NDIA IEEE FORT HUACHUCA ANNUAL CYBER & IT DAY: "Raytheon Missiles and Defense Artificial Intelligence/Machine Learning Interests through 15 DARPA-IARPA Programs" Fort Huachuca Thunder Mountain Activity Center, Feb 22, 2024

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Raytheon Company: Missiles and Defense Tucson Overview

- **RTX (NYSE): # 1 or 2 Largest US Aerospace & Defense Companies in US: $ 74B Sales (2023), $ 78B (2024), $196B Backlog**
  - **Raytheon Company is one of 3 corporate entities within RTX, Headquartered in Tucson, $ 26B Sales (2023) and $ 52B Backlog; Industry HQ for 60+ Missile Programs to US Government, NATO and Indo-Pacific Allied Nations; 55,000 employees USA, 15,000 In Tucson (largest private employer in Southern Arizona)**
  - **5 Business Units:**
    1) **Advanced Products and Solutions**
    2) **Air & Space Defense Systems**
    3) **Land and Air Defense Systems**
    4) **Naval Power**
    5) **Advanced Technology**
  - **Advanced Technology 4 Sub Business Units:**
    1) **Advanced Effectors and Space (Tucson)**
    2) **Advanced Integrated Surface Sensors (Metro Boston)**
    3) **Airborne Spectrum Dominance (Metro LA, Metro Dallas)**
    4) **Advanced Architectures**

Advanced Effectors and Space Sub Business Unit

1) Integrated Kill Chain Architecture (IKCA) Directorate

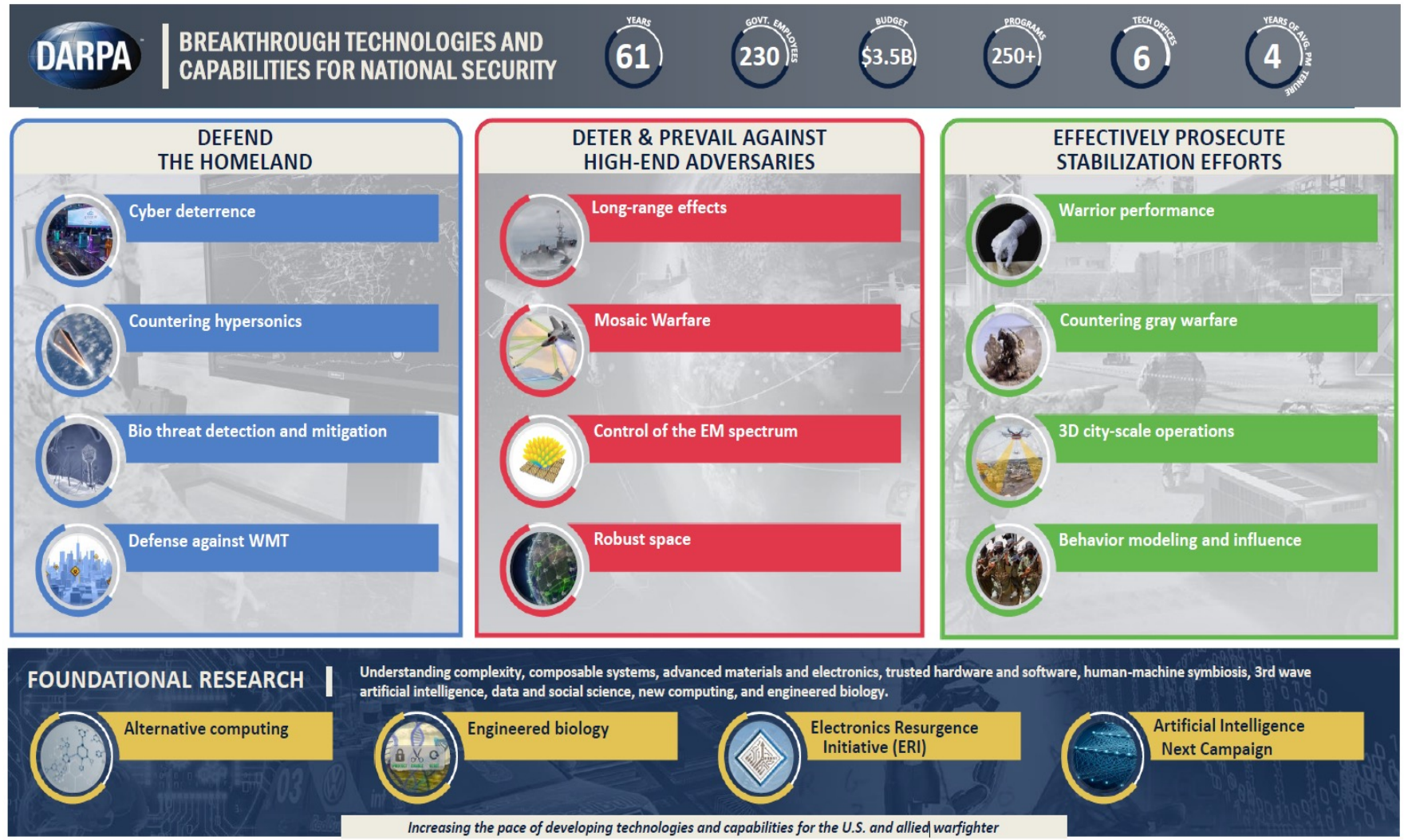
- Operations Analysis
- Offensive Systems Engineering
- Optical Warfare
- Networked/Collaborative Autonomous Systems
- Intelligence Community
- Supply Base Technology Innovations (Universities, Labs, Small Business)

2) Advanced Air Warfare Systems Directorate
3) Advanced Hypersonics Weapons Directorate
4) Alternate Missions & Space Directorate

Typical Customers: Defense Advanced Research Projects Agency
Intelligence Advanced Research Projects Agency
Advanced Research Projects Agency-Energy
Homeland Security – Advanced Research Projects Agency
Air Force Research Laboratory, Army Research Laboratory, Naval Research Laboratory, Office of Naval Research, Intelligence Agencies

DARPA-Defense Advanced Research Projects Agency (in close coordination with IARPA)

