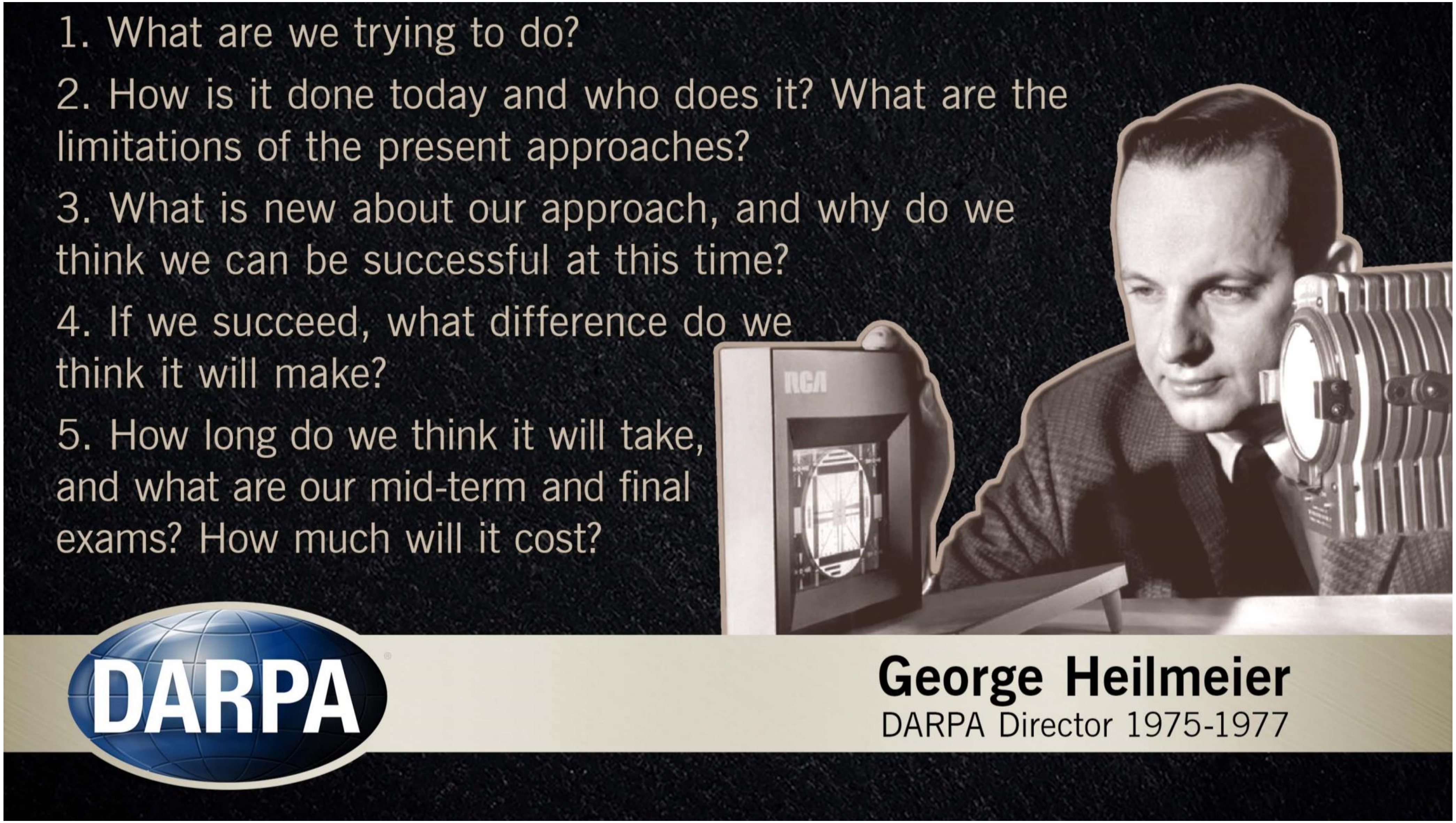
- Drive for off-scale impact
- Risk tolerant
- Honor in public service

DARPA's culture persists and the agency delivers

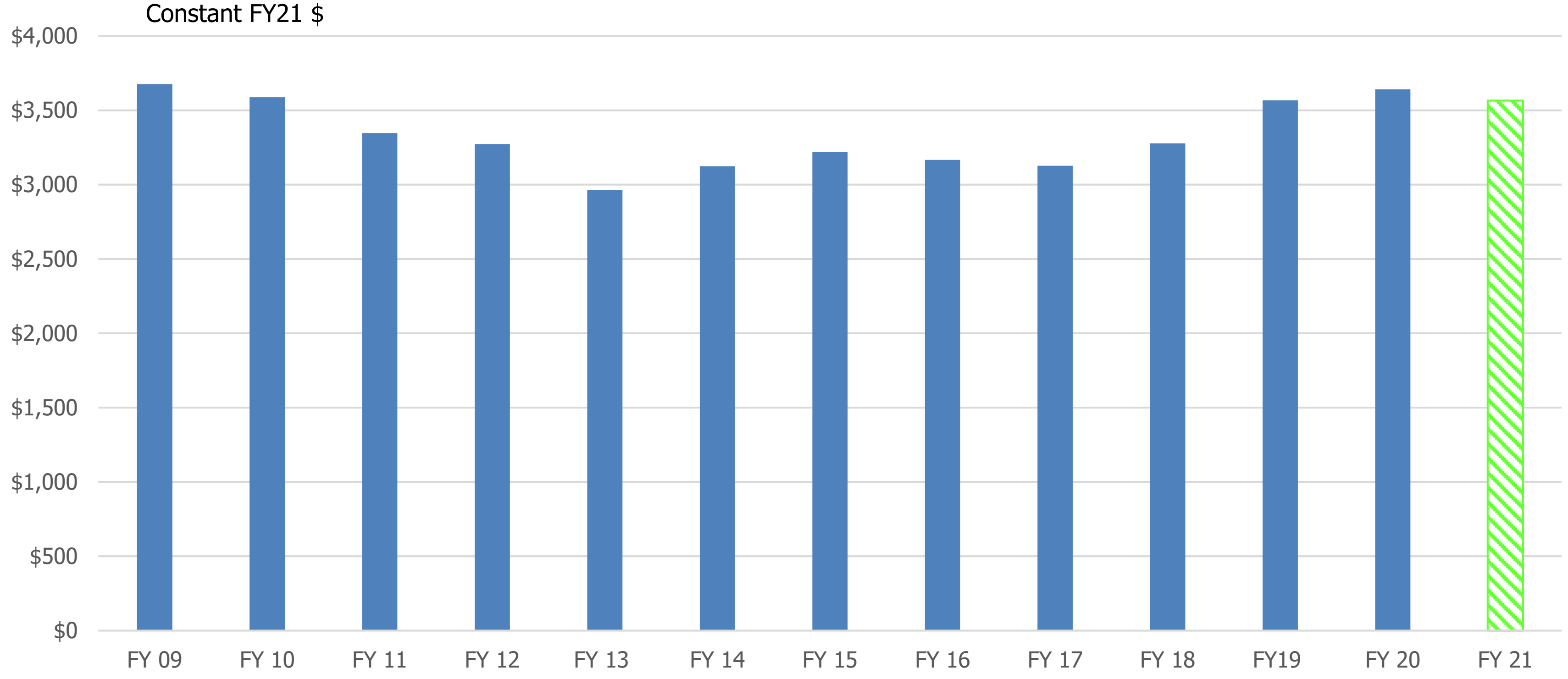
Role in S&T community

- **Do not work to requirements**
- **Separate and distinct from Service R&D organizations**
- **Pursue ideas that are out of the comfort zone of other agencies**

The Heilmeier Catechism



DARPA's budget



	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY19	FY 20*	FY 21
DARPA Topline (Then Year $M)	$3,014	$2,985	$2,835	$2,814	$2,580	$2,753	$2,872	$2,868	$2,888	$3,089	$3,427	$3,571	$3,566
FY21 Deflators/Inflators (%)	81.98	83.2	84.71	85.97	87.04	88.12	89.21	90.58	92.35	94.23	96.07	98.09	100
DARPA Topline (Constant FY21 $M)	$3,677	$3,588	$3,347	$3,273	$2,964	$3,124	$3,219	$3,166	$3,127	$3,278	$3,567	$3,641	$3,566

*FY 2020 includes $113M CARES Act Supplemental for DARPA COVID support efforts

92% of funding to projects

66% to industry

18% to universities

25% of total DoD S&T funding

DARPA | PREVENT AND IMPOSE TECHNOLOGICAL SURPRISE

62 YEARS

194 GOVT. EMPLOYEES

$3.5B BUDGET

250+ PROGRAMS

4 YEARS OF AVG. PM TENURE

15% 34% 14% 37%

DEFEND THE HOMELAND

- Cyber deterrence
- Countering hypersonics
- Bio threat detection and mitigation
- Defense against WMT

DETER & PREVAIL AGAINST HIGH-END ADVERSARIES

- Assault Breaker II
- Long-range effects
- Control of the EM spectrum
- Robust space

EFFECTIVELY PROSECUTE STABILIZATION EFFORTS

- Warrior performance
- Countering gray warfare
- 3D city-scale operations
- Behavior modeling and influence

FOUNDATIONAL RESEARCH

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.

- Alternative computing
- Engineered biology
- Electronics Resurgence Initiative (ERI)
- Artificial Intelligence Next Campaign

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

Past investments anticipated current needs of the COVID-19 fight

Photo source: USA Today

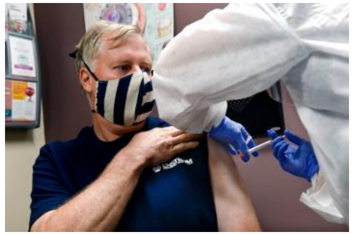
First vaccine trials

The first coronavirus vaccine to start human testing is from DARPA investment in the Moderna company. The vaccine is made via a new genetic method that does not depend on an overseas supply chain, or massive supplies of eggs as in traditional manufacturing. These features allow U.S. production of vaccine doses to be rapidly increased.

The Washington Post

National Security

How a secretive Pentagon agency seeded the ground for a rapid coronavirus cure



A nurse gives a volunteer an injection as part of a trial of a possible covid-19 vaccine, developed by the National Institutes of Health and Moderna, on July 27 in Binghamton, N.Y. (Hans Pennink/AP)

By Paul Sonne
July 30, 2020 at 9:22 p.m. EDT

The scientists were working through the night over a weekend in February in their Vancouver offices, running a blood sample from an early American covid-19 survivor through a credit card-sized device made up of 200,000 tiny chambers, hoping to help save the world.

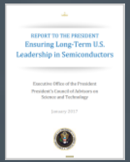
Their mission was part of a program under the Pentagon's secretive technology research agency. The goal: to find a way to produce antibodies for any virus in the world within 60 days of collecting a blood sample from a survivor.

Established years before the current pandemic, the program was halfway done when the first case of the novel coronavirus arrived in the United States early this year. But everyone involved in the effort by the Defense Advanced Research Projects Agency (DARPA) knew their time had come ahead of schedule.

THE ELECTRONICS RESURGENCE INITIATIVE

Consisting of ***20+*** new and existing DARPA programs and a ***5 year, $1.5 Billion investment***, ERI aims to forge forward-looking collaborations among the commercial electronics community, defense industrial base, university researchers, and the DoD to ensure far-reaching improvements in electronics performance well beyond the limits of traditional scaling

PCAST Report



ERI ELECTRONICS RESURGENCE INITIATIVE SUMMIT 2018 | SAN FRANCISCO, CA | JULY 23-25

Added 7 programs in Defense Applications, Security, & Differentiated Access

DARPA 2020 ERI Summit & MTO Symposium

5 Years

FY17 | FY18 | FY19 | FY20 | FY21 | FY22 | FY23

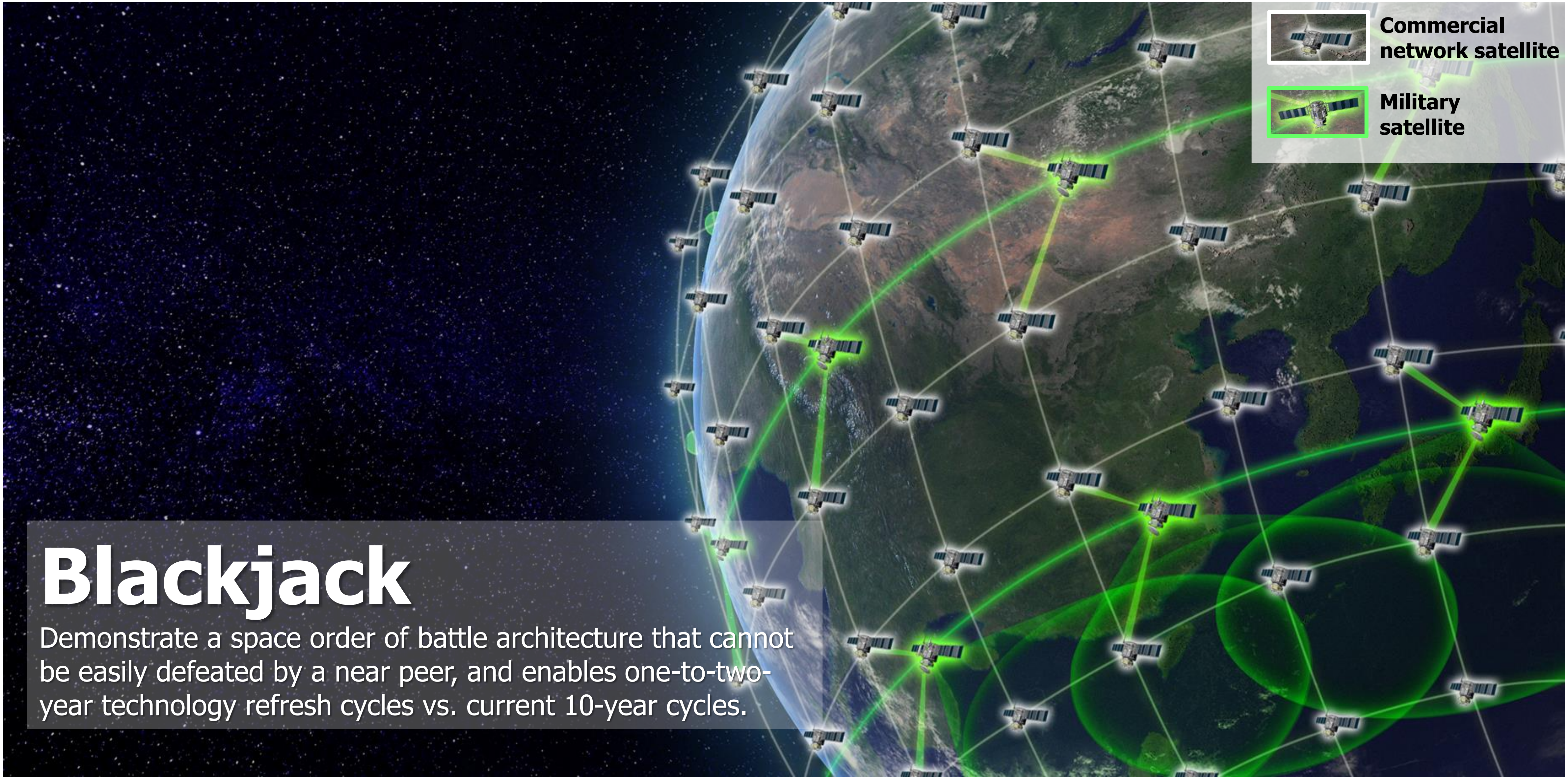
7 foundational programs

ERI officially starts *with 6 programs in Materials & Integration, Designs, & Architectures*

ERI ELECTRONICS RESURGENCE INITIATIVE SUMMIT 2019 | Detroit, MI | July 15 - 17

Universities			Commercial			Defense	
Arizona State University	Purdue University	University of Southern CA	Applied Materials	Le Wiz	Skywater	Army Research Lab	NIST
Brown University	Stanford University	University of Texas	ARM	Micron	Synopsys	Boeing	Northrop Grumman
Cornell University	University of California	University of Utah	Cadence	NVIDIA	STR	General Dynamics	Oak Ridge National Lab
Georgia Tech	University of Illinois - UC	University of Washington	Ferric Semiconductor	Qualcomm	TSMC	General Electric	Raytheon
MIT	University of Michigan	Yale University	IBM	Samsung	Xilinx	HRL Laboratories	Sandia National Labs
Princeton University	University of Minnesota		Intel			Lockheed Martin	

