DARPA/DSO 101

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LTC Philip Root, Deputy Director
Defense Sciences Office

June 18, 2019

DARPA Technical Offices

DARPA and the 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

Program Managers

Anne Fischer
Chemical Systems

Jan Vandenbrande
Math, Design, & Production Automation

John Paschkewitz
Systems, Design, & Materials

Bill Carter
Materials Science

Michael Fiddy
Electromagnetic waves, scattering & structures

Tatjana Curcic
Quantum Information Science

Jiangying Zhou
Artificial Intelligence

John Main
System Frontiers

Bart Russell
Behavioral & Cognitive Science

Adam Russell
Behavioral & Social Sciences

Alé Lukaszew
Physics & Materials

MAJ David Lewis
Physics

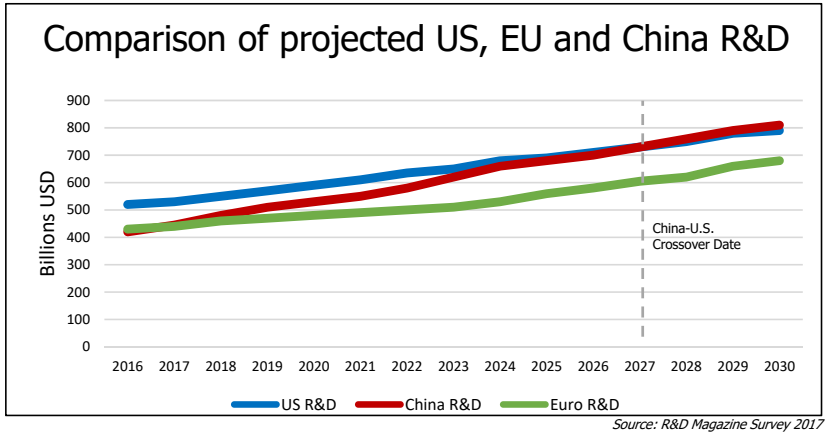
Ted Senator
Artificial Intelligence

Vincent Tang
Applied Physics

Mark Wrobel
Radiation science; health physics

DSO Mission Focus: Increasing the Pace

Globalization and proliferation of technology (peer, non-peer and non-state actors) implies that U.S. can no longer rely on having/keeping technological advantage



Source: R&D Magazine Survey 2017

"The Department of Defense is facing an unprecedented threat to its technological and industrial base. Continued globalization and our open society, both in academia and business, has offered China and others access to the same technology and information that is critical to the success of our future warfighting capabilities. China is making significant and targeted investments in the same technologies of interest to the Department."

Joint witness statement of Michael D. Griffin, et al., before the House Committee on Armed Services hearing on Military Technology Transfer: Threats, Impacts, and Solutions for the Department of Defense, 115th Cong., June 21, 2018

Defense Implications

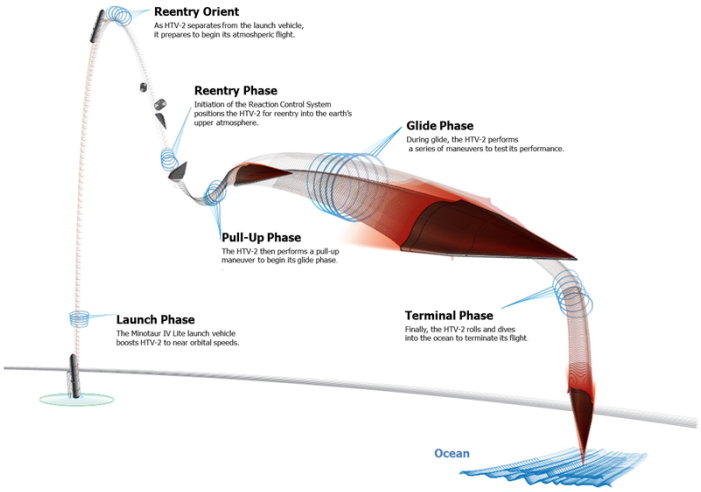
- Reduced time to:
  - o Identify new Science & Technology (S&T)
  - o Effectively assess value
  - o Exploit for DoD
- Counter new S&T even as it is being exploited for its own use
  - o Equal access to emerging technologies will disrupt future conflicts

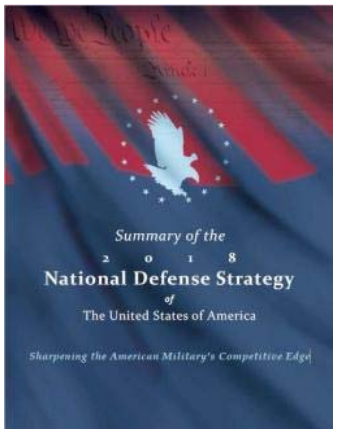
Technical Opportunities

- Early identification of S&T with potential to significantly disrupt operational paradigms
- S&T breakthroughs to mitigate the use of emerging technologies by our adversaries