ARIZONA TECHNOLOGY COUNCIL
a place to connect and grow



16 Technology "Flavors" of AI

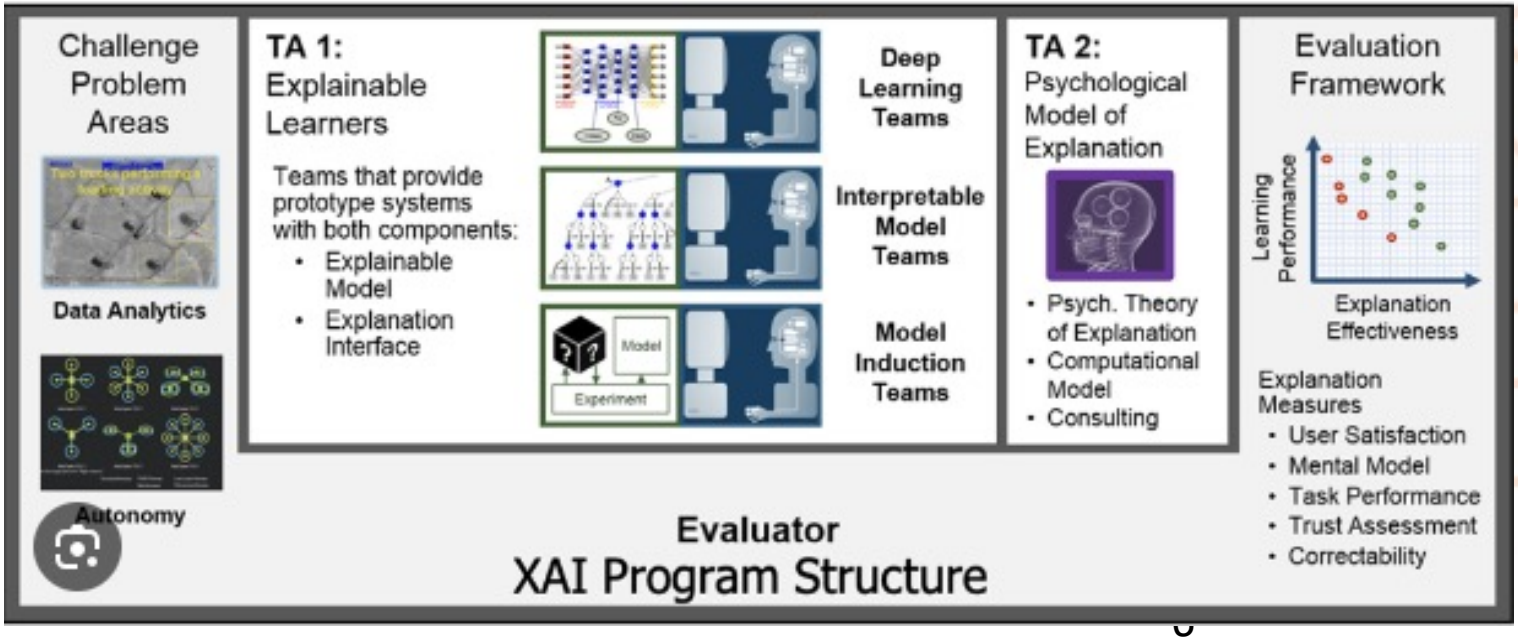
- Sensor Hardware/Software/Firmware in Find/Fix/Track/Target/Engage/Assess
- Collaborative Autonomy
- Supervised vs Unsupervised Learning
- Reinforcement Learning
- Symbolic AI
- Advanced Modeling and Simulation
- Advanced Heuristics
- Convolutional Neural Networks
- All-Source Intelligence Fusion
- Cognitive Amplifiers
- Design of Experiments and Bayesian Networks
- Genetic Algorithms
- Intelligent Agents
- Decision Process Optimization
- Natural Language Processing
- Ontological Reasoning

United States has NO current comprehensive federal/state legislation/regulatory framework, Supreme Court guidance, FAR/DFARs clauses, or clarifying Case Law

"Interest 1": DARPA XAI Program

Explainable AI Program (2017-2021) Goal: develop a suite of machine learning techniques that:

1) Produce more explainable models, while maintaining high level of learning performance and prediction accuracy
2) Enable human users to understand, appropriately trust, and effectively manage the next generation of ML systems, who will be able to explain their rationale, characterize strengths and weaknesses, and understand how they will behave in future



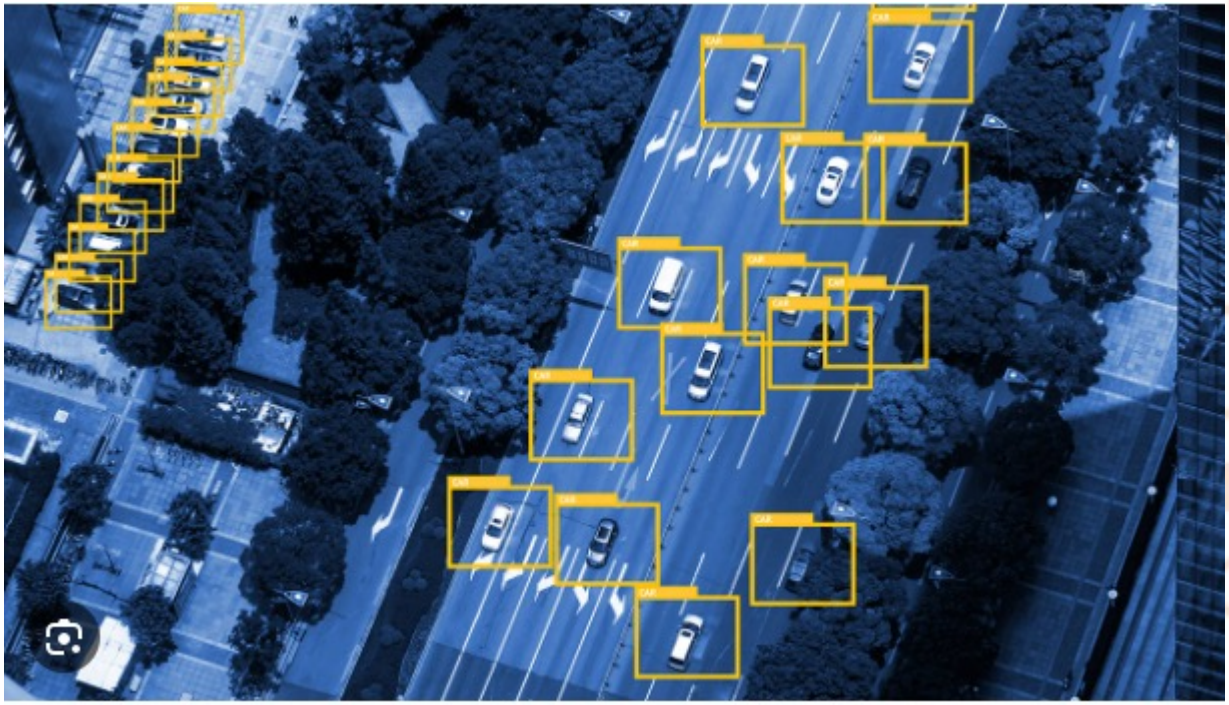
“Interest 2”: DARPA MOSAIC Program Family

Mosaic Goal (2021-2025): overwhelm opponent with a parallel deployment on wide front with wide diversity of weapon and sensor systems, and turn this real-time complexity into an asymmetric strategic advantage, through development of interfaces, communications links, and precision navigation and timing software; and tool to avoid fratricide.