Military space – Pivot to Low Earth Orbit

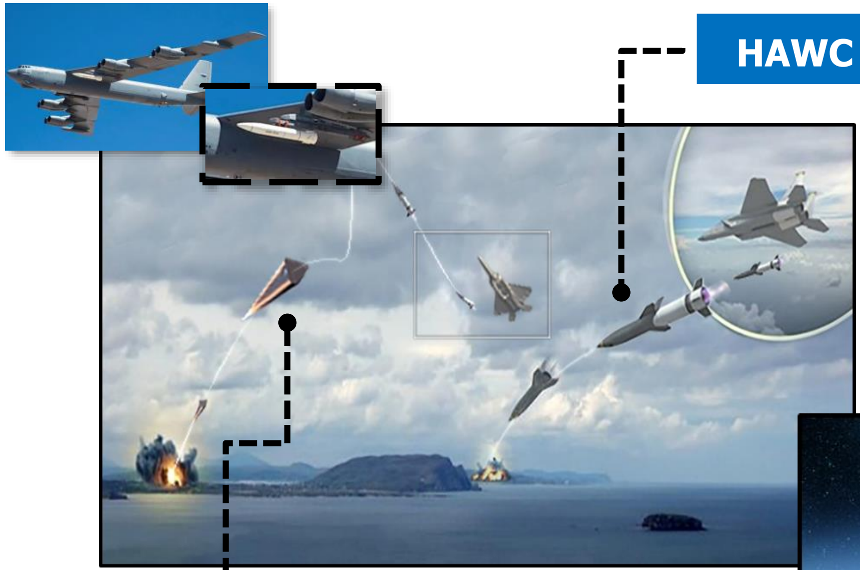


Blackjack

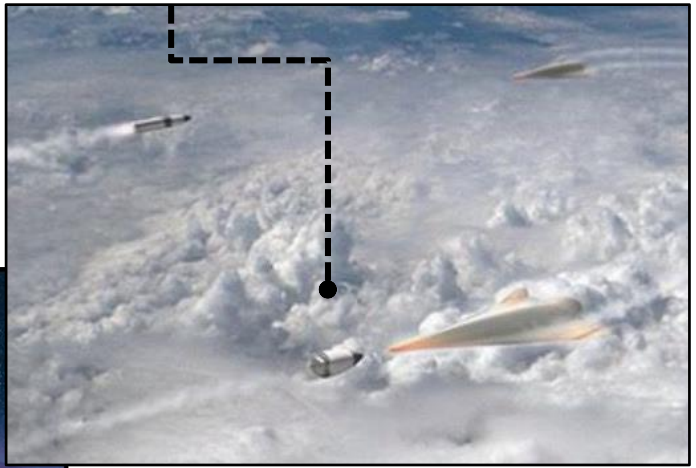
Demonstrate a space order of battle architecture that cannot be easily defeated by a near peer, and enables one-to-two-year technology refresh cycles vs. current 10-year cycles.

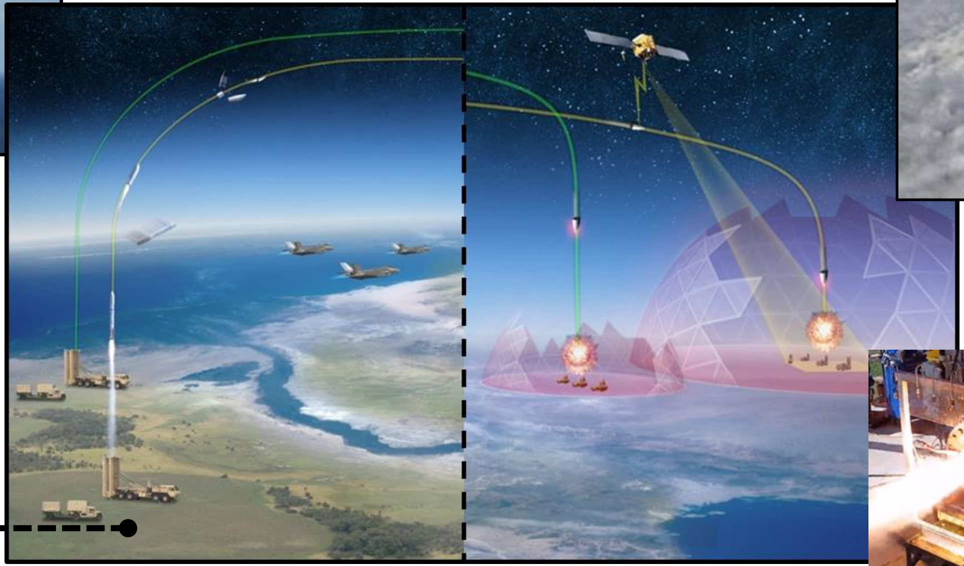
Air-launched and ground-launched hypersonics

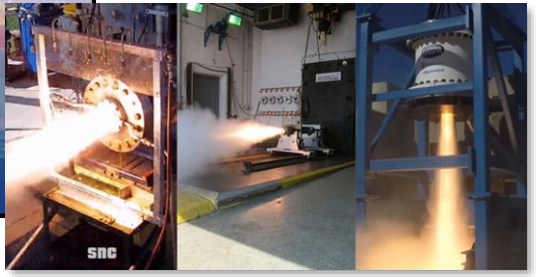
HAWC Hypersonic Air-breathing Weapon Concept



Glide Breaker *Countering hypersonics*







TBG Tactical Boost Glide

OpFires Operational Fires

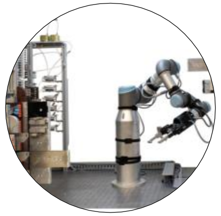
AI Next Campaign: $2B over five years to drive AI technologies

*90+ programs **applying** AI*

RF spectrum

SC2

Drug discovery

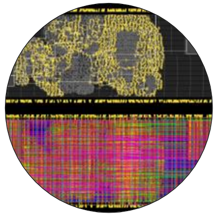


Make-It

Virtual dogfighting

ACE

Chip design



IDEA

Cybersecurity

HACCS

Underground operations

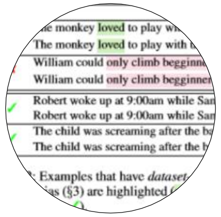
SubT

*27 programs **advancing** AI*

Explainability

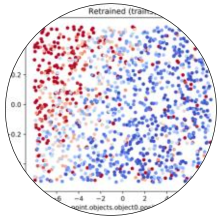
XAI

Reasoning



MCS

Robustness

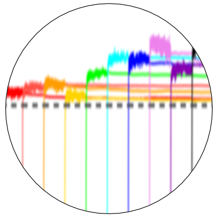


Assured Autonomy

Ethics

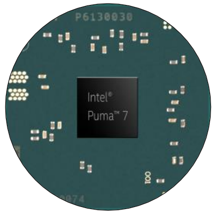
URSA

Generalizability



L2M

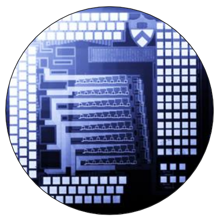
Extreme performance



HIVE

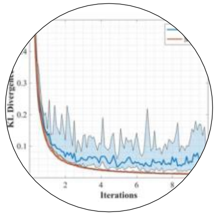
*18 topics **exploring** new frontiers in AI*

Electro-optical AI hardware



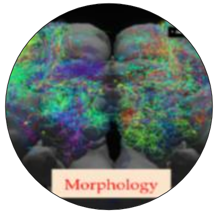
PEACH

Learning with limited data



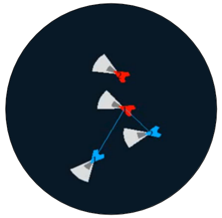
VIP

Insect brain-modeled hardware



µBRAIN

AI-based military game theory

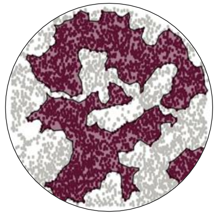


SI3-CMD

Physics-informed AI

AIRA

Controlling complex systems



PAI

Working with DARPA

Programs

- Represent most of DARPA's funding opportunities
- Open to all capable sources
- Proposals solicited through specific program BAAs
- Often multi-year, multi-disciplinary efforts
- Technology development to move from "possibility" to "capability"

Challenges

- Compete on unique DARPA R&D problems
- Tend to include phases with culminating events where winners win monetary or other prizes
- May result in a prize with up to a $10M fair market value

Seedlings and Explorations

- Open to all capable sources
- Usually submitted through Office-Wide BAA
- Small short duration (6-9 months) projects
- Move concepts from "disbelief" to "mere doubt"
- Lead to the next generation of program ideas

THE HILL

The certainty of the unknown — why increased federal investment in science and technology is a necessity

BY REPS. JIM LANGEVIN (D-R.I.), AND ELISE STEFANIK (R-N.Y.), OPINION CONTRIBUTORS — 05/21/20 09:30 AM EDT

As America faces a once in a generation health crisis, Congress has appropriated over 2.5 trillion dollars to the COVID-19 response in just a month and a half. Yet the percentage of federal spending on research and development – namely on the scientists and engineers who can innovate us out of this crisis and better prepare us for the next – has been in decline since the 1970s.

In a time when our national defense planning has shifted focus to great power competition, addressing the challenge posed by rising powers requires an ambitious plan for national investment and aggressive talent development in science and technology. Despite bipartisan support for increased investment in our national security innovation base in this era of strategic competition, growth in the science and technology budget is almost always sacrificed to field the mature technologies of today.

While we grappled with the COVID-19 pandemic, it is important to consider how the federal government can invest in innovations that will lead us out of this crisis, and protect against similar crises in the future. One agency is well-equipped to handle such investment: The Defense Advanced Research Projects Agency (DARPA).

DARPA/DSO 101

Dr. Valerie Browning, Director
Defense Sciences Office

August 25, 2020

DARPA's mission

Breakthrough Technologies and Capabilities for National Security

Precision Guidance & Navigation

Communications/Networking **IR Night Vision**

Stealth **Radar Arrays** **UAVs** **Hypersonics**

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

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

ARPAnet/Internet **Autonomy**

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

DARPA Technical Offices

BTO — BIOLOGICAL TECHNOLOGIES OFFICE

Biology for security
- Outpacing infectious disease
- Neurotechnology
- Gene editing & synthetic biology

DSO — DEFENSE SCIENCES OFFICE

- Frontiers in math, computation & design
- Limits of sensing & sensors
- Complex social systems
- Anticipating surprise

I2O — INFORMATION INNOVATION OFFICE

- Symbiosis: partner with machines
- Analytics: understand the world
- Cyber: deter cyber attack

MTO — MICROSYSTEMS TECHNOLOGY OFFICE

- Electronics: drive solutions for DoD access and infrastructure
- Spectrum: focus on usability of highly-adaptive systems
- Sensors: enable high-end capabilities to proliferate into the field

STO — STRATEGIC TECHNOLOGY OFFICE

- Lethality: resilient killchains over invulnerable systems
- Surprise: heterogeneity over uniformity
- Continuous speed: agility and adaptability over performance

TTO — TACTICAL TECHNOLOGY OFFICE

Enterprise disruption: platforms, systems, and technologies that enable new warfighting constructs

Crosscutting themes
- Eliminate high-value assets
- Exploit cross-domain seams
- Enable decision-making asymmetry

DARPA and the Defense Sciences Office

DEFENSE SCIENCES OFFICE

DARPA: Create and prevent technological surprise

DSO—"DARPA's DARPA"

- Creates opportunities from scientific discovery
- Invests in multiple, often disparate, scientific disciplines--everywhere the rest of DARPA is, and more
- Focuses on mission-informed research

DSO: The Nation's first line of defense against scientific surprise

DSO: Changing what is possible

TRENDS & CHALLENGES

Disruptive Innovation

Undergoverned spaces

Need for Operational Speed

Resilient Systems

THRUST AREAS

- Frontiers in Math, Computation & Design
- Limits of Sensing & Sensors
- Complex Social Systems
- Anticipating Surprise

Foundational investments across the physical and social sciences to change what's possible

Current DSO Thrust Areas

Frontiers in Math, Computation & Design

(quantum information processing, alternative computing, foundational AI science, design tools)

Limits of Sensing & Sensors

(quantum sensing, imaging through scattering media, novel light matter interactions, 3D scene reconstruction)

Complex Social Systems

(new social science tools and methodologies, human-machine teaming, wargaming, deterrence)

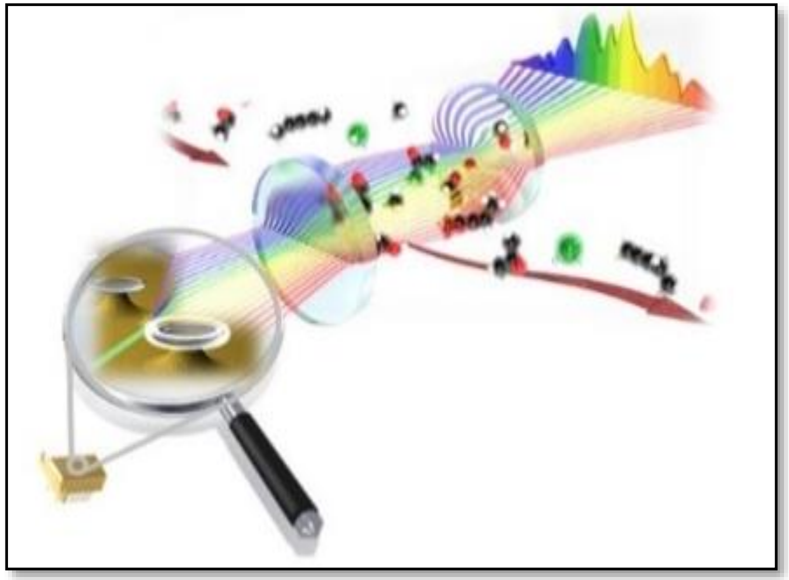
Anticipating Surprise

(WMD/WMT detection, materials for harsh environments, advanced manufacturing, autonomy)

Limits of Sensing & Sensors

Motivation: Sensing and measurement of various signals are ubiquitous to military systems and missions

- ISR
- PNT
- Health monitoring
- Target ID/tracking



Limits of Sensing & Sensors is exploring both fundamental and practical limits of novel DoD sensors

Topics of interest:

- New sensing modalities
- Fundamental sensing limits
- Engineered materials that enable novel optics and imaging capabilities
- Fundamental and practical limits of quantum enabled sensing and metrology
- Practical and deployable sensing and sensor designs

Complex Social Systems

DEFENSE SCIENCES OFFICE

Motivation: Understanding the dynamics of complex social networks is critically important for many military operations

- Stability and deterrence
- Counter-terrorism
- Training and mission planning
- Wargaming


The Economist, April 2012

Complex Social Systems is addressing challenges in leveraging social behavior science innovation for DoD

- Reproducibility/replicability in DoD scenarios
- Planning for heterogeneous teams of humans and machines

Topics of interest:

- Accurate and scientifically validated models of the social dynamics underlying different kinds of conflict
- Capabilities to improve understanding of causality in complex social systems
- Artificial intelligence and other tools that enable improved human-machine symbiotic decision-making
- New concepts in war-gaming and conflict simulation to identify and understand option for deterrence and stability operations

Anticipating Surprise

Motivation: Ensure that U.S. warfighters have access to the most advanced technologies

Anticipating Surprise invests in "leap ahead" capabilities for specific current and/or future threats

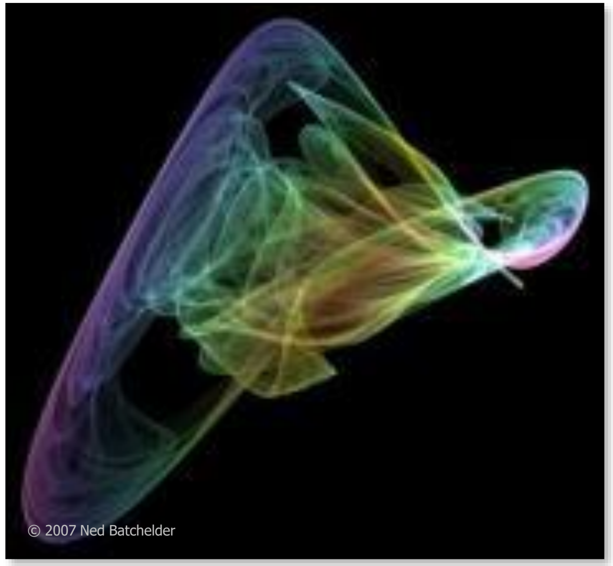
- Hypersonics
- WMD/WMT
- Robust space situational awareness
- Etc.