DSO Mission Focus: Need for Speed

The speed/complexity of military engagement is increasing





"We face an ever more lethal and disruptive battlefield, combined across domains, and conducted at increasing speed and reach"
– National Defense Strategy

Defense Implications

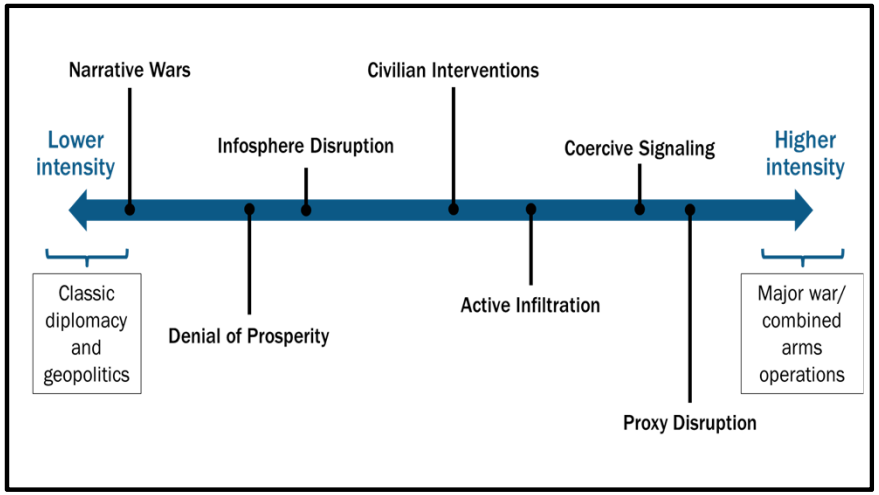
- Compression of DoD's OODA loop
  - o Fidelity of the input critical
  - o Trusted decision making at increased speed and calculable confidence
- Greater payoff to disruption/delay of our adversaries information/decisions processes

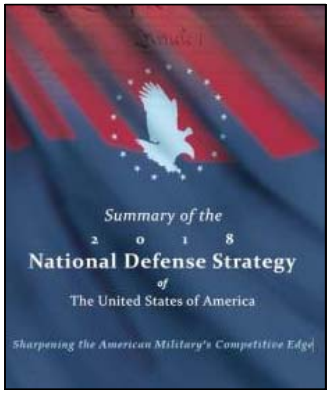
Technical Opportunities

- New sensors and sensor modalities to rapidly incorporate unique information
- Accurate models of physical, environmental and social effects to support decision making across multiple domains
- Alternatives to traditional computing/machine learning for faster, more robust decisions
- Approaches to impose complexity on adversary

DSO Mission Focus: Need for Multi-Dimensional Threat Spectrum Deterrence

U.S. options for escalation, deterrence and stabilization are significantly complicated by the growing diversity of local and global actors with distinct interests, motivations, and values, especially in undergoverned spaces





"We are facing increased global disorder… Both revisionist powers and rogue regimes are competing across all dimensions of power… deliberately blurring the lines between civil and military goals."

Defense Implications

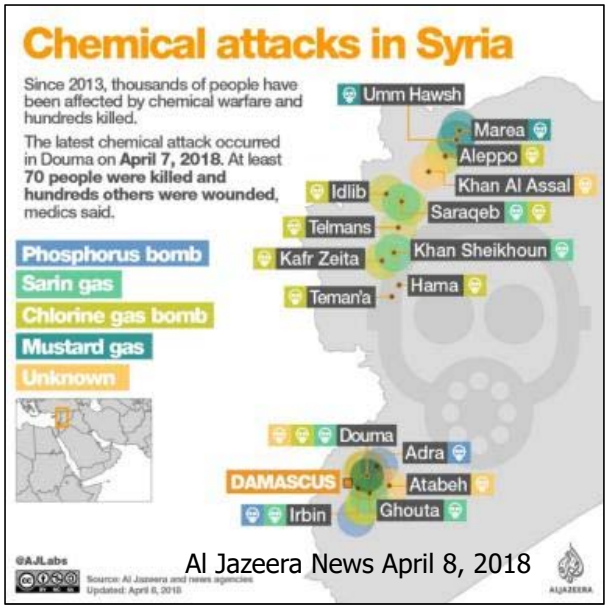
- New requirements to effectively match and control escalation to achieve a specific adversary response (e.g., de-escalation)
- Need to restore geopolitical influence and power projection in regions proximate to peer adversaries
- Coalition building and stabilization are more complex/transient due to diverse and fluid incentives, values, and actors