“Interest 3”: DARPA TRACE Family of Programs

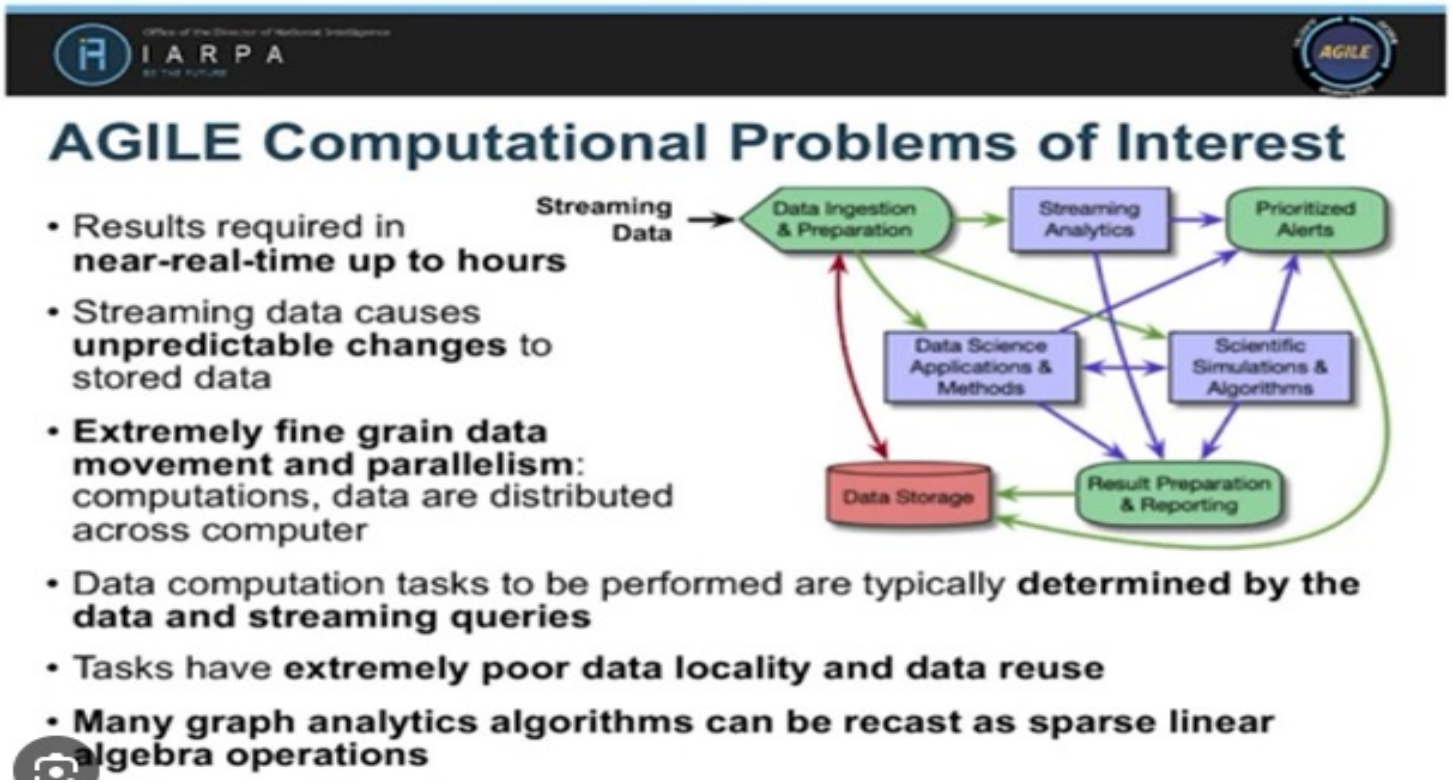
TRACE (Target Recognition and Adaption in Contested Environments) Goal: develop accurate, real-time, low power, automatic target recognition (ATR) systems to provide responsive long range targeting for tactical and strategic airborne surveillance and strike applications

Sister Programs: ACE, Gambit, ASTARTE



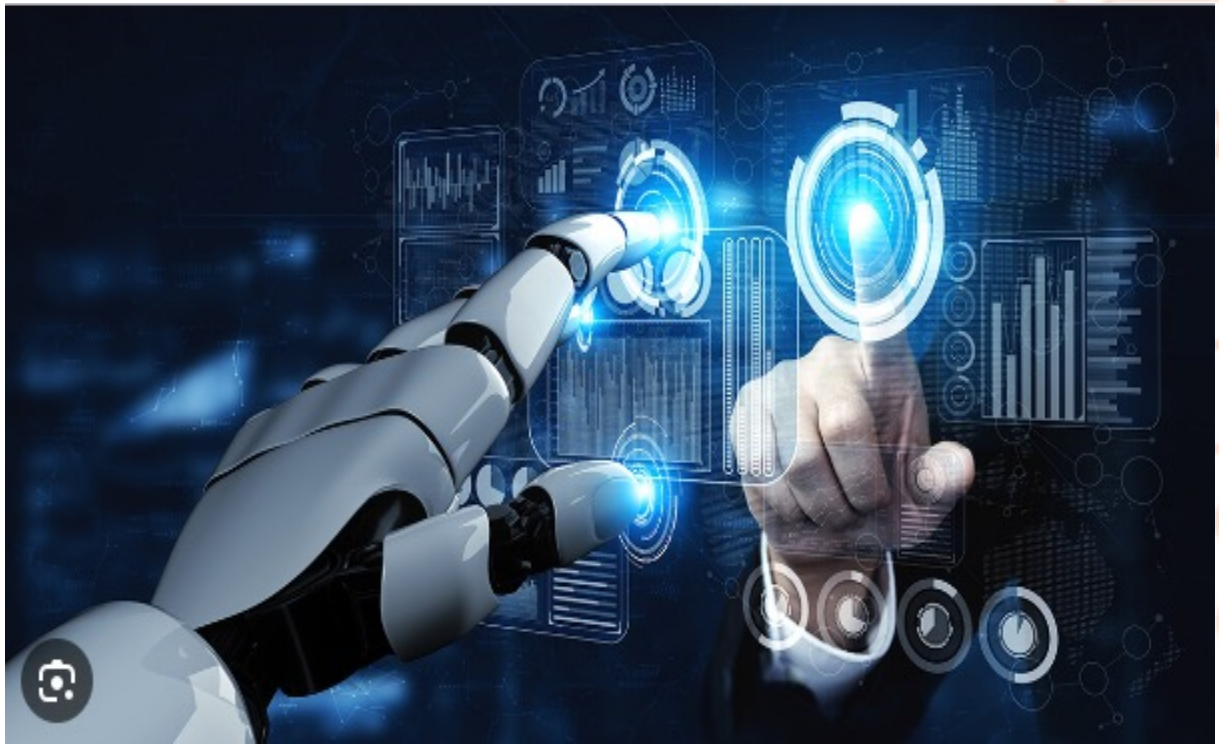
"Interest 4": IARPA AGILE Program

AGILE (Advanced Graphic Intelligence Logical Computing Environment) Goal (2023-):
optimize operations on sparse, time-varying data randomly distributed on complex systems through new computer HW/SW architectures and intelligent mechanisms to access, move and store complex data streams and structures enabling efficient data-analytic algorithms