Topics of interest:

- Novel functional and structural materials and manufacturing processes
- Materials for harsh environments
- Defense against WMD/WMT threats
- Energetic materials
- New propulsion concepts
- Novel approaches to energy storage and power generation

Frontiers in Math, Computation & Design

Motivation: DoD operational environments are increasingly technologically sophisticated, fast-paced, complex and dynamic


© 2007 Ned Batchelder

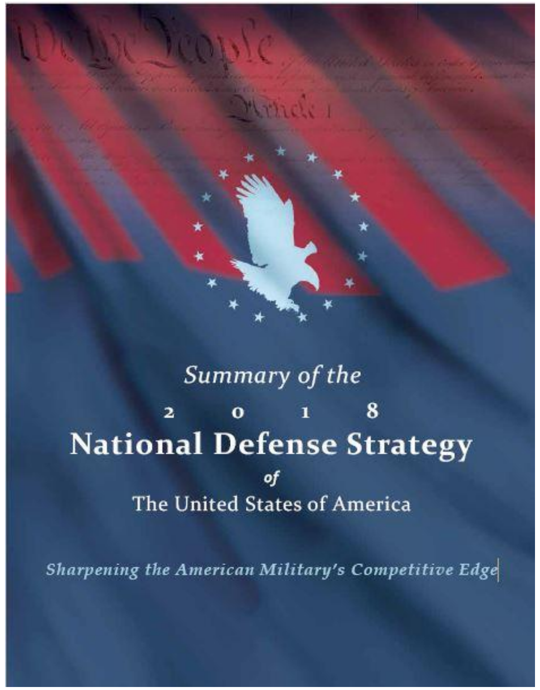
Frontiers in Math, Computation & Design is addressing challenges in how we design and plan for future military needs:

- Materials
- Platforms
- Systems

Topics of interest:

- Mathematical, computational, and design frameworks and tools that provide robust solutions to challenging DoD problems such as planning, optimization, and platform design
- Fundamental scientific underpinnings and limits of machine learning and artificial intelligence
- Alternative computing models, architectures, and substrates for faster, more robust decision making

Disruptioneering



- "Harness and protect the National Security Innovation Base"
- "Deliver performance at the speed of relevance"

– National Defense Strategy

Disruptioneering is a DSO rapid acquisition approach to increasing the speed of innovation:

- High risk concept exploration
- Acquisition tailored to speed (idea to program in 90 days)
- Program Announcement (DARPA-PA-20-01) released May 14, 2020:
  - https://beta.sam.gov/opp/2b0e8684bf054bcb8b9b280cb4498849/view#general

Artificial Intelligence Exploration (AIE)

DEFENSE SCIENCES OFFICE

AIE will enable DARPA to fund pioneering AI research to discover new areas where R&D programs may be able to advance the state of the art

- The pace of discovery in AI science and technology is accelerating worldwide
- The AI Exploration (AIE) program is part of DARPA's broader AI investment strategy that will help ensure the U.S. maintains a technological advantage in this critical area
- Program Announcement (DARPA-PA-20-02) released August 20, 2020:
  - https://beta.sam.gov/opp/667875ba2f464ccfa38688ea1a718fe7/view

This new approach enables DARPA to go from idea inception to exploration in fewer than 90 days!

Young Faculty Award (YFA)

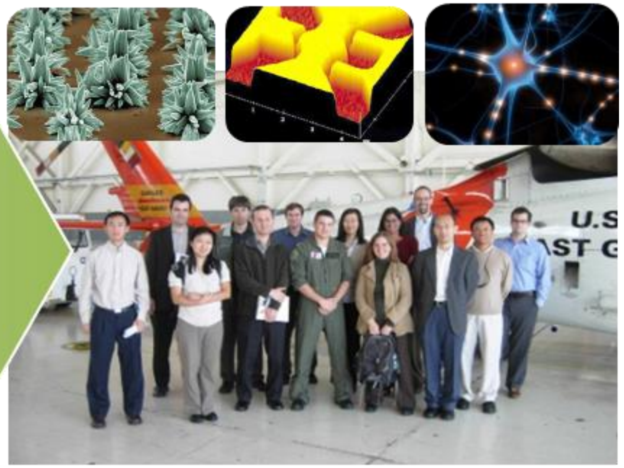
Identify and engage **rising stars** in junior research positions, emphasizing those without prior DARPA funding, and expose them to DoD needs and DARPA's program development process

The YFA program provides:

- Research funding
- DoD contacts
- Military visits/exercises
- PM Mentor

The YFA program yields:

- Insight into DoD problems
- Novel ideas
- Career development
- Future DARPA performers



2021 YFA topics anticipated to be posted in September 2020

Develop the next generation of academic scientists, engineers, and mathematicians who will focus a significant portion of their career on DoD and National Security issues

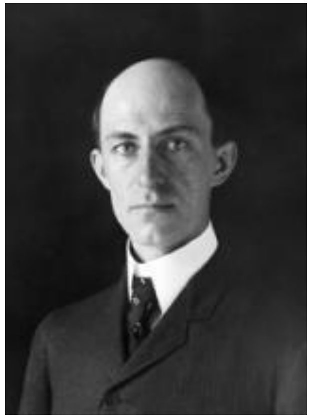
Evolutionary vs. Revolutionary R&D

"The flying machine which will really fly might be evolved by the combined and continuous efforts of mathematicians and mechanicians in from one million to ten million years"

- The New York Times
  - 9 October 1903

"We started assembly today"

- Orville Wright's Diary
  - 9 October 1903



Biological Technologies Office (BTO)

Kerri Dugan, Ph.D.
Acting Director, BTO
Defense Advanced Research Projects Agency

Blake Bextine, Ph.D.
Acting Deputy Director, BTO
Defense Advanced Research Projects Agency

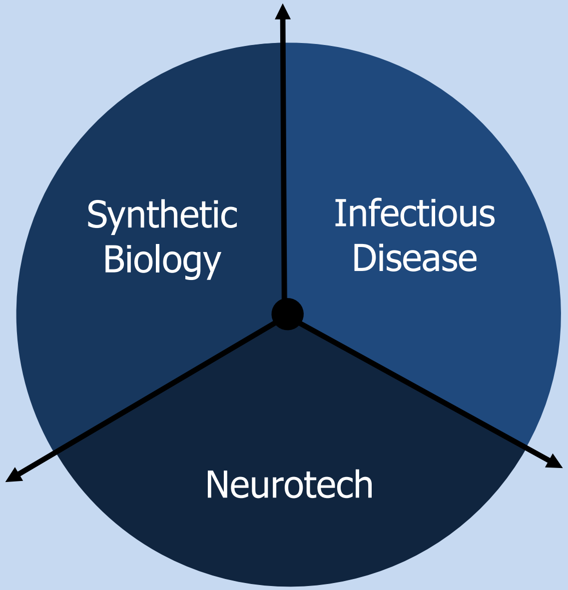
Briefing Prepared for Vice Presidents of Research

25 AUG, 2020

Office Trajectory

Foundations

Invest in scientific areas and push towards capabilities



Capabilities

Target capabilities leveraging multiple areas of biotechnology

- Detection and Protection
- Physiological Interventions
- Warfighter Performance
- Operational Biotechnology

Operationalization

Integrate capabilities into systems that leverage biotechnology

Overmatch

Military Immune System

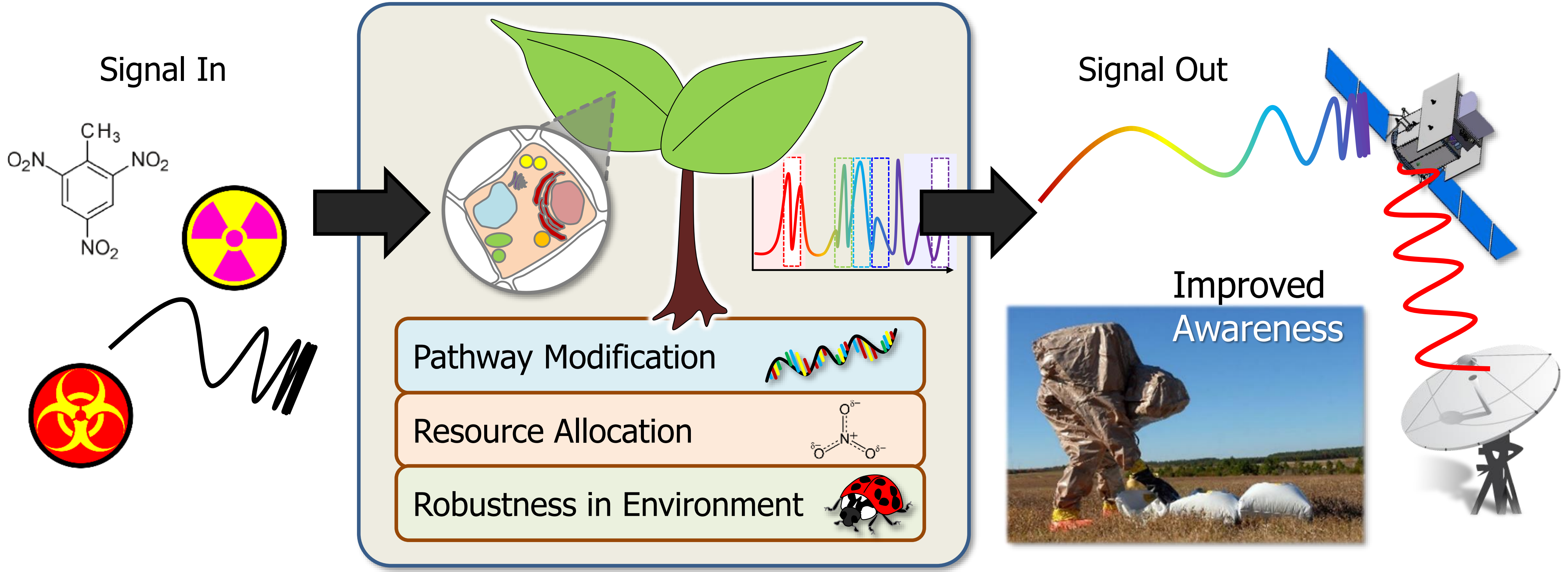
Operational Biology

BTO Focus Areas

Advanced Plant Technologies (APT)

DETECT AND PROTECT

DoD Problem: Persistent CBRNE monitoring requires sustained power and maintenance

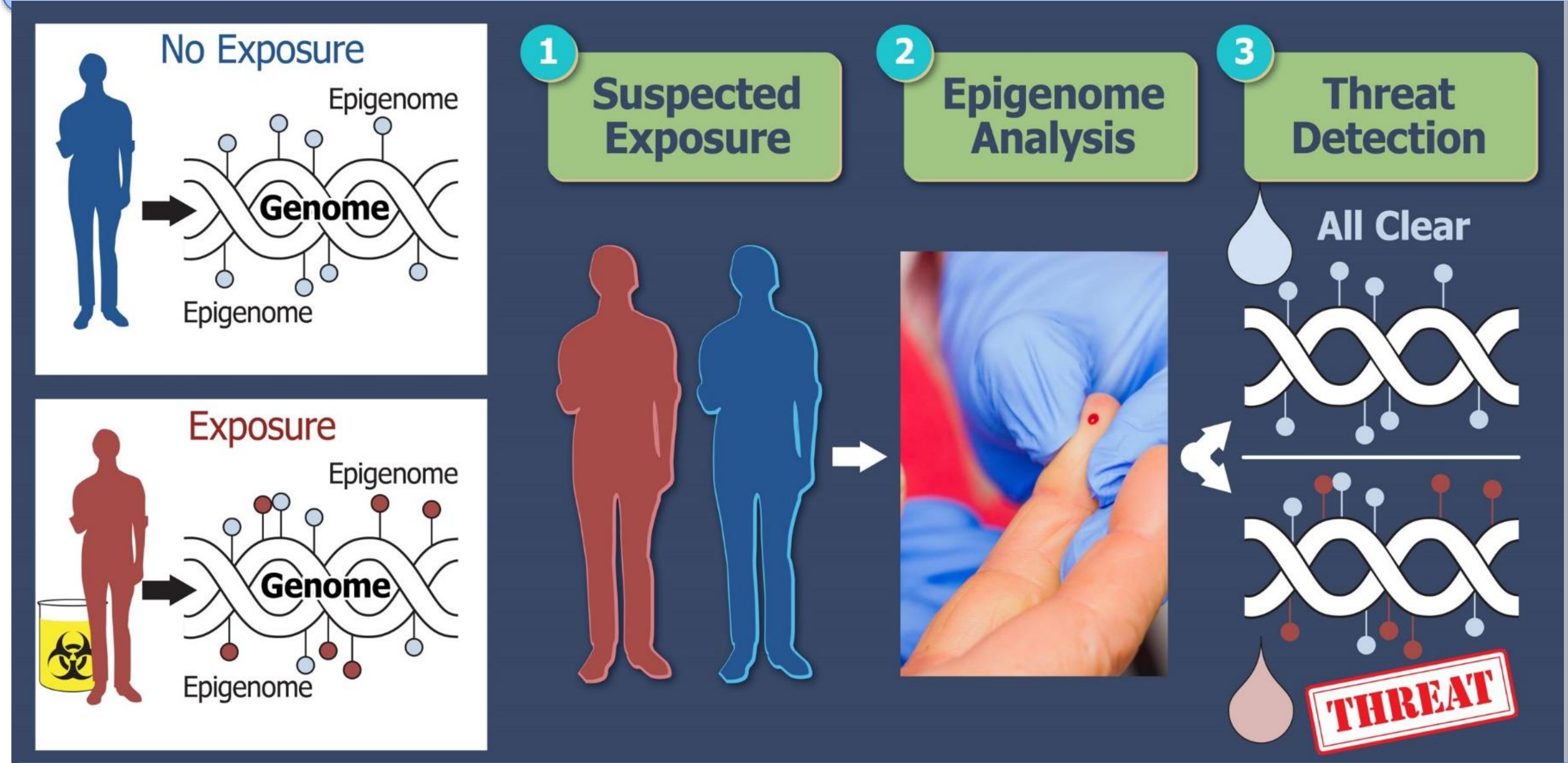


Vision: Develop plants capable of serving as next-generation, persistent, ground-based sensors to protect deployed troops and the homeland by detecting and reporting on chemical, biological, radiological, nuclear, and explosive threats

Epigenetics Characterization and Observation (ECHO)

DETECT AND PROTECT

DoD Need: Build a biographical description from an individual's epigenome to transform forensics and diagnostics for national security