Technology Opportunities

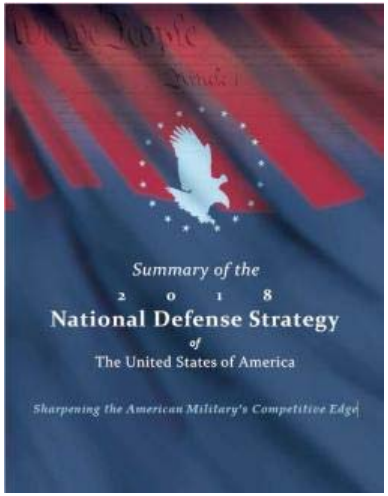
- Capabilities to predict consequences of actions by understanding and modeling decision-making, intentions and reactions of adversaries/allies
- New options for measured DoD escalation or mitigating adversaries' escalation
- Proactively characterizing undergoverned spaces in terms of actors, incentives, and dynamics
- Enabling distributed operations/Mosaic Warfare to impose complexity on adversary

DSO Mission Focus: Counter WMD

Proliferation of weapons of mass destruction (WMD) continues, including short range/tactical nuclear



Al Jazeera News April 8, 2018



> Rogue regimes, such as North Korea, continue to seek out or develop [WMD] … Terrorists … continue to pursue WMD, while the spread of nuclear weapon technology and advanced manufacturing technology remains a persistent problem.
> - National Defense Strategy

Defense Implications

- Counter the use of WMD
- Prevent proliferation
- Respond to the use of WMD via early warning and maintenance of operations

Technical Opportunities

- Sensors and sensor networks that can warn early enough to avoid and/or treat
- Capability to understand adversaries' intent to use WMD in order to thwart "left of boom"
- Approaches that reduce the value to the adversary of using WMD

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)

How We Think: The Heilmeier Catechism

Important questions to consider when approaching DARPA with ideas:

- What are you trying to do?
- How is it done today and who does it? What are the limitations of the present approaches?
- What is new about our approach, and why do we think it will succeed?
- If we succeed, what difference will it make?
- How long do we think it will take?
- What are our mid-term and final exams?
- How much will it cost?

Young Faculty Award (YFA)

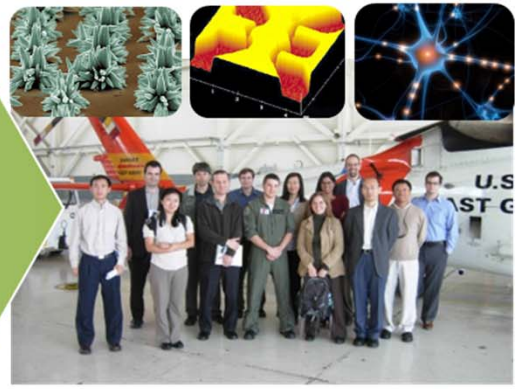
Identify and engage **rising stars** in junior research positions, emphasizing those without prior DARPA funding, and expose them to DoD needs and DARPA's program development process

The YFA program provides:

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

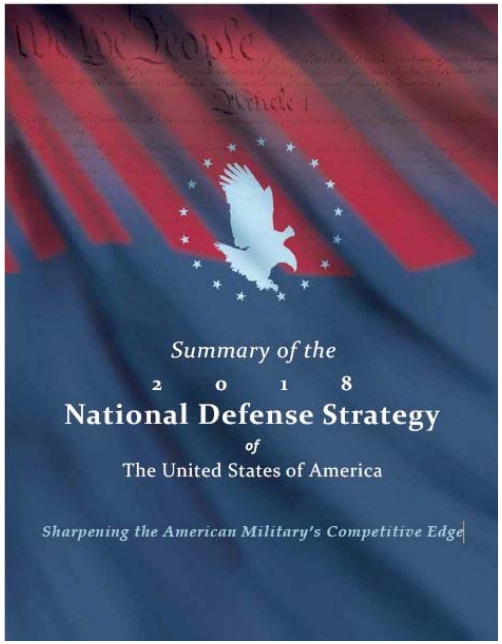
The YFA program yields:

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



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

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)

Artificial Intelligence Exploration (AIE)

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 (PA) release: July 20, 2018
  - https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-PA-18-02/listing.html

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

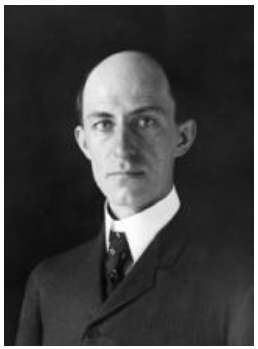
Evolutionary vs. Revolutionary R&D

"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



Housekeeping

- Presentations will be posted on the DARPA website after the event
- Email questions about the BAA to HR001119S0071@darpa.mil
- Responses to questions asked today will be posted http://www.darpa.mil/work-with-us/interact-with-DSO (Under How to Work with DARPA/DSO)
- You will receive a survey following the event, please complete as your feedback is valuable and helps us to plan for future events
- Sign up for DSO News Updates via Constant Contact at http://www.darpa.mil/work-with-us/interact-with-DSO (Under Resources)
- Find PM bios, program information, and contact PMs at http://www.darpa.mil/about-us/offices/dso

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