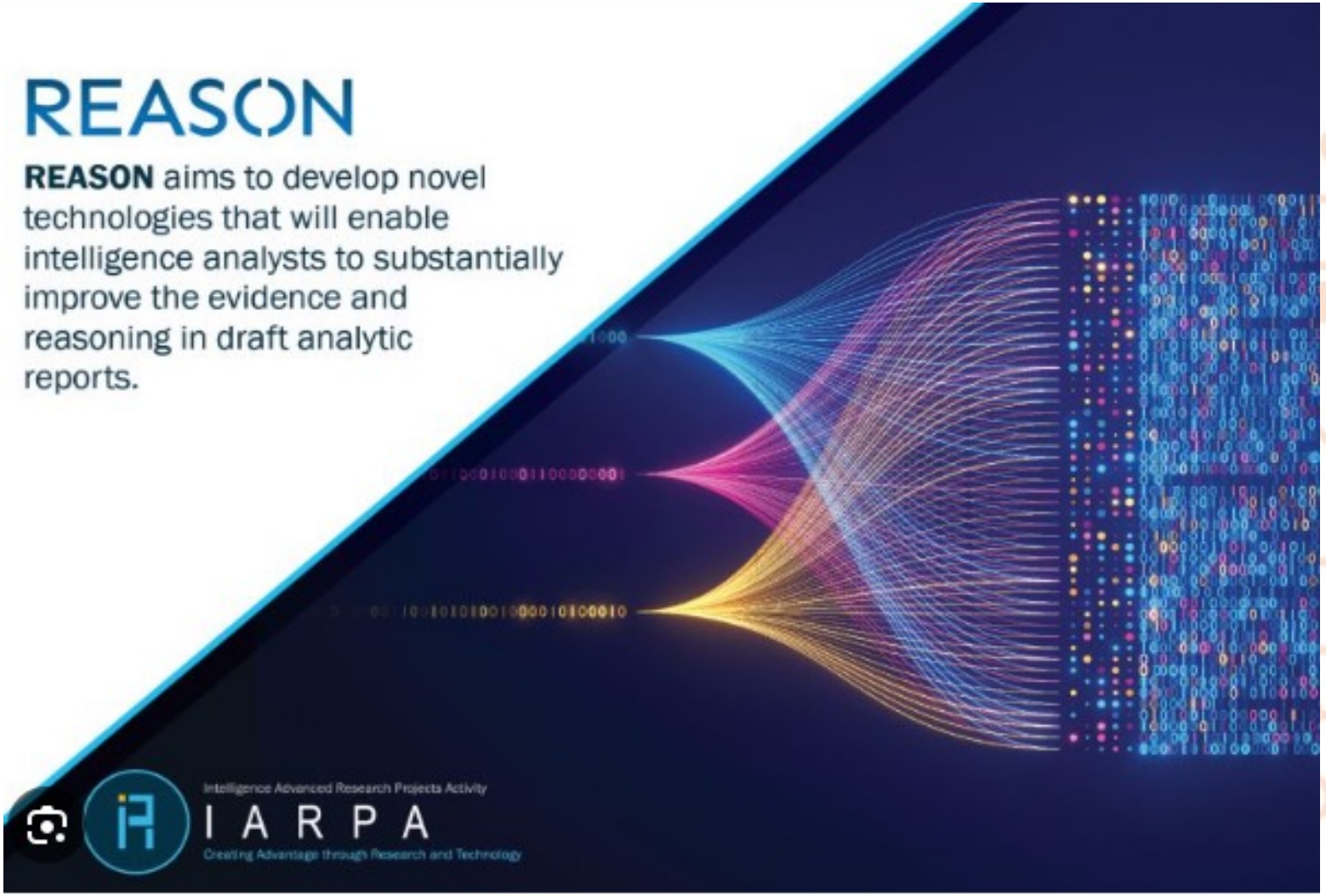


“Interest 5”: DARPA ITM Program

ITM (In The Moment) Program Goal (2023-): develop AI system to mimic human decision making in most complex, rapidly changing scenarios (catastrophes) through algorithmic expression of key human attributes to build basis of trust in context of human-off-the-loop decision making.