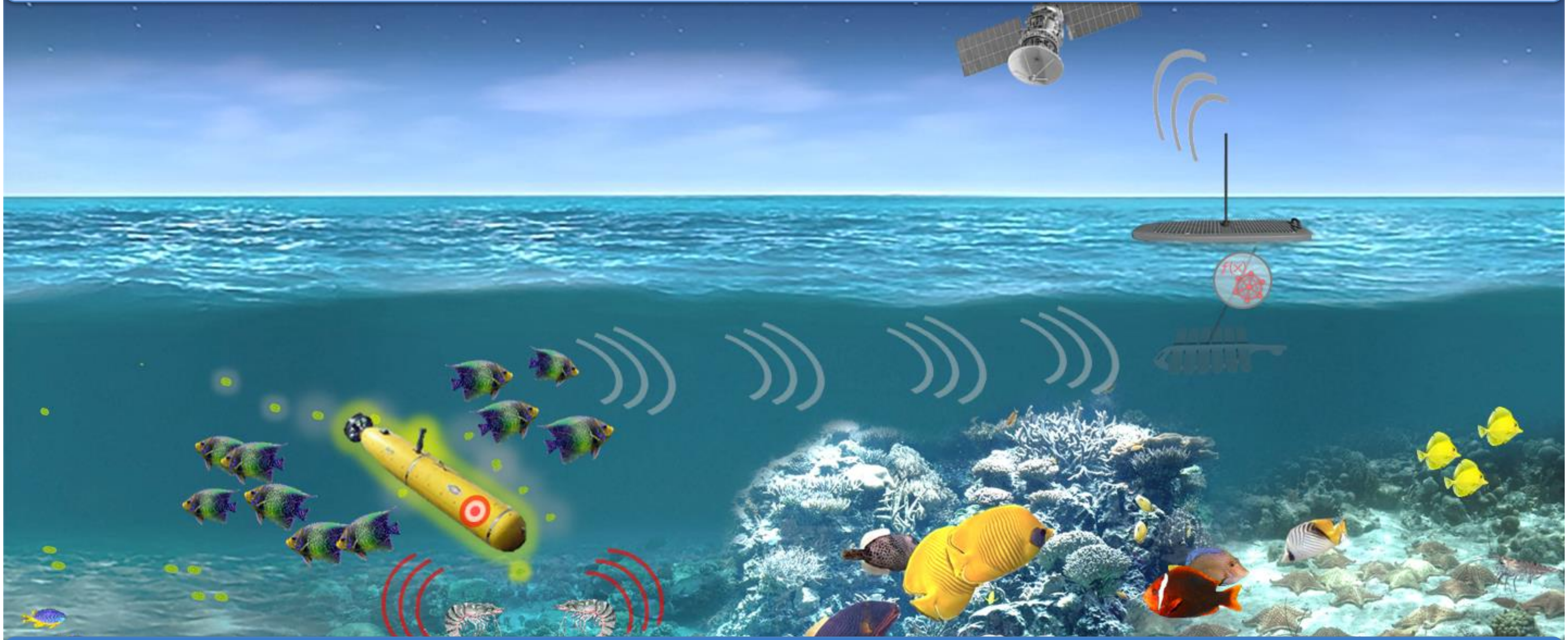
- Signatures indicative of WMDs, Precursors, Infectious Disease
- Novel bioinformatics tools with high sensitivity, specificity, and temporal resolution

Vision: Ability to detect and analyze an individual's epigenome for exposure to chemical, biological and radiological events in field forward or austere conditions

Persistent Aquatic Living Sensors (PALS)

OPERATIONAL BIOTECHNOLOGY

DoD Problem: Current underwater surveillance requires logistically challenging sensor systems that limit persistence and scale of detection area



Vision: Detect underwater targets by leveraging marine organism signals and translate those signal into relevant DoD information

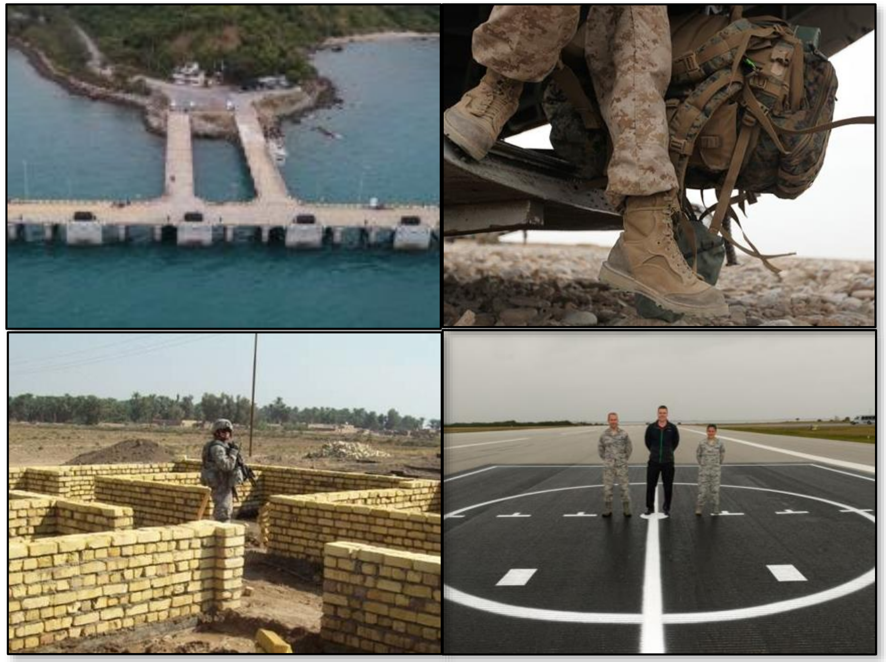
Engineered Living Materials (ELM)

OPERATIONAL BIOTECHNOLOGY

DoD Problem: Construction materials are inert, resource-intensive, and start to degrade immediately when deployed

Traditional inert building materials

Self-grown engineered living materials



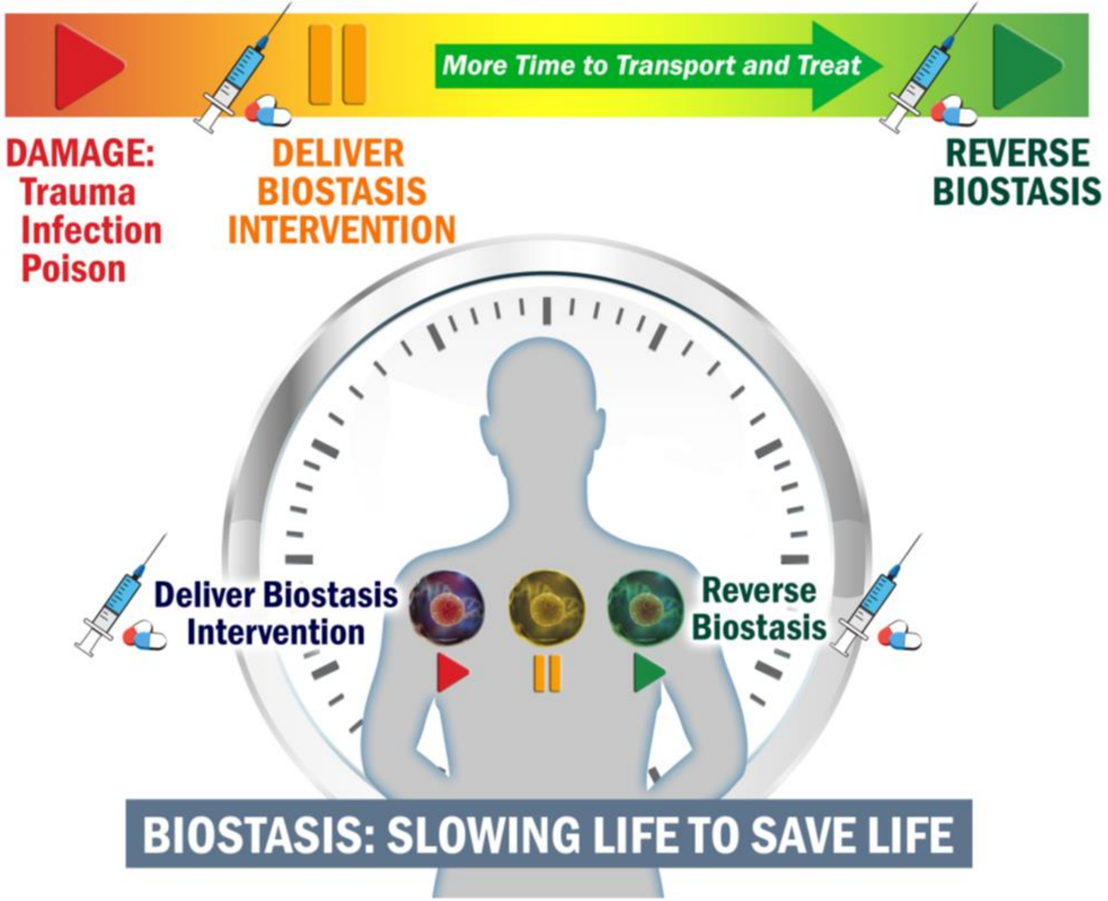
Use cases for grown engineered living materials

Vision: Engineer living, DoD-relevant building materials that grow in field, self-repair, and respond predictably to their environment

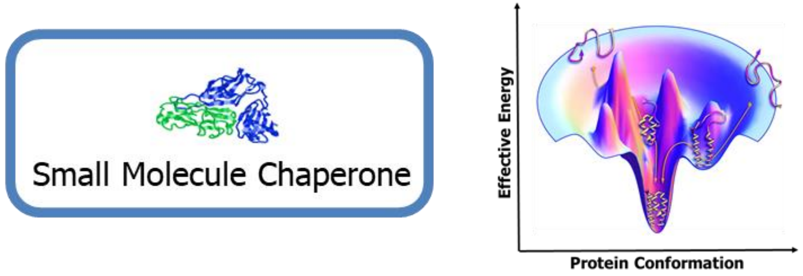
Biostasis

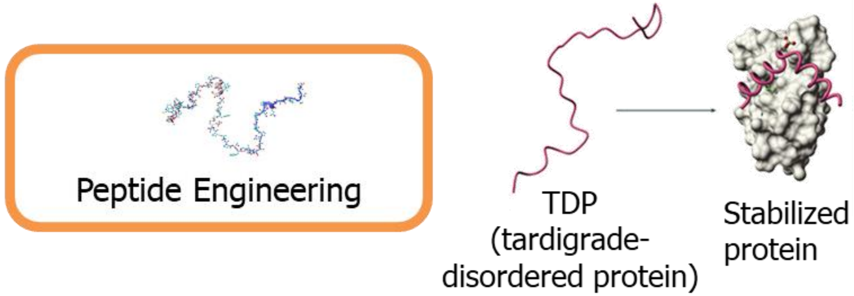
PHYSIOLOGICAL INTERVENTIONS

DoD Problem: Time is not on the military's side during trauma events



Biostasis Technologies

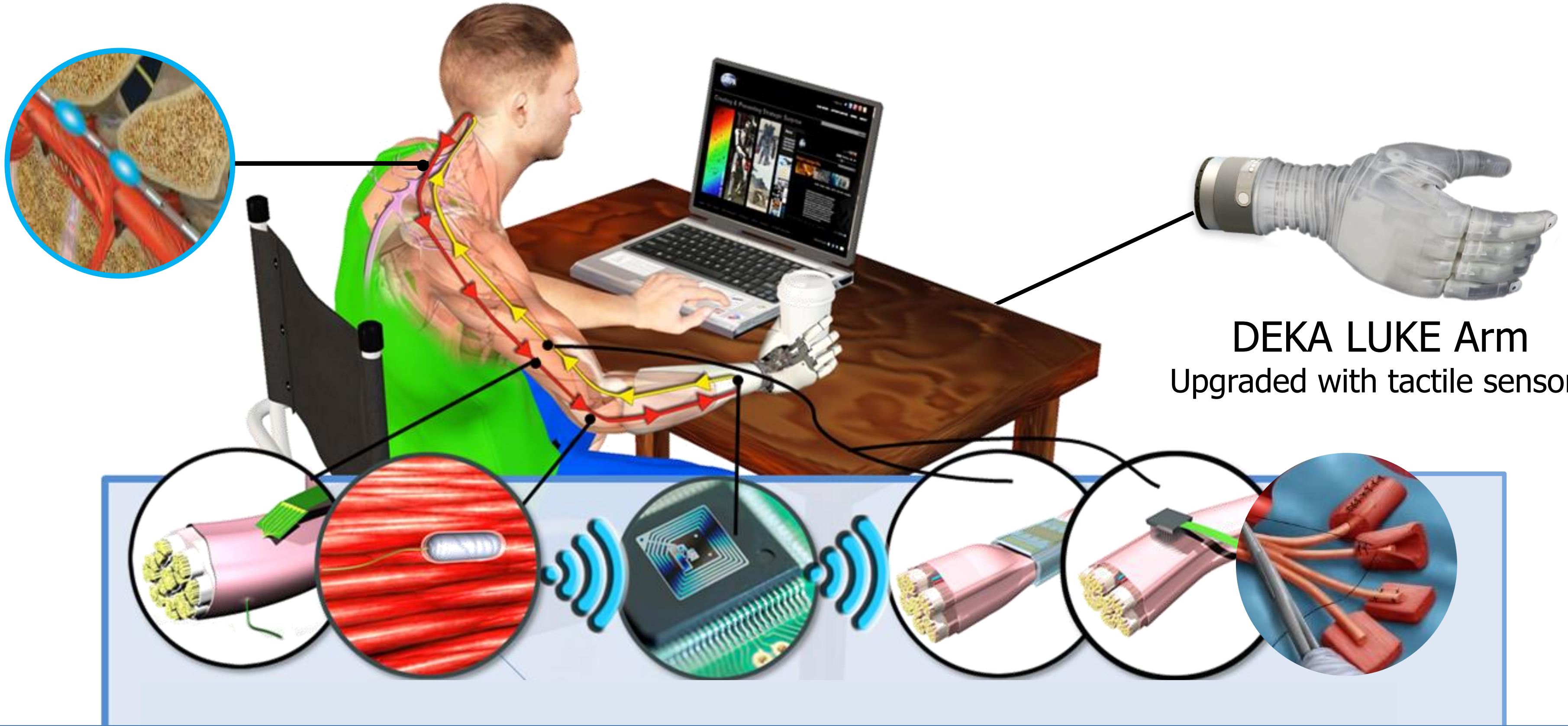




Vision: Extend the time for lifesaving medical treatment, "the Golden Hour," following traumatic injury or acute infection, increasing survivability for military personnel operating in far-forward conditions

Prosthetic Hand Proprioception and Touch Interfaces (HAPTIX)

DoD Problem: Existing SOA prostheses for wounded warriors do not provide sensory feedback



Vision: Create integrated, implantable devices that enable veteran amputees to control and sense state-of-the-art prostheses

BTO Persons, Backgrounds, and Programs

Program Manager	Tech Background	Detect & Protect	Physiological Intervention	Warfighter Performance	Operational Biology
Lori Adornato Ph.D.	Oceanography	PALS			
Blake Bextine Ph.D.	Entomology/Botany	Insect Allies, APT			ELM, ReSource
Anne Cheever Ph.D.	Synthetic Biology	Safe Genes			Living Foundries
Linda Chrisey Ph.D.	Microbiology				BioReporters, ReVector
Rohit Chitale Ph.D.	Infectious Disease	PREEMPT			
Seth Cohen Ph.D.	Chemistry	INTERCEPT	HEALR		AWE
Jean-Paul Chretien Ph.D.	Epidemiology	DIGET			
Kerri Dugan Ph.D.	Molecular Biology	RTA			
Al Emondi Ph.D.	Neuroengineering		BG+	INI, N3, NESD	
Amy Jenkins Ph.D.	Infectious Disease	P3, NOW, PREPARE			
Tristan McClure-Begley Ph.D.	Pharmacology	Battlefield Medicine	Biostasis, Focused Pharma	TNT, Panacea	
Paul Sheehan Ph.D.	Chemical Physics	Friend or Foe	BETR		ADAPTER, Biological Control
Eric Van Gieson Ph.D.	Biomedical Engineering	ECHO, PPB		MBA	

HEALR: Proposals Due 17 Sept 2020

Distribution Statement A. Approved for public release.

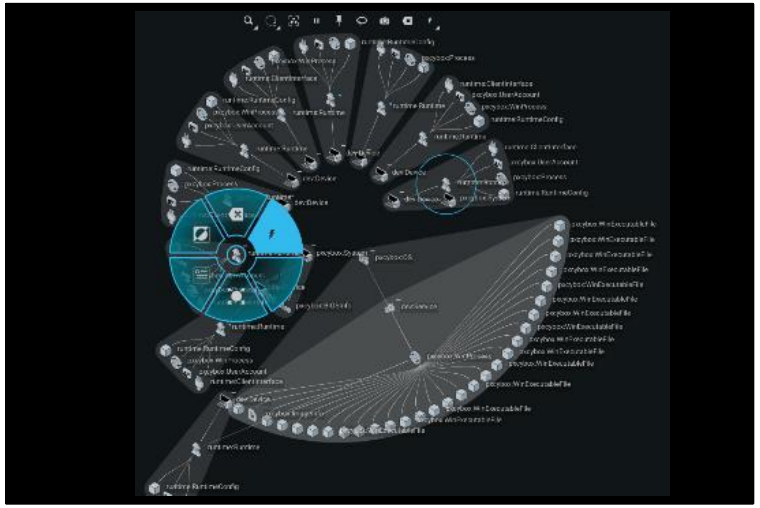
DARPA Information Innovation Office (I2O)

William Scherlis, Office Director
Jennifer Roberts, Deputy Director

August 2020

Information Innovation Office (I2O) – Four interdependent focus areas

Advantage in **cyber operations**



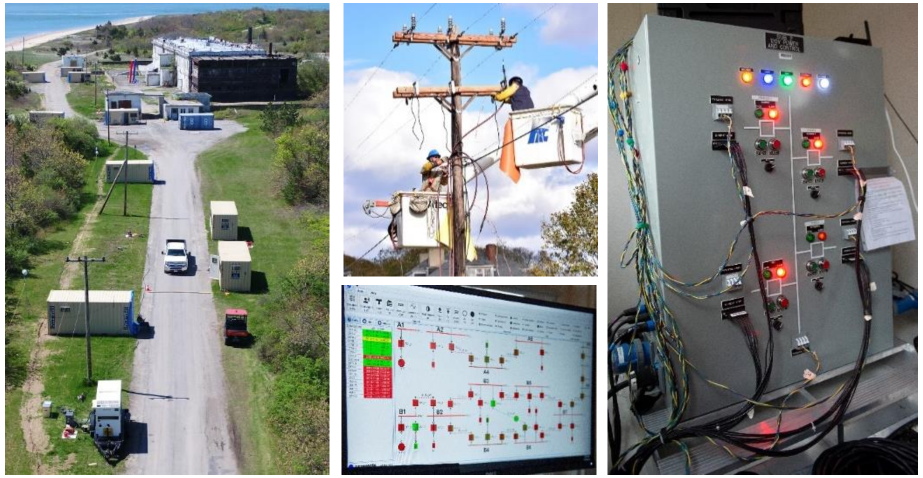
Proficient **artificial intelligence**

Resilient, adaptable, and **secure systems**

Confidence in the **information domain**

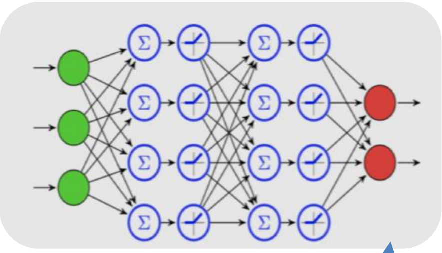
Information Innovation Office (I2O) – Example programs in each area

Advantage in cyber operations



RADICS
- Black start recovery of the power grid during a cyber attack

Proficient AI



Assured Autonomy
- *Explain*
- *Analyze/assure* - UUV

Northrop Grumman

Function & safety cases

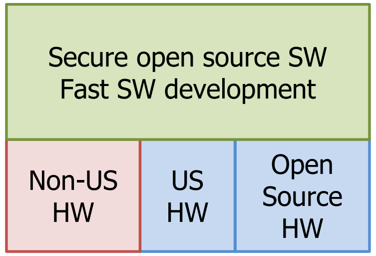
SMT solver

… (n == 5 + m) v (p ∧ ¬q) …

SMT: Satisfiability modulo theories

Resilient, adaptable, and secure systems

OPS-5G
- *Open* – Hardware/software decoupling
- *Programmable* – Configure to the mission
- *Secure* – Trust and security

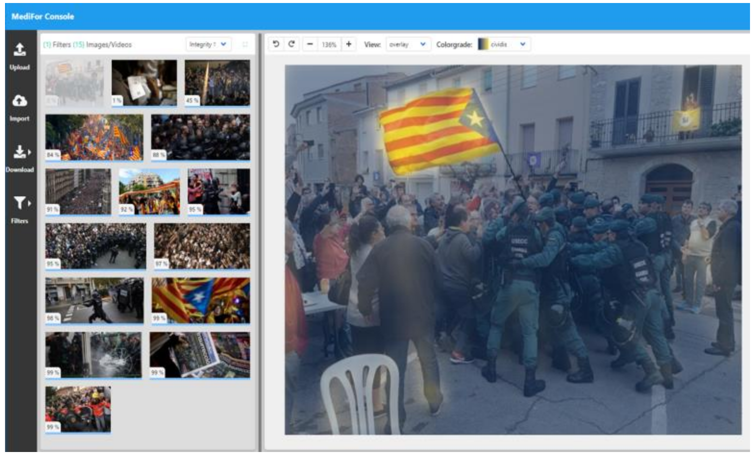


OPS-5G

Confidence in the information domain

Media Forensics (MediFor)
- *Images/video* – Deep fakes

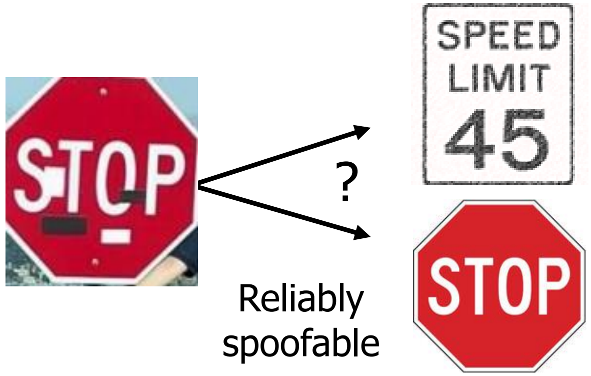
Semantic Forensics (SemaFor)
- *Multi-modal* – False narratives



Proficient artificial intelligence

I2O Thrust areas:
- Proficient AI
- Advantage in cyber operations
- Resilient, adaptable, and secure systems
- Confidence in the information domain

Fragility, opacity, dynamism



Trustworthiness

Dog or wolf?

Challenges

- **AI engineering.** How do we engineer systems to safely deliver AI to the mission?
- **Teams with integrated AI.** How can AI best partner with human teams?
- **Mission-tailored AI ensembles.** How can the full range of AI techniques be used to create advantage in diverse mission contexts?
- **Rapid training.** How can AI systems be reliably and efficiently trained, with much less data? How can the AI learn to improve itself?
- **Self-moderating systems.** How can AI systems gain awareness of system health, strengths and limitations, and available resources so that systems can adapt to complex mission contexts?

Robust physical world attacks on deep learning models
https://arxiv.org/pdf/1707.08945.pdf

UCI canine image

Cyber operations

I2O Thrust areas:
- Proficient AI
- Advantage in cyber operations
- Resilient, adaptable, and secure systems
- Confidence in the information domain

Cyber operations teams supported by advanced tooling, analytics, and AI

Challenges

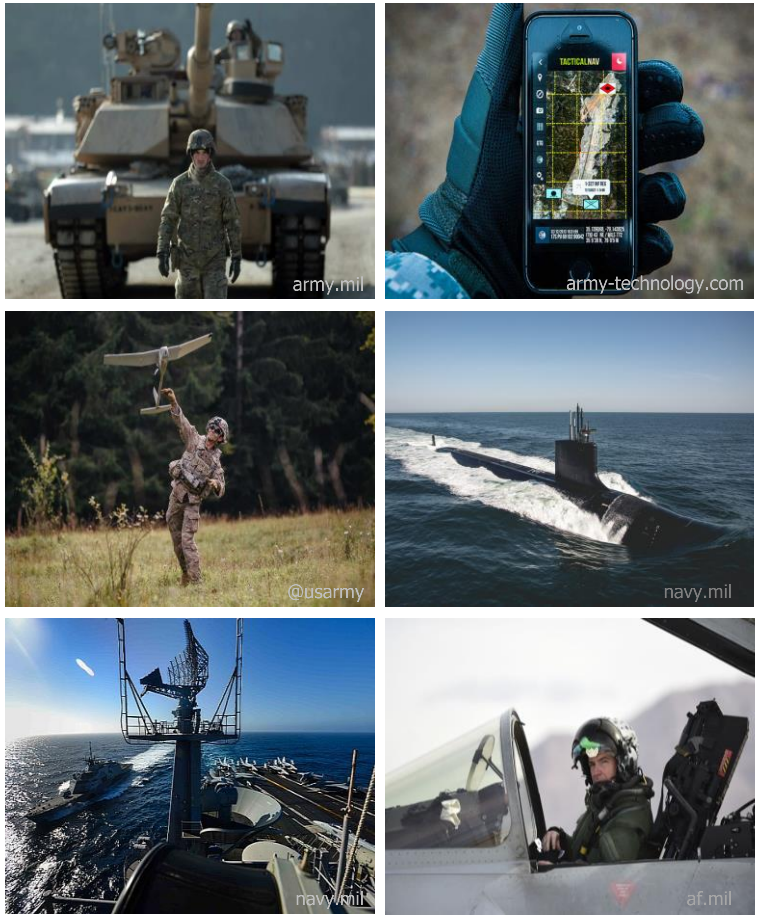
- **Attacks.** How can cyber attacks be prevented, detected, misdirected, and deterred?
- **Operators.** How can cyber operators best be supported in the face of rapidly evolving threats, continuous TTP enhancements, and optempos ranging from milliseconds to months?
- **Domains.** How can cyber operations capability be effectively integrated with kinetic and non-kinetic BMC2?
- **Data and SA.** How do we provide effective situation awareness, both real time and forensic, based on an overwhelming quantity of data?
- **Confidence.** What are mechanisms to assess confidence in cyber tools and TTPs with respect to effectiveness of engagement?

Georgia Army National Guard photo by Staff Sgt. Tracy J. Smith

Resilient, adaptable, and secure systems

I2O Thrust areas:
- Proficient AI
- Advantage in cyber operations
- → Resilient, adaptable, and secure systems
- Confidence in the information domain

Software is the most critical building material of our age



It is the *materiel* of cyber and AI

Challenges

- **Operate through.** How can we engineer resilient systems that can operate through cyber attacks?
- **Rapid evolution.** How do we build and assure systems that can rapidly evolve in the face of changing threats and improving algorithms? How can we deliver “framework and apps” model for military capabilities, analogous to mobile devices and desktops?
- **Re-certification.** What tooling and evidence can be developed to facilitate rapid and confident re-certification based on direct evaluation and measurement, rather than on process and compliance?
- **Cyber-physical and IoT.** How can we facilitate the rapid, confident, and assured development of embedded and highly distributed systems?
- **Legacy enhancement.** How do we enhance security, performance, and capability for existing legacy systems?
- **Safe sharing.** How can we safely and securely share complex structured data and active documents?
- **Configuration.** How can we be confident that configuration and component updates for large systems are safe and compatible? In addition, how can we be confident that the code that was evaluated is the code that is running?

Confidence in the information domain

I2O Thrust areas:
- Proficient AI
- Advantage in cyber operations
- Resilient, adaptable, and secure systems
- Confidence in the information domain

Human intuition can be misleading in non-kinetic domains

ThisPersonDoesNotExist.com

I2O in the Information Domain:
Effective and confident operations in the complex and diverse terrain of information and non-kinetic battle management

Challenges

- **Predict.** How do we predict transits to kinetic, and use that information to deter or mitigate those transits? What are effective TTPs for non-kinetic engagement, and how can we measure that effectiveness?
- **Data and SA**. In developing situation awareness in non-kinetic domains, what are data sources beyond social media? How can their reliability be evaluated?
- **Complexity in non-kinetic multi-domain operations (MDO).** What analytics and tools can be provided to better support MDO at all echelons, and enable us to prevail in the complexity battle?
- **Human language.** How can human language processing be adapted to exploit the linguistic constraints of engineering, scientific, legal, and other stylized documents to extract rich meanings? How can we rapidly and confidently build models of adversary information campaigns across the spectrum from strategic to tactical?

Context of the target operating environment

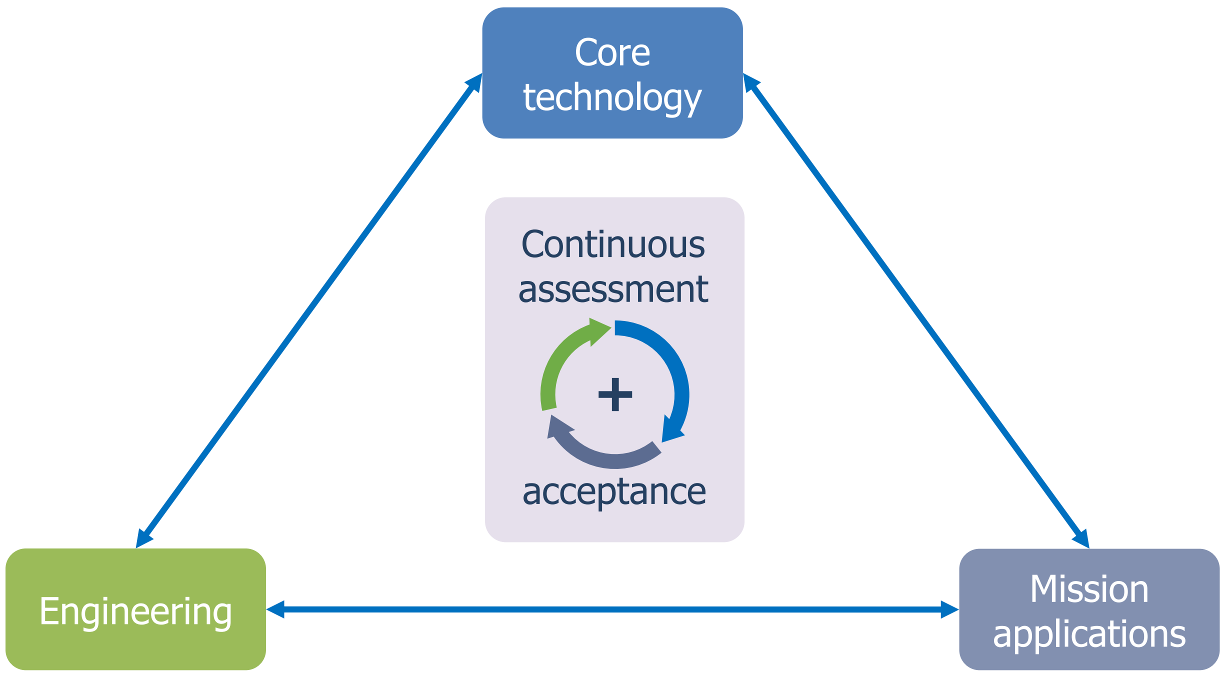
1. **Computing technologies** are advancing rapidly. There is no plateau in sight.

2. **Today's adversaries** (2+N) are sophisticated and nimble in the cyber and information domains.

3. **Critical military systems** are more likely to need continual enhancement. Threats are evolving rapidly, as are emerging computing capabilities.

4. **Flexibility in equities** is required. Aggressively advance both defensive and offensive capability.

5. **Human-machine partnering** is essential for future multi-domain operations. This teaming will be a source of advantage in battle management.