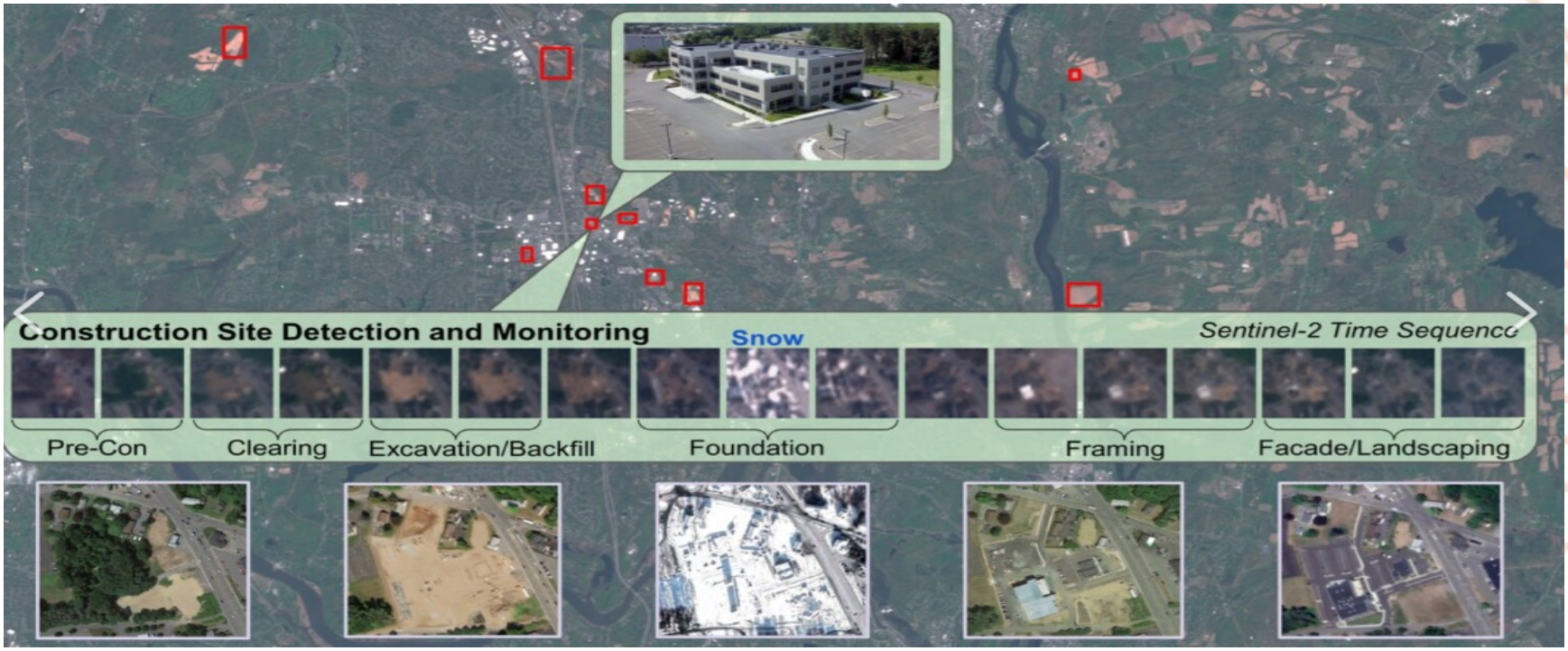


“Interest 6”: IARPA REASON Program



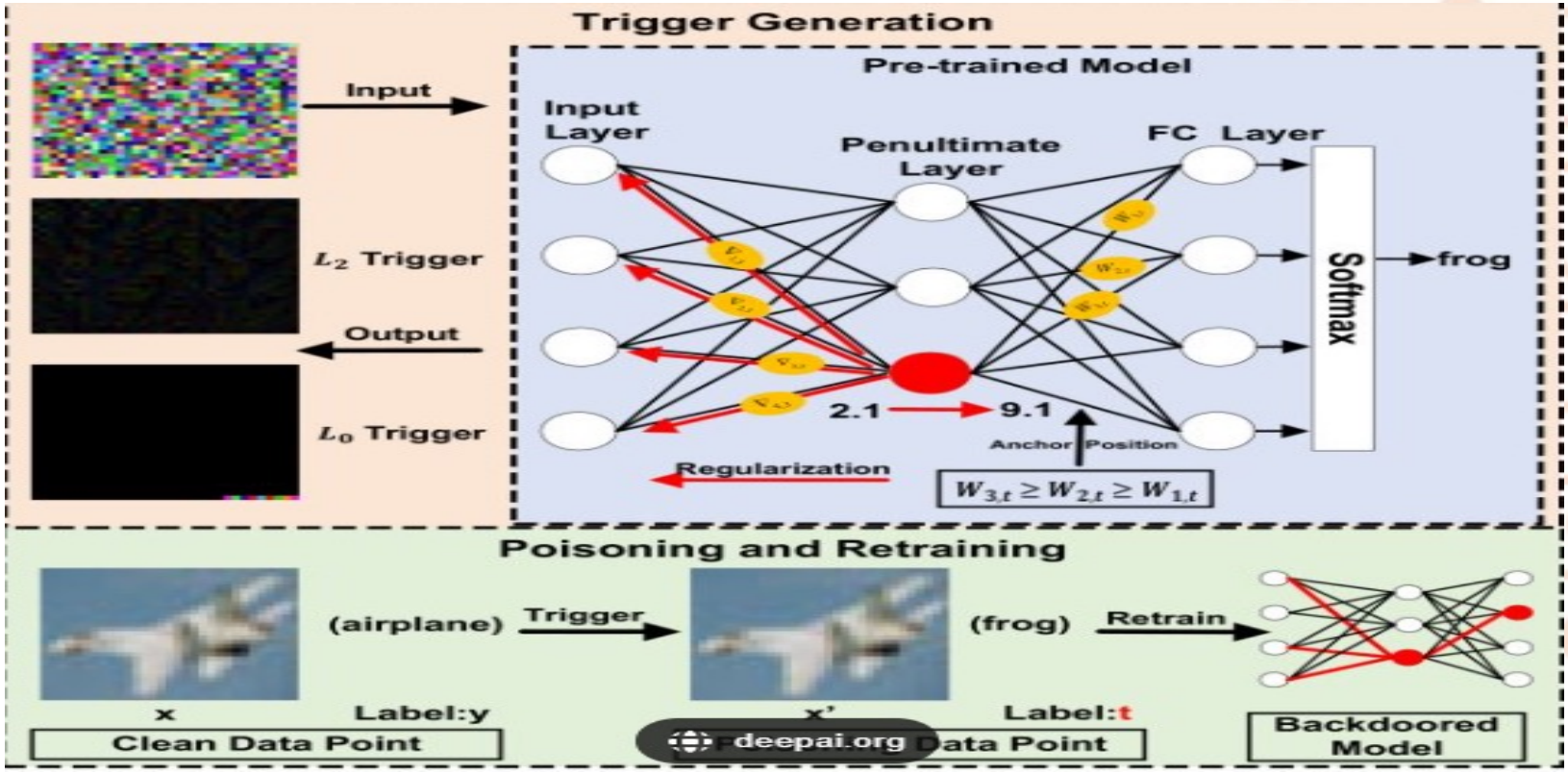
“Interest 7”: IARPA SMART Program

SMART Program Goal: automation of broad-area search of multi-source satellite imagery to detect, monitor, and characterize the progression of anthropogenic or natural processes. By augmenting the manual imagery analysis process with global-scale image processing and machine learning, SMART will provide timely discovery and robust monitoring of man-made and natural change