MTO Overview

Dr. Mark Rosker, MTO Director

Briefing prepared for VPR Summit

August 25, 2020

DARPA

DARPA

MTO
MICROSYSTEMS TECHNOLOGY OFFICE

MTO’s core mission is the development of **high-performance, intelligent microsystems and next-generation components** to enable dominance in national security **C4ISR, EW, and DE applications**

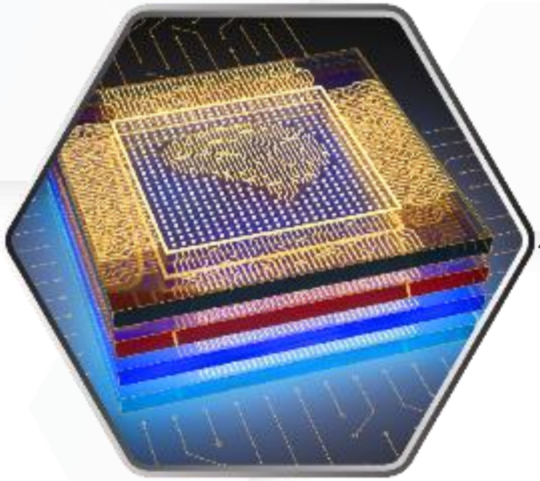
The **effectiveness, survivability, and lethality** of these systems depends critically on microsystems

C4ISR: Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance

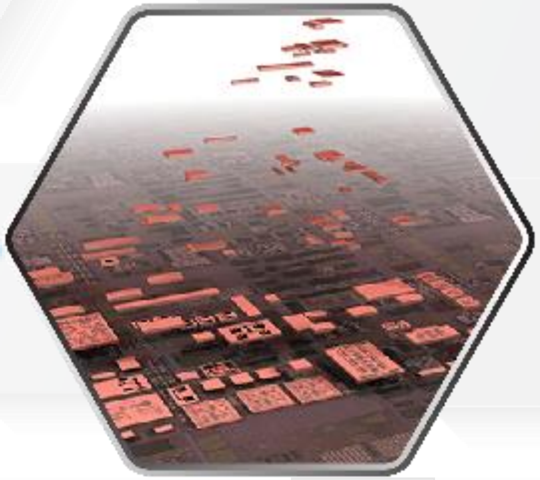
MTO
MICROSYSTEMS TECHNOLOGY OFFICE

DARPA

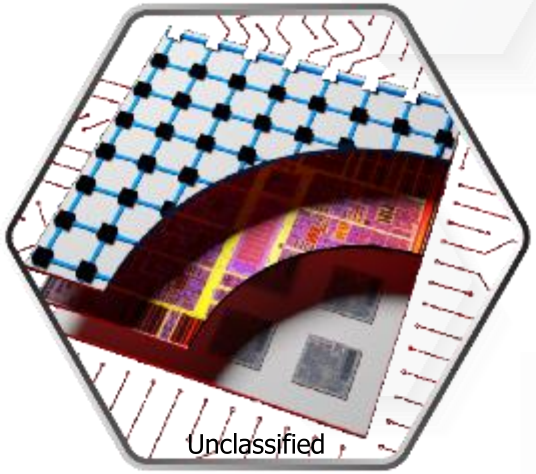
Embedded Microsystem Intelligence / Localized Processing



Next Gen Front-End Technologies for Electromagnetic Spectrum Dominance



Microsystem Integration for Functional Density & Security

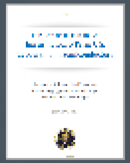


Disruptive Defense Microsystem Applications

THE ELECTRONICS RESURGENCE INITIATIVE

Consisting of ***20+*** new and existing DARPA programs and a ***5 year, $1.5 Billion investment***, ERI aims to forge forward-looking collaborations among the commercial electronics community, defense industrial base, university researchers, and the DoD to ensure far-reaching improvements in electronics performance well beyond the limits of traditional scaling

PCAST Report



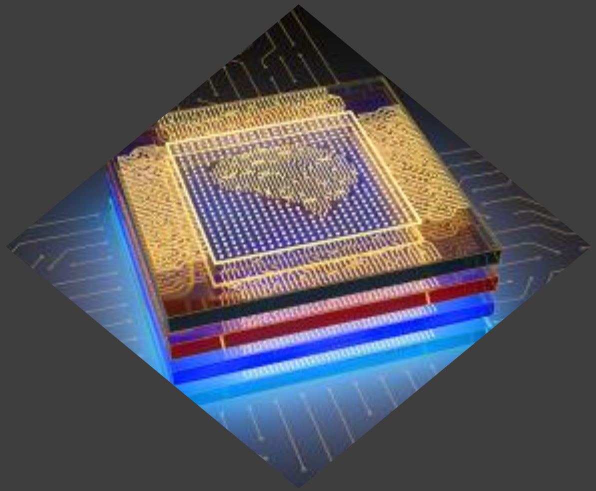
- **FY17**: *PCAST Report*; *7 foundational programs*
- **FY18**: ERI Summit; ***ERI officially starts*** *with 6 programs in Materials & Integration, Designs, & Architectures*
- **FY19**: *Added 7 programs in Defense Applications, Security, & Differentiated Access*; ERI Summit
- **FY20**: ERI Summit
- **FY21**
- **FY22**
- **FY23**: ***5 Years***

Universities			Commercial			Defense	
Arizona State University	Purdue University	University of Southern CA	Applied Materials	Le Wiz	Skywater	Army Research Lab	NIST
Brown University	Stanford University	University of Texas	ARM	Micron	Synopsys	Boeing	Northrop Grumman
Cornell University	University of California	University of Utah	Cadence	NVIDIA	STR	General Dynamics	Oak Ridge National Lab
Georgia Tech	University of Illinois - UC	University of Washington	Ferric Semiconductor	Qualcomm	TSMC	General Electric	Raytheon
MIT	University of Michigan	Yale University	IBM	Samsung	Xilinx	HRL Laboratories	Sandia National Labs
Princeton University	University of Minnesota		Intel			Lockheed Martin	

Embedded Microsystem Intelligence / Localized Processing: Key Challenges

Increasing information processing density & efficiency

Problem: Current processors cannot be scaled to DoD needs



Potential Approaches

- Low temperature computing
- New computing materials
- New computing algorithms

Making decisions at the edge faster

Problem: Conventional algorithms and associated platforms not sufficiently fast for emerging threats

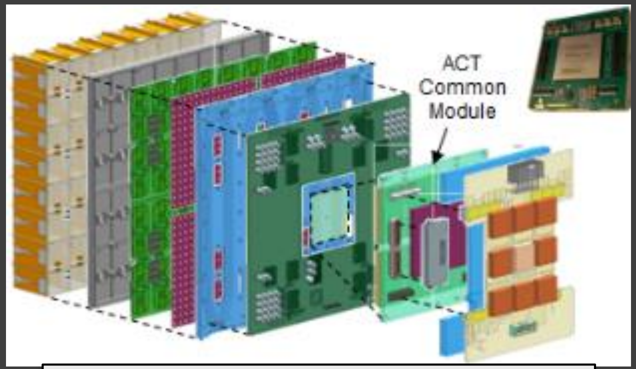
STRIPES.com

Potential Approaches

- Artificial intelligence / machine learning for decision making at the edge

Reducing the glut of digitized sensor data

Problem: Volume of data captured in static sensor architectures overwhelms processing capability



ACT Signal Processing Challenge:

51.2 GSPS/element * 10 bit/Sample * 2 Pol * 512 elements = **524 Tbps**

Potential Approaches

- New reconfigurable architectures with more on-chip functionality
- Scalable algorithms

Embedded Microsystem Intelligence / Localized Processing

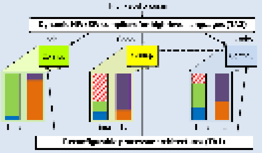
Increasing information processing density and efficiency

HIVE

Fast, small, random, global memory access across a flat, low-latency network

FRANC

New materials for combined memory and computation

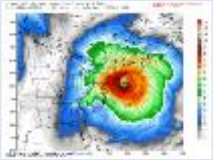


SDH

Reconfigurable HW architectures and supporting SW development

DPRIVE

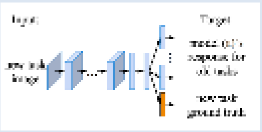
Full homomorphic encryption: data processed while encrypted



PAPPA**

Design for massively parallel processing

Making decisions at the edge faster

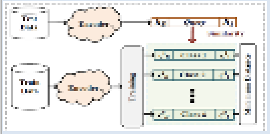


L2M

AI models that learn from experience

PEACH*

Photonic reservoir AI for compact, low-latency edge hardware



HyDDENN*

Specialized chips for AI at the edge

Reducing the glut of digitized sensor data

ReImagine

Develop a layer that incorporates imaging and FPGA-like characteristics

Key
Blue = ERI
* = AIE
** = μE

(U) Next Gen Front-End Technologies for EM Spectrum Dominance: Key Challenges

Reducing SWaP-C of front-end elements

Problem: Bulky electronics and optics undermine ability to miniaturize sensors and systems

Marino et al., Lincoln Laboratory Journal (2005)

Potential Approaches

- Wafer-scale electronics and optics
- Chip-scale sensors
- Advances in quantum sensors

Increasing tactical range

Problem: Range of EW, DE, and C4ISR is limited by inherent properties of current electronic materials and transmitter efficiency

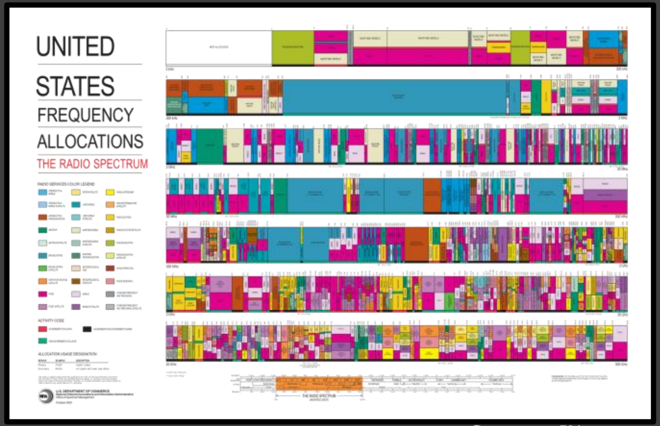
MIT

Potential Approaches

- Emerging electronic materials
- New PA architectures / circuit design techniques

Enabling robust operation in congested spectrum

Problem: RF components are insufficiently adaptable or robust to operate in increasingly congested spectrum



SpectrumIN.com

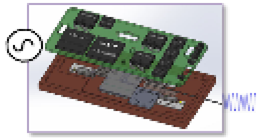
Potential Approaches

- New materials / devices integrated directly onto RF MMICs
- Real-time adaptive technologies for navigating crowded RF environments

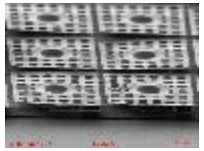
Next Generation Front-End Technologies for Electromagnetic Spectrum Dominance

Reducing SWaP-C of front-end elements

MOABB
Create ultra small LIDAR systems using optical phased arrays



DODOS
Compact optical synthesizer for frequency control

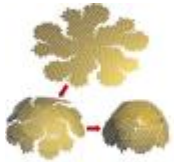


LOTS
Development of highest performing, manufacturable uncooled sensor

AMEBA
Exploiting the efficiency of mechanical motion at low frequencies

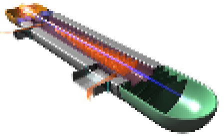
AMBIIENT
Measure gradients directly to isolate neural signals from Earth's background

QuiVER
Tensor magnetometers and algorithms for DoD applications

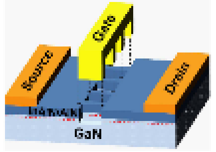


FOCII
Curved focal plane arrays for improved optical performance and minimize size

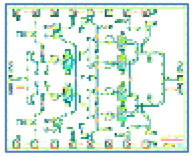
Increasing tactical range



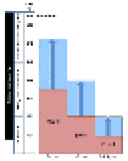
HAVOC
High power vacuum electronics at higher frequency



DREAM
New materials and devices for high power and efficiency at millimeter wave



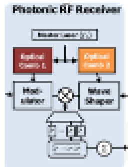
MGM
Mature fastest GaN transistor process with improved yield and cycle time



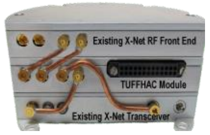
FD-MID
Deplete absorber layer of midwave infrared detectors for improved sensitivity

WIRED
Reduce SWaP-C of infrared detectors through wafer-scale ROIC processing

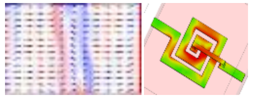
Enabling robust operation in congested spectrum



HERMES
Access to wide RF bandwidths using integrated silicon photonics

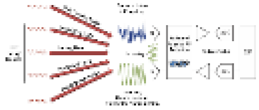


SPAR
Signal processing elements to enable jamming resilient frequency hopping

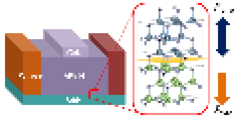


M3IC
Self-biased magnetic materials for integration with MMICs

SC2
AI radio networks that collaboratively manage spectrum



WARP
Adaptive embedded control that autonomously responds



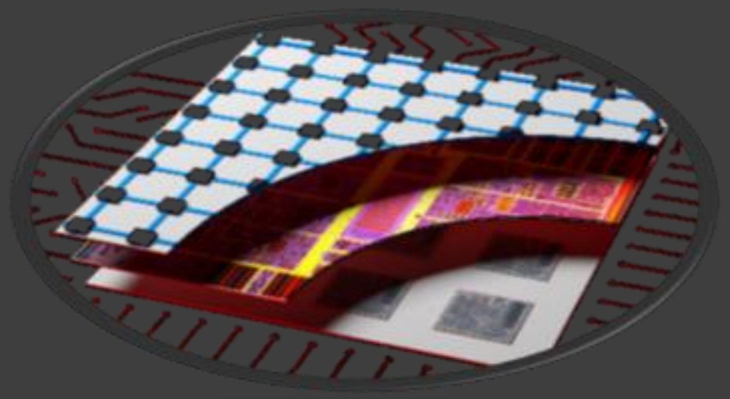
TUFEN
Ferroelectric behavior in doped nitride materials

Key
Blue = ERI

Microsystem Integration for Functional Density & Security: Key Challenges

Overcoming the inherent throughput limits of 2D electronics

Problem: 2D computing with traditional interconnects between processor and memory limits throughput and drives energy consumption

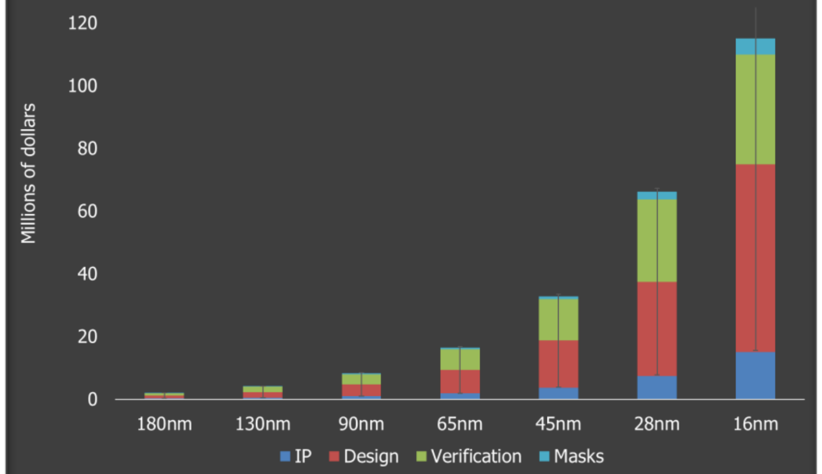


Potential Approaches

- 3-dimensional electronics
- Integration of photonics with optics
- New materials *e.g.,* nanotubes
- Heterogeneous electronics with Si-like back-end processing

Mitigating the skyrocketing costs of electronics design

Problem: Increasingly complex circuit architectures are making design costs prohibitive for commercial industry and DoD

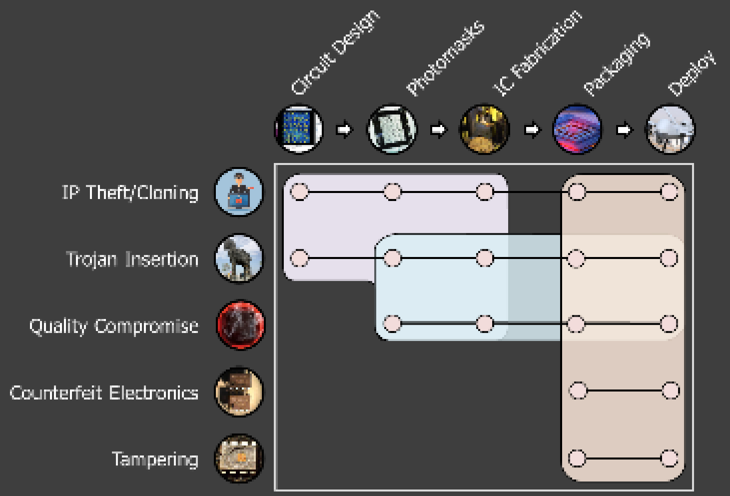


Potential Approaches

- Design tools and hardware with machine learning capability
- Trusted open source tools
- Modular circuit design with relevant standards and interconnects

Overcoming security threats across the entire hardware lifecycle

Problem: Persistent hardware threats limit the ability to access and utilize advanced electronics technology

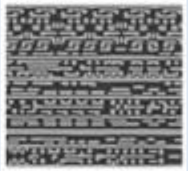


Potential Approaches

- EDA based technologies
- Inspection based technologies
- Supply chain based technologies

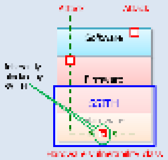
Microsystem Integration for Functional Density & Security

Overcoming security threats across the entire hardware lifecycle

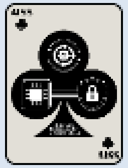


OMG
Logic locking and Trojan detection for foundry access

GAPS
Architectures for provable privacy and security



SSITH
Hardware security architectures that are secure, scalable and adaptable



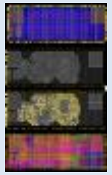
AISS
Security-conscious design for integrated circuits

SHEATH
Board monitoring for dynamic Trojan attack detection

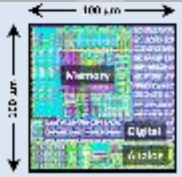
Mitigating the skyrocketing costs of electronics design

CHIPS
Modular circuit design through standards / fast interconnects

POSH
Trusted components and verification tools for efficient design of complex chips



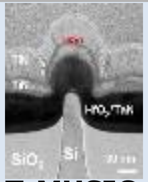
IDEA
Electronic design automation that learns



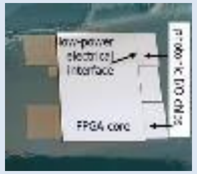
RTML
Machine learning hardware that adapts in real time

Overcoming the inherent throughput limits of 2D electronics

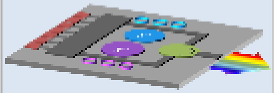
3DSoC
Utilize 3rd dimension & carbon nanotubes for 50x compute performance



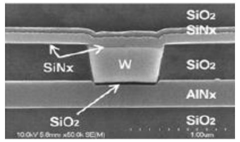
T-MUSIC
Mixed-mode electronics for superior performance



PIPES
In-package optical signaling through integration of nanophotonics



LUMOS
Integrated lasers and amplifiers on high-performance photonics platforms



FPCMS
Integrate phase change material switches with commercial silicon

Key
Blue = ERI

(U) Disruptive Defense Microsystems Applications: Key Challenges

Revolutionizing communications (5G and beyond)

Problem: Ensuring network availability and security

Medium.com

Potential Approaches

- Digital arrays
- Low power element-level beamforming
- Advanced techniques for secure comms

Reducing latency in EW

Problem: Adaptive threats challenge ability to detect and counter

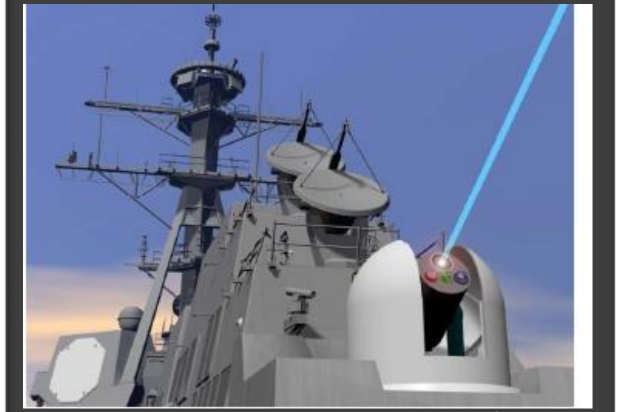
Navalnews.com

Potential Approaches

- Neural networks for RF signal recognition
- Embedded machine learning for cognitive EW systems

Generating / directing high power radiation

Problem: Advanced threats require high power countermeasures



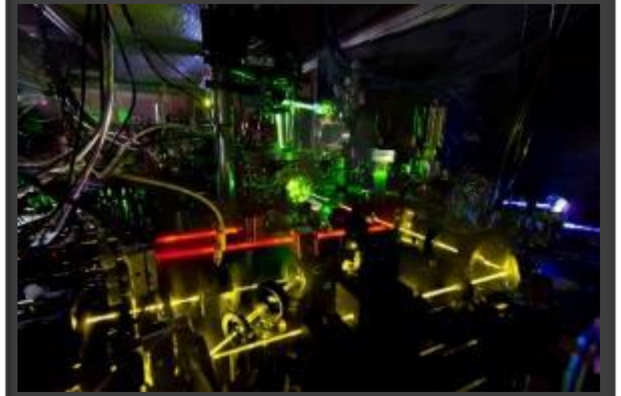
Navalnews.com

Potential Approaches

- Ultra-efficient, high power laser diodes
- Compact, high power laser arrays
- High power microwave systems

Delivering accurate position and timing w/o GPS

Problem: Low SWaP-C solutions required for GPS-denied environments

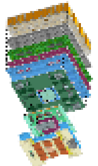


Potential Approaches

- Modern atomic physics for low SWaP clocks
- Advanced MEMS for inertial guidance
- Integrated photonic chips for clocks / gyros

Disruptive Defense Microsystems Applications

Revolutionizing communications (5G and Beyond)

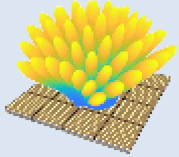


ACT-IV / Hedgehog

Digital array leveraging the ACT common module

DSSoC

Power and cost efficient domain-specific architectures

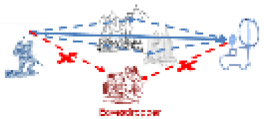


MIDAS

Element-level millimeter wave, multi-beam digital phased arrays

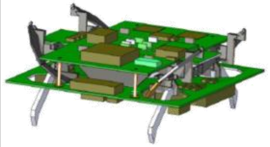
DRBE

Large-scale RF cross-connected environment emulator



WiSPER

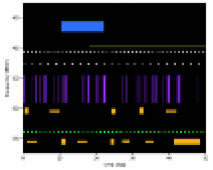
Secure comms through spectral, temporal, and spatial diversity



SHRIMP

Improve actuation and battery efficiency for untethered platforms

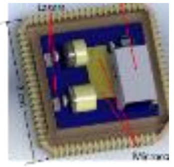
Reducing latency in EW



RFMLS

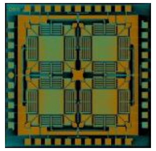
Teach deep neural networks to recognize and label RF signals

Delivering accurate position and timing w/o GPS



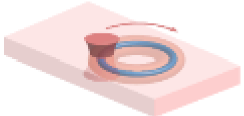
ACES

Leverage modern atomic physics techniques for low SWaP clocks



PRIGM

Integrate improved MEMS and electronics for inertial guidance



A-PHI

Photonic integrated chips to realize atomic clocks and gyroscopes

Generating / Directing High Power Radiation

EUCLID

Boost power and efficiency of laser diodes for high energy lasers

Key
Blue = ERI

DARPA Outreach

D. Wes Bennett Jr.
DARPA Director of Contracts Management

August 2020

Doing Business with DARPA

DARPA makes pivotal investments that lead to breakthrough technologies for national security

Revolutionary not Evolutionary

To maximize the pool of innovative proposal concepts it receives, DARPA strongly encourages participation by all sources: industry (small and large), academia, and entrepreneurial individuals

The DARPA Culture:

- Maintain and encourage innovation and the ability to execute rapidly and effectively
- DARPA Program Managers – “Key individuals” are:
  - Selected from industry, academia, and government agencies (longevity with DARPA 3-5 years)
  - Considered at the top of their fields
  - Tackles difficult challenges and takes big risks which push the limits of their disciplines

Doing Business with DARPA

- Become familiar with DARPA's challenges and opportunities for National Security http://www.darpa.mil/about-us/about-darpa

- Contact a DARPA Program Manager (PM) about your idea prior to submitting a abstract, white paper, or proposal to gain insight, PMs are key to working with DARPA http://www.darpa.mil/about-us/people

- Visit www.grants.gov or www.fedbizopps.gov to view DARPA Broad Agency Announcements (BAAs), Research Announcement (RAs), and Program Solicitations (PS)

- Visit https://sbir.defensebusiness.org/ to view DoD Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Program Announcements

- For DARPA SBIRS/STTRs: https://www.fbo.gov/index?s=opportunity&mode=form&id=e1f89874eee960aa313bc998ab848c81&tab=core&_cview=1

Doing Business with DARPA

Characteristics of DARPA Solicitations for Research:

- No common Statement of Work (SOW)
- Varying technical approaches/solutions are anticipated
- Proposals are evaluated with technical merit and approach as the main factor
- Communication with proposers allowed during the open period of the BAA
- White papers or proposal abstracts may be solicited
- Industry Days where Program Managers brief interested communities on the research

Typical Solicitation Types:

- Program-specific BAAs released throughout the year (typically allow any type of award)
- Office-wide BAAs for one or two years with general tech-office scope
- Research announcements for grants or cooperative agreements (e.g., Young Faculty Award)
- Program Solicitations for Other Transactions (e.g., Artificial Intelligence Exploration)
- Requests for Proposals or Quotes for services or commodities (e.g., IT, SETA, Security)

Seedlings vs. Programs vs. Challenges

Seedlings

- Open to all capable sources
- Usually submitted through Office-Wide BAA
- Small short duration (6-9 months) projects
- Move concepts from “disbelief” to “mere doubt”
- Lead to the next generation of program ideas

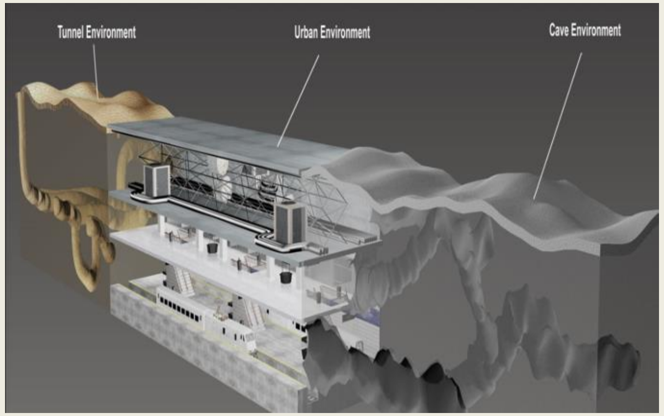
DARPA Improv

Explore ways to combine or convert commercially available products such as off-the-shelf electronics, components created through rapid prototyping, and open-source code to cost-effectively create sophisticated military technologies

Challenges

- Compete on unique DARPA R&D problems
- Tend to include phases with culminating events with monetary or other prizes
- May result in a prize with up to a $10M fair market value

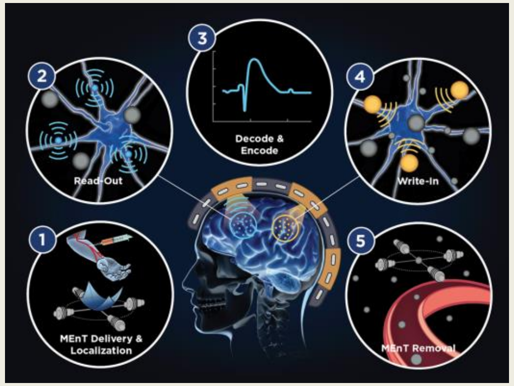
Subterranean Challenge



Programs

- Open to all capable sources
- Proposals solicited through specific program BAAs
- Often multi-year, multi-disciplinary efforts
- Technology development to move from “possibility” to “capability”

Next-Generation Nonsurgical Neurotechnology



BATTELLE

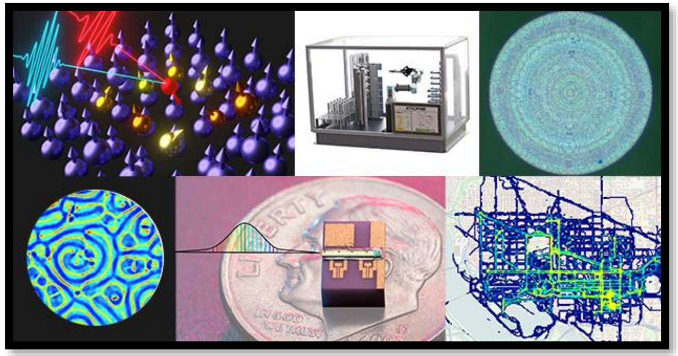
Cellular Nanomed Inc

MIAMI

Open Exploration Opportunities

- Feasibility Study (3-9 months) to optional proof of concept (9-15 months) - $1M total
- Risk reduction – targeted investments leading to potential future investment
- 90 days from concept release to award

Disruptioneering

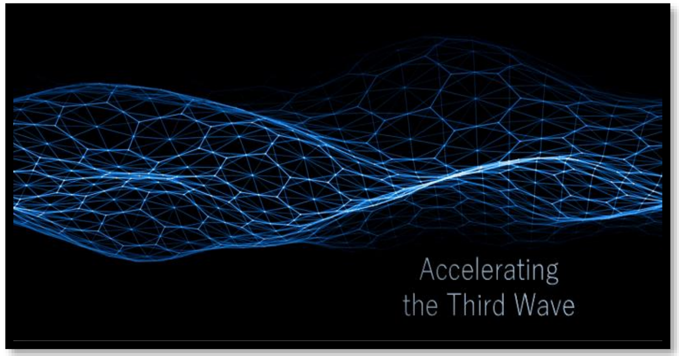


Quickly explore the most radical and potentially highest-payoff for fundamental research

Microsystem Exploration

Explore frontiers in embedded microsystem intelligence and localized processing; novel electromagnetic components and technologies; microsystem integration for functional density and security; and disruptive microsystem applications in C4ISR, electronic warfare, and directed energy

AI Exploration



AI addressing limitations of first and second wave AI technologies shaping a future in which AI-enabled machines serve as trusted, collaborative partners in solving problems of importance to national security

Evaluation of Proposals

- <u>Typical</u> Evaluation Criteria (listed in descending order of importance)

  - Overall Scientific and Technical Merit
    - Innovative, feasible, achievable, and complete
    - Technical team has expertise and experience needed
    - Major technical risks identified and mitigated

  - Potential Contribution and Relevance to the DARPA Mission
    - Relevant to the national technology base
    - Pivotal early technology investment that creates or prevents strategic surprise for national security

  - Cost Realism
    - Proposed costs are realistic for the approach
    - Accurately reflects technical goals and objectives of the solicitation
    - Reflects sufficient understanding of the costs and level of effort needed to successfully perform
    - Prime and subawardee costs are substantiated by the details provided in the proposal

Review and Feedback

- Review
  - DARPA policy to ensure impartial, equitable, comprehensive proposal evaluations
  - Scientific / Technical review, of conforming proposals, based on evaluation criteria
  - Proposals are not evaluated against each other since there is no common work statement
- Feedback
  - Abstract feedback includes brief rationale on whether DARPA recommends proposer submits full proposal
    - Proposer may submit a full proposal regardless of DARPA's feedback
  - After full proposal submittal and notification of non-selection, proposers may request in-formal feedback session
    - Explanation of the scientific review process and evaluation criteria used
    - Only proposer's proposal will be discussed
    - Discuss proposer's strengths and weaknesses under each evaluation criteria

SBIR/STTR Program

<u>DARPA pilot to advertise SBIR/STTR topics outside of the three pre-determined announcements issued at the DoD level</u>

- Align SBIR/STTR funding opportunities with DARPA's programs
- Place select awardees into DARPA Entrepreneurial Investigator Initiative (EI2) to provide targeted commercialization assistance
- Stimulate technological innovation
- Increase private sector commercialization of Federal R&D to increase competition, productivity and economic growth
- Foster and encourage participation by socially and economically disadvantaged small businesses;
- Stimulate a partnership of ideas and technologies between innovative SBCs and research institutions

Phase	SBIR	STTR
Phase I	$225K Base (10 mos.)	$225K Base (10 mos.)
Phase II/ Adoptions	$1M Base (24 mos.) $500K Option (12 mos.)	$1M Base (24 mos.) $500K Option (12 mos.)
Phase II Enhancement	$1:$1 Match Up to $500K	$1:$1 Match Up to $500K
Phase III	No time limit No SBIR funds	No time limit No STTR funds

SBIR

3.2% R&D Budget

FY19 - $100M

STTR

.45% R&D Budget

FY19 – $12M

SBIR/STTR is the Largest Source of Early Stage Technology Financing in the U.S.