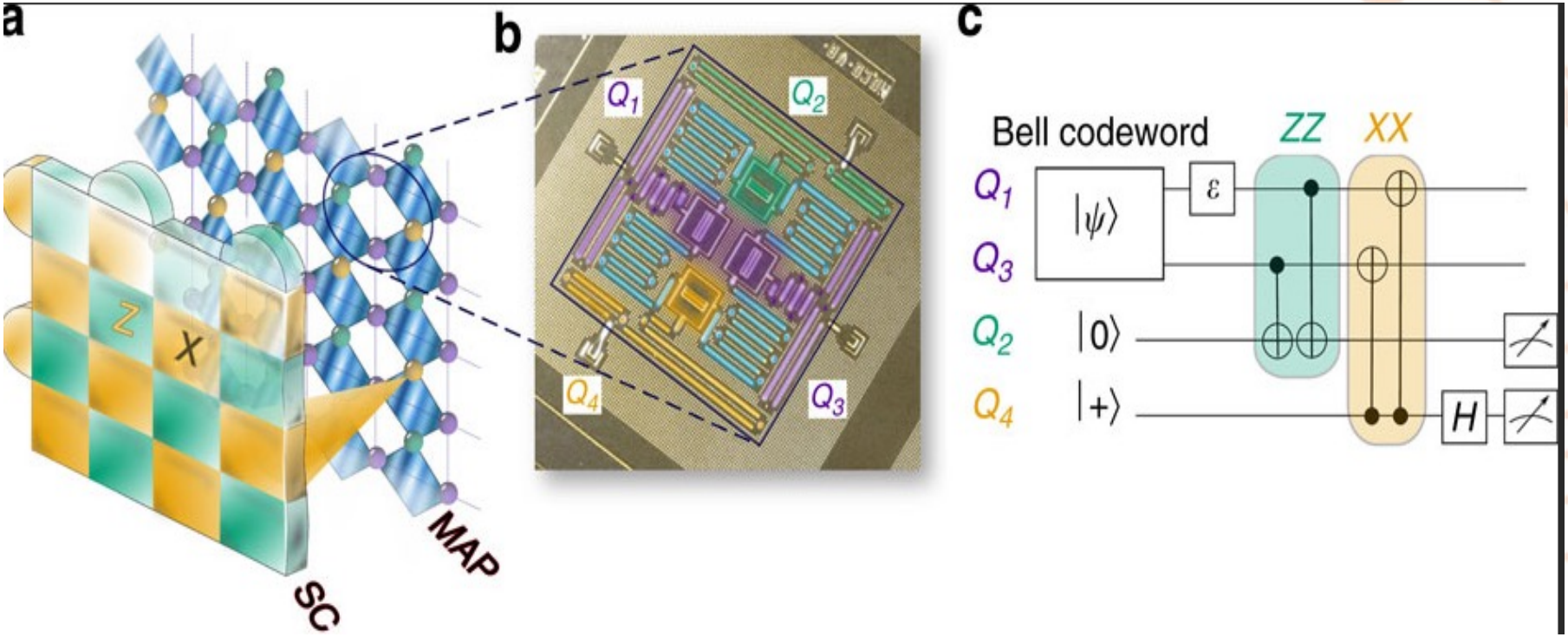
"Interest 8": IARPA TROJAI Program

TROJAI Program Goal: defend AI systems from intentional, malicious attacks, by conducting research and developing technology to detect these attacks in AI systems that must withstand system failure during mission critical tasks.



“Interest 9”: IARPA ELQ Program

ELQ (Entangled Logical Qubits) Program goal: advance the state of the science in universal fault-tolerant quantum computing (UFTQC) by demonstrating high-fidelity entanglement between error-corrected logical qubits using a modular architecture, essential to greatly outperform classical computing in solving certain classes of problems.



"Interest 10": IARPA SCISRS Program

SCISRS Program Goal: to develop smart radio techniques to automatically detect and characterize RF anomalies that may indicate a compromise of secure data in complex RF environments. The specific types of anomalies include low probability of intercept (LPI) signals, altered or mimicked signals, and abnormal unintended emissions.

Tasks per Phase: easy ← → hard

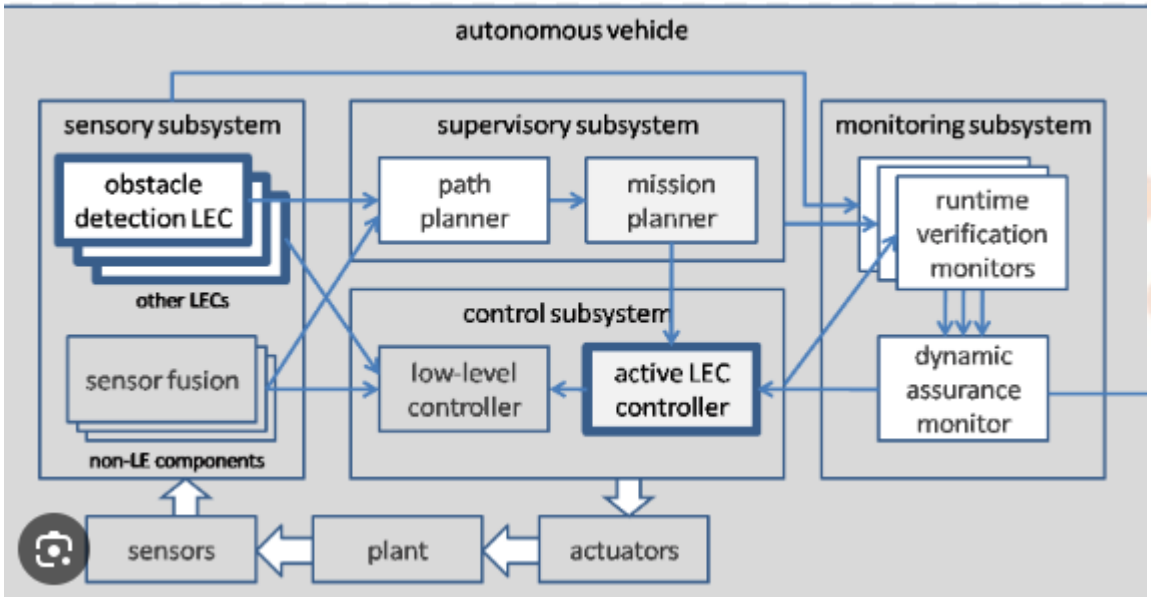
Signal/Transmission Type	True Positive Rate, False Positive Rate		
	Phase 1	Phase 2	Phase 3
Overt Communication	90%, 5%	94%, 2%	98%, 1%
LPI	50%, 10%	50% (80% old), 10%	50% (80% old), 10%
Altered/Mimicked	-	50%, 10%	50% (80% old), 10%
Metadata for Comm. Signals*	80%, 10%	88%, 5%	95%, 2%
Emanations**	must report #	125% x phase 1 best #	200% x phase 1 best #
Anomalous Emanations***	80%, 10%	80%, 10%	50%, 10%

“Interest 11”: DARPA SeeMe

is designed to show that small satellites can be built affordably to give small squads timely tactical imagery directly from a small satellite. A future constellation of small satellites would deliver high-resolution images of precise locations of interest to the soldier’s handheld device.