Embedded Entrepreneur Initiative (EEI)

Embedded Entrepreneur Initiative:

- Pilot Accelerator Program for SBIR/STTR Phase II performers
- Goal to move technology from lab to sustainable business for commercial/defense sector sales
- Submit a compelling commercialization strategy along with SBIR/STTR proposal
- Determination for acceptance into the Embedded Entrepreneur Initiative is made following successful SBIR/STTR award
- $250,000 additional funding to bring an entrepreneur-in-residence onto SBIR/STTR contracts
- Provides access to DARPA advisors, mentors from industry, and DARPA's network of investors
- Help build and refine a go-to market strategy over the course of the DARPA Award
  - Customer engagement plan
  - Market analysis and mapping
  - Competitive analysis
  - Techno-economic analysis
  - IP securement strategy and
  - Financial Plan

http://www.darpa.mil/work-with-us/for-small-businesses/commercialization-continued

SBIR/STTR – Eligibility

Small Business Innovative Research

- Small businesses with 500 or fewer employees
- Independently owned and operated for profit
- Have its principal place of business in the U.S.
- Be at least 51% owned by U.S. citizens or lawfully admitted permanent resident aliens
- The primary employment of the principal investigator must be with the small business
- A minimum of 2/3 of the research work must be performed by the proposing firm in Phase I and 1/2 in Phase II

Small Business Technology Transfer

- Small businesses with 500 or fewer employees; there is no size limit on the research institution
- Partnership with a U.S. research institution
- 40% of work performed by small business
- 30% of work performed by research institution
- Small business must manage and control the STTR funding agreement
- Principal investigator may be employed at the small business or research institution

UNDERSTANDING IPAS AT DARPA

Mary Vander Linden
Director, Strategic Resources Office

OVERVIEW OF IPA

Intergovernmental Personnel Agreement (IPA) – a ***formal yet flexible*** arrangement between government and the affiliated:

- Academic Institution
- Federally Funded Research and Development Center (FFRDC)
- Non-Profit Organization

Government reimburses personnel costs to home organization

- Salary reimbursed based on expertise and experience
- DARPA pays 12 month per diem or household move

Brings world-leading expertise to DARPA for a limited term to drive high-risk research programs with unparalleled autonomy

IPA DOCUMENTATION

OF 69 # (REV. 2-89)
U.S. Office of Personnel Management
FPM Chapter 334

Assignment Agreement

Title IV of the Intergovernmental Personnel Act of 1970 (5 U.S.C. 3371-3376)

INSTRUCTIONS

This agreement constitutes the written record of the obligations and responsibilities of the parties to a temporary assignment arranged under the provisions of the Intergovernmental Personnel Act of 1970.

Tax ID #:
DUNS #:
Cage Code:

The term "State or local government," when appearing in this form, also refers to an institution of higher education, and Indian tribal government, and any other eligible organization.

Procedural questions on completing the assignment agreement form or on other aspects relating to the mobility program should be addressed to either mobility program coordinators in each Federal agency or to the staff of the Personnel Mobility Program in the U.S. Office of Personnel Management.

Copies of the completed and signed agreement should be retained by each signatory.

PART 1 - NATURE OF THE ASSIGNMENT AGREEMENT

1. Check Appropriate Box — [X] New Agreement — [ ] Modification — [ ] Extension

PART 2 - INFORMATION ON PARTICIPATING EMPLOYEE

2. Name *(Last, First, Middle)*: Arpa, Jane S.

3. Social Security Number:

4. Home Address *(Street, City, State, Zip Code)*
1010 Home Address
Affiliation Town, VA 12345

5.- **A.** Have you ever been on a mobility assignment — [ ] YES — [X] NO

5.- **B. If "YES"**, date of each assignment *(Month and Year)*
From: March 2019 — To: March 2021

PART 3 - PARTIES TO THE AGREEMENT

6. Federal Agency *(List office, bureau or organizational unit which is party to the agreement)*: Defense Advanced Research Projects Agency

7. State or Local Government *(identify the government agency)*: Affiliated University

8. Is assignment being made through a faculty fellows program? If "YES", give name of the program — [ ] YES — [X] NO

PART 4 - POSITION DATA

A - Position Currently Held

9. Employment Office Name and Address *(Street, City, State, Zip Code)*
Affiliated University
4321 University Street
Affiliation Town, VA 12345

10. Employee's Position Title: Professor of Technology

11. Office Telephone Number *(Include the Area Code)*: 123-465-7890

12. Immediate Supervisor *(Name and Title)*: Dr. Supe R. Visor, Provost for Academic Affairs

B - Type of Current Appointment

13. Federal Employees *(Check appropriate box.)*
[ ] Career Competitive
[ ] Other *(Specify)*:
Grade Level: N/A

14. State and Local Employees
State or Local Annual Salary: $XXX,XXX
Original Date Employed by the State or Local Government *(Month, Day, Year)*: October 1, 2015

C - Position To Which Assignment Be Made

15. Employment Office Name and Address *(Street, City, State, Zip Code)*
Defense Advanced Research Projects Agency
675 North Randolph Street
Arlington, VA 22203

16. Assignee's Position Title: Program Manager

17. Office Telephone Number *(Include the Area Code)*: 098-765-4321

18. Immediate Supervisor *(Name and Title)*: Dr. John Darpa, Director, Technical Sciences Office

Previous edition is usable — 50 69 - 105

DARPA Overprint, May 16

Designed using Adobe, DARPA/MSO

PART 5 - TYPE OF ASSIGNMENT

19. Check Appropriate Boxes
[ ] On detail from a Federal agency
[ ] On leave c from a Federal agency
[X] On detail to a Federal agency
[ ] On appointment in a Federal agency
[X] Full Time
[ ] Part Time
[ ] Intermittent

20. PERIOD OF ASSIGNMENT *(Month, Day, Year)*
From: March 7, 2019 — To: March 6, 2021

PART 6 - REASON FOR MOBILITY ASSIGNMENT

21. Indicate the reasons for the mobility assignment and discuss how the work will benefit the participating governments. In addition, indicate how the employee will be utilized at the completion of this assignment.

The IPA will assist in resolution of difficult technical and managerial issues and gain an in-depth understanding of current and long-term defense issues and the role that his/her organization can play in helping to resolve these issues.

SPECIAL QUALIFICATIONS: Clearance requirements are a final TOP SECRET with access to SCI. The IPA's security office will forward his/her current clearance, SCI accesses, and a visit request NTE the term of the IPA agreement (or three years, whichever is shorter) to DARPA/SID via JPAS SMO DDAAUS2, attention Mr. Steve Security. If any additional security investigations are needed while the IPA is at DARPA, DARPA will be responsible for the coordination and cost. Subsequent reinvestigations will be the responsibility of the sending organization. If there is any change in the IPA's security clearance, or access, the IPA's security office will notify DARPA/SID immediately by calling Mr. Steve Security at 703-XXX-XXXX with a follow-up in writing (Steve.Security@darpa.mil).

PART 7 - POSITION DESCRIPTION

22. List the major duties and responsibilities to be performed while on the mobility assignment.

As a Program Manager the Technical Sciences Office (TSO), Dr. Arpa will be responsible for a wide range of activities related to the development and management of programs in quantum theory and other technical areas of interest to DARPA/TSO.

PART 8 - EMPLOYEE BENEFITS

23. Rate of Basic Pay During Assignment: $XXX,XXX

24. Special Pay Conditions *(Indicate any conditions that could increase the assigned employee's compensation during the assignment period)*: **See block 25 below

25. Leave Provisions *(Indicate the annual and sick leave benefits for which employee is eligible. Specify the procedures for reporting, requesting and recording such leave.)*

Leave allowance of _____ will apply. Use of leave will be approved by the supervisor and reported to _____ in accordance with internal procedures for reporting time and attendance data. Leave provisions are only for the purposes of reporting the usage of, requesting and recording leave.

---

* (block 24)
Eligible for salary increase January 1 of each year; however, reimbursement of any increase will not exceed the current federal prevailing rate of increase.

This agreement is subject to a reduction of salary and fringe during any DoD mandated furlough period.

Acknowledgment (initial): ______________ assigned employee ______________ sending institution authorizing official

Page 2

Designed using Adobe, DARPA/MSO

IPA DOCUMENTATION

PART 9 - FISCAL OBLIGATIONS

Identify, where appropriate, the office to which invoices and time and attendance records should be sent.

26. Federal Agency Obligations *(If paying more than 50 percent of a Federal employee's salary beyond a 6-month period, specify rationale for cost-sharing decision.)*

DARPA will reimburse Affiliated University for Dr. Arpa's salary (block 23) and for Affiliated University share of employee fringe benefits (block 31) equivalent to XX% of salary and variable pay. Billings should include a separate breakdown of salary, variable pay, and fringe benefits and be submitted quarterly to:

DARPA Comptroller
via email at DARPAIPAINVOICES@DARPA.MIL

Invoices must be submitted on company letterhead and must be signed and dated by authorized individual.

The invoice period will cease on the termination date of this agreement.

27. State or Local Government agency Obligations

Affiliated University will continue to pay Dr. Arpa's salary and benefits and withhold employee contributions for benefits and taxes.

*Salary beyond the salary cited in block 23 is the sole responsibility of Affiliated University.

In accordance with this agreement, invoice reimbursements by DARPA will not exceed computations and limitations identified in Blocks 23, 24 & 26 without prior written approval from the Director, Strategic Resources Office, DARPA.

PART 10 - CONFLICTS OF INTEREST AND EMPLOYEE CONDUCT

[X] 28. Applicable Federal, State or local conflict-of-interest laws have been reviewed with the employee to assure that conflict-of-interest situations do not inadvertently arise during this assignment.

[X] 29. The employee has been notified of laws, rules and regulations, and policies on employee conduct which apply to him/her while on this assignment.

PART 11 - OPTIONS

30. Indicate coverage **"N/A"**, if not applicable.

A. Federal Employees Group Life Insurance

[ ] Covered [X] N/A

B. Federal Civil Service Retirement system or Federal Employees Retirement System

[ ] Covered [X] N/A

C. Federal employee Health Benefits

[ ] Covered [X] N/A

31. State or Local Agency Benefits (Indicate all State employee benefits that will be related by the State or local agency employee being assigned to a Federal agency. Also include a statement certifying coverage in all State and local employee benefit programs that are elected by Federal employee on leave without pay from the Federal agency to a State or local agency.)

Health and life insurance, disability, social security, unemployment, retirement and leave (personal, vacation, sick, and holidays). **

*See Block 32 for clarification.

32. Other Benefits *(Indicate any other employee benefits to be made part of this agreement.)*

Clarification of Fringe Benefits Coverage: The organization cited in block 9 of this agreement will be responsible for providing benefits from within the approved amounts set forth in this agreement. The fringe rate listed in Block 26 of this agreement will cover only the benefits stated in Block 31.

Leave (personal, vacation, sick, and holiday) are included in the base and supplemental pay rate subject to any prevailing wage cap. Unused leave pay-outs are not an allowable expense under this IPA.

acknowledgment (initial) _________
sending institution authorizing official

PART 12 - TRAVEL AND TRANSPORTATION

33. Indicate: (1) Whether the Federal agency or State or local agency will pay travel and transportation expenses to, from, and during the assignment as specified in Chapter 3344 of the Federal Personnel Manual, and (2) which travel and relocation expenses will be included.

Business travel expenses related to this assignment will be paid by DARPA.

In accordance with the Joint Travel Regulations (Chapters 2 & 5), DARPA will pay Dr. Arpa's the applicable Arlington, VA per diem rate, for a period not to exceed one year.

PART 13 - APPLICABILITY OF RULES, REGULATIONS AND POLICIES

34. Check Appropriate Boxes.

[X] A. The rules and policies governing the internal operation and management of the agency to which my assignment is made under this agreement will be observed by me.

[X] B. I have been informed that my assignment may be terminated at any time at the option of the Federal agency or the State or local government.

[ ] C. I have been informed that any travel and transportation expenses covered from Federal agency appropriations may be recoverable as a debt due to the United States, if I do not serve until the completion of my assignment (unless terminated earlier by either employer) or one year, whichever is shorter.

[X] D. I have been informed of applicable provisions should my position with my permanent employer become subject to a reduction-in-force procedure.

[ ] E. I agree to serve in the Civil Service upon the completion of my assignment for a period equal to that of my assignment. Should I fail to serve the required time, I have been informed that I will be liable to the United States for all expenses (except salary) of my assignment. (For Federal Employees Only).

PART 14 - CERTIFICATION OF ASSIGNED EMPLOYEE

In signing this agreement, I certify that I understand the terms of this agreement and agree to the rules, regulations and policies as indicated in Part 13 above.

35. Location of Assignment *(Name of Organization)*	36. Date *(Month, Day, Year)* From	To
Defense Advanced Research Projects Agency 675 North Randolph Street Arlington, VA 22203	March 7, 2019	March 6, 2019
37. Signature of Assigned Employee	38. Date of Signature *(Month, Day, Year)*	

PART 15 - CERTIFICATION OF APPROVING OFFICIALS

In signing this agreement, we certify that;

- the description of duties and responsibilities is current and fully and accurately describes those of the assigned employee;
- this assignment is being entered in to serve a sound, mutual public purpose and not solely for the employee's benefit;
- at the completion of the assignment, the participating employee will be returned to the position he or she occupied at the time this agreement was entered into or a position of like seniority, status pay.

State or Local Government Agency	Federal Agency
39. Signature of Authorizing Officer	40. Signature of Authorizing Officer
41. Date of Signature *(Month, Day, Year)*	42. Date of Signature *(Month, Day, Year)*
43. Typed Name and Title Dr. Supe R. Visor Provost for Academic Affairs	44. Typed Name and Title Mary Vander Linden Director, Strategic Resources Office

PRIVACY ACT STATEMENT

Sections 3373 and 3374, Assignment of Employees To or From State or Local Governments, of Title 5, U.S. Code, authorizes collection of this information. The data will be used primarily to formally document and record your temporary assignment to or from a State or Local government, institution of higher education, Indian tribal government, or other eligible organization. This information may also be used as the legal basis for personal and financial transactions, to identify you when requesting information about you, e.g., from prior employers, educational institutions, or law agencies, or by State, local or Federal income taxing agencies.

Solicitation of your Social Security Number (SSN) is authorized by Executive Order 9397, which is permitted by use of the SSN as an identifier of individual records maintained by Federal agencies. Furnishing your SSN or any other data is voluntary. However, failure to provide any of the requested information may result in your being ineligible for participation in the Intergovernmental Assignment Program.

IPA PROGRAM FUELS NATIONALLY SIGNIFICANT RESEARCH

- Responsible for preeminent researchers becoming Program Managers
  - Majority of IPA hires from academia
  - Devise new thrusts for Tech Office to reshape a research field
  - Invest millions in DARPA-hard, high-risk research to make the state-of-the-art obsolete

- Strategic investment vs. one-off personnel loan
  - Cultivate research communities that pursue and mature technology which is not commercially viable
  - Freedom to explore difficult questions and establish next-generation technology standards for government and industry

"If the best minds refuse to contribute, worse ones will"

Washington Post Editorial Board on DARPA's Artificial Intelligence portfolio, 12 Sep 2018