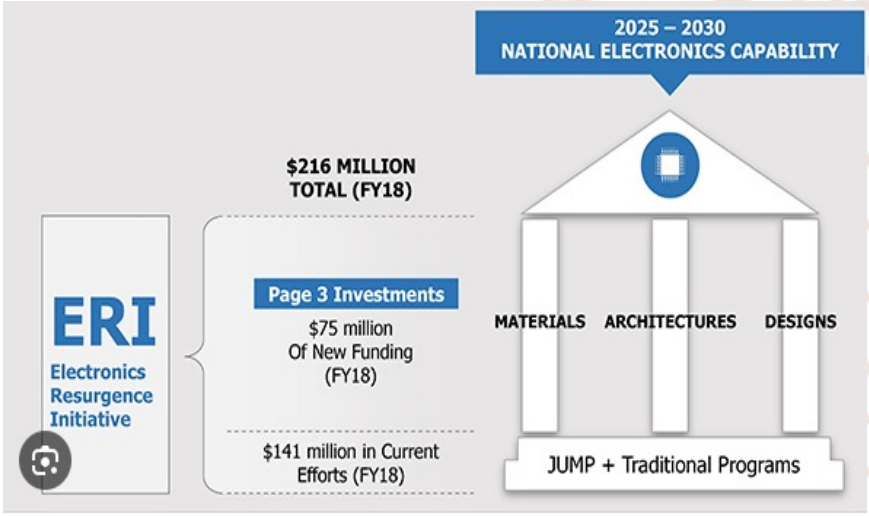
"Interest 12":DARPA CASE Program

The CASE (Cyber Assured Systems Engineering) Program goals are to achieve research breakthroughs in: 1) the elicitation of cyber resiliency requirements before the system is built; 2) the design and verification of systems when requirements are not testable; 3) tools to automatically adapt software to new non-functional requirements; and 4) techniques to scale and provide meaningful feedback from analysis tools that reside low in the development tool chain



"Interest 13": DARPA ERI/JUMP Initiative

- The DARPA Electronics Resurgence Initiative and the JUMP 2.0 Program goals are accelerate reshoring of the manufacturing of complex 3D microsystems for extreme environments, optimizing design and test for complex circuits and prototypes, overcoming security threats across the entire hardware lifecycle, increasing information processing density and efficiency; accelerating innovation in artificial intelligence hardware to make decisions at the edge faster; and securing communications

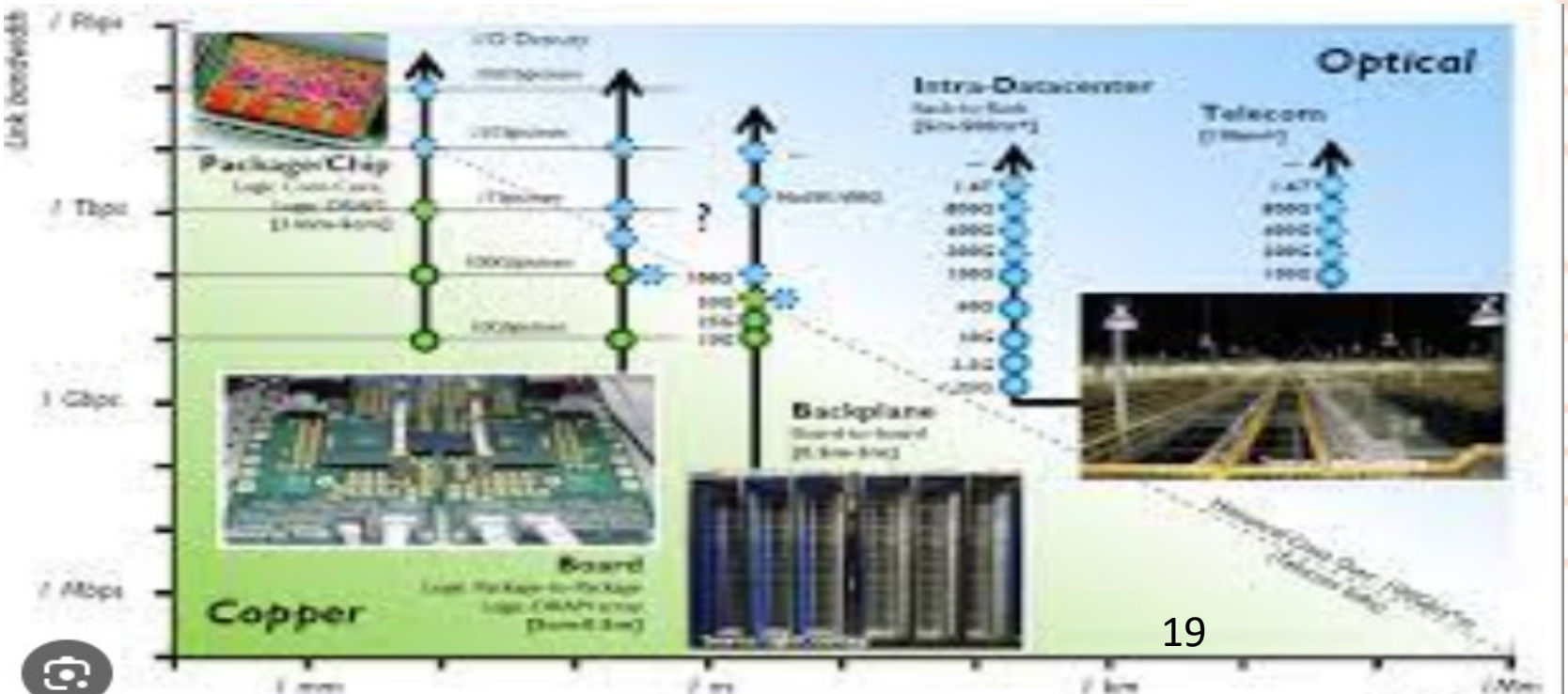


OODA Loop - The Next Phase of the DARPA Electronics Resurgence Initiative (ERI): The Joint University...

Visit ›

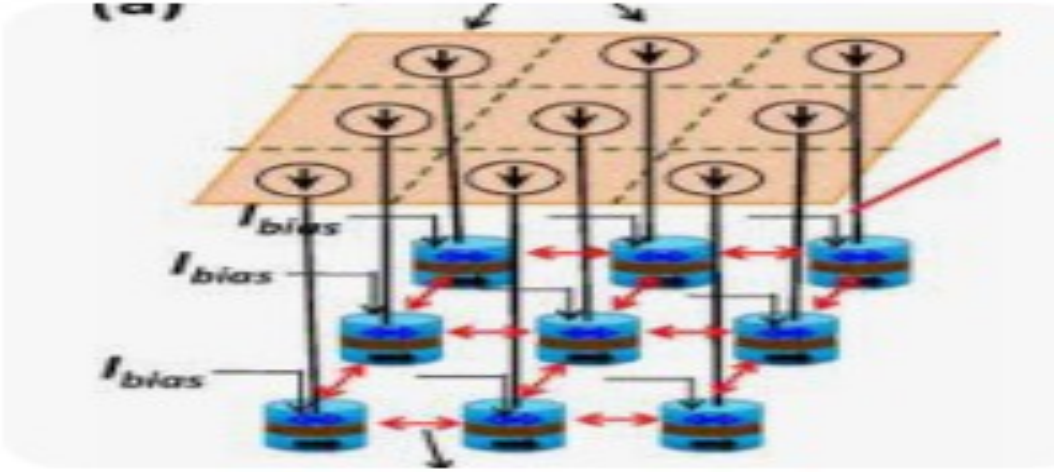
“Interest 14”: DARPA PIPES Program

The Photonics in the Package for Extreme Scalability (PIPES) program is using light to vastly improve the digital connectivity of packaged integrated circuits, with a goal of enabling revolutionary performance gains through parallelism and modularity. PIPES seeks to embed optical signaling technologies within the package of application-specific integrated circuits (ASICs) and field-programmable gate arrays (FPGAs) to enable data links with unprecedented bandwidth density, efficiency, and reach. Specifically, PIPES aims to integrate state-of-the-art electronics with photonic modules that deliver 100 Tbps per package at energies less than 1 picojoule per bit



“Interest 15”: DARPA FRANC Program

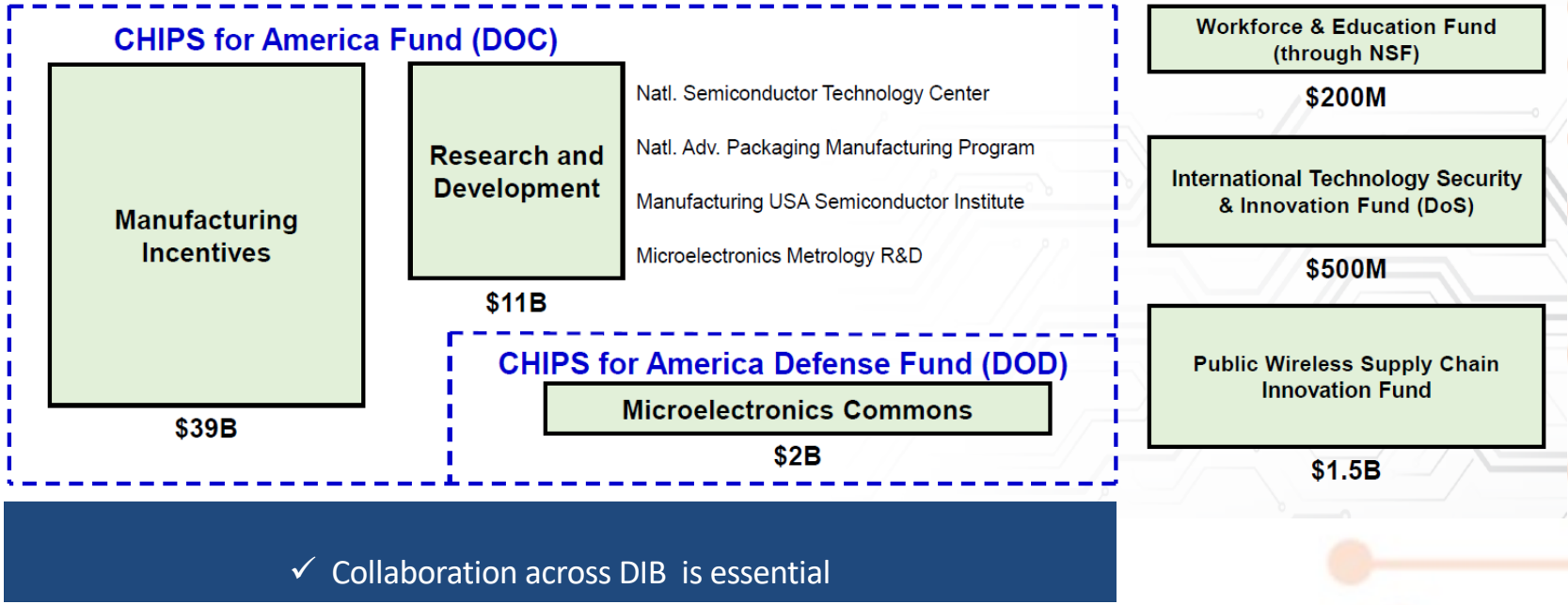
FRANC (Foundations Required for Novel Compute) Programs goal is to develop innovative approaches to advance compute technologies beyond the Von Neumann topology. Leveraging recent advances in materials, devices, and integration technology, the program seeks to develop novel memory-centric compute topologies that break the traditional separation of processors and memory components to realize dramatic advances in compute efficiency and throughput of the workload, especially for applications constrained by size, weight, and power (SWaP). Innovative compute architectures and new, fast non-volatile storage and memory-centric computing devices will be explored under FRANC to enable low latency compute near or inside the data storage elements. Such approaches are particularly suited for applications relevant to artificial intelligence (AI) where in-memory computation provides unique advantages over traditional Von Neumann computation.



Darpa
Framework for Novel Compu...

CHIPS and Science Act - Funding

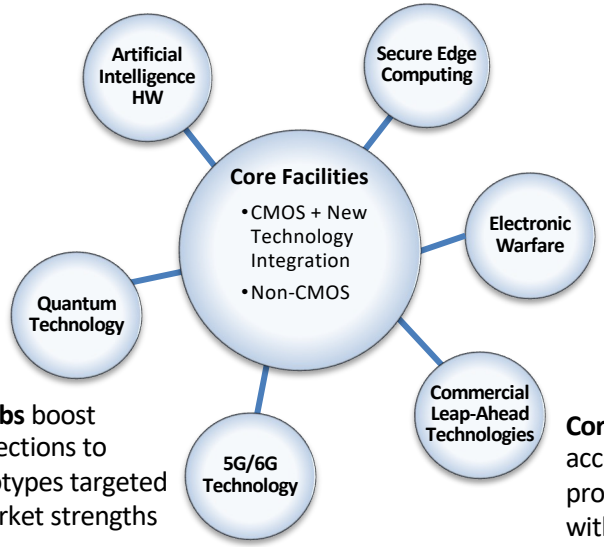
- **Provides $54.2 billion for semiconductor manufacturing incentives and research investments, as well as an investment tax credit for semiconductor manufacturing.**



✓ Collaboration across DIB is essential

Microelectronics Commons: Lab to Fab Operational View

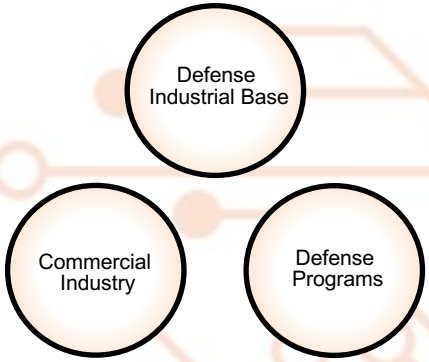
Research Universities, **Start-ups** face barriers to Technology Demonstration



Innovation Hubs boost research connections to facilitate prototypes targeted to regional market strengths

ME COMMONS

Core Facilities provide access to scale early stage prototyping, and engage with industry and gov't to provide Defense production capacity and commercialization



Commercial adoption and optimization for Defense program demonstrators

Proof of Concept → Production in Laboratory → Capacity to Produce Prototype → Capacity in production environment → Demonstration of Production Rates → Defense Program and Commercial Adoption