USD(R&E)

CTO Panel

2024 PACIFIC OPERATIONS SCIENCE & TECHNOLOGY (POST) CONFERENCE

Mr. Maynard Holliday
PTDO Assistant Secretary of Defense for Critical Technologies
Office of the Assistant Secretary of Defense for Critical Technologies (OASD(CT))
February 2024

OUSD RESEARCH & ENGINEERING CRITICAL TECHNOLOGIES PANELISTS

Mr. Maynard Holliday

PTDO Assistant Secretary of Defense for Critical Technologies

Office of the Assistant Secretary of Defense for Critical Technologies (OASD(CT))

Dr. Robert Mantz

Principal Director, Renewable Energy Generation & Storage

Office of the Assistant Secretary of Defense for Critical Technologies (OASD(CT))

Dr. Devanand Shenoy

Principal Director, Microelectronics

Microelectronics Commons Executive Director

Office of the Assistant Secretary of Defense for Critical Technologies (OASD(CT))

Mr. David Eccles

Principal Director, Space Technology

Office of the Assistant Secretary of Defense for Critical Technologies (OASD(CT))

CRITICAL TECHNOLOGY AREAS

The creation of the Office of the Assistant Secretary of Defense for Critical Technologies was informed by the 2022 and 2019 National Defense Strategies, which initially established the previous modernization priority areas. Expanding on the original priorities, there are now 14 critical technology areas that are vital to maintaining the United States' national security, grouped into three categories.

Seed Areas of Emerging Opportunity

- Advanced Materials
- Biotechnology
- FutureG
- Quantum Science

These CTAs are aligned under the ASD for Science & Technology

Effective Adoption Areas

- Advanced Computing & Software
- Human-Machine Interfaces
- Integrated Network Systems-of-Systems
- Microelectronics
- Renewable Energy Generation & Storage
- Space Technology
- Trusted AI & Autonomy

Defense-Specific Areas

- Directed Energy
- Hypersonics
- Integrated Sensing & Cyber

Hypersonics

2024 PACIFIC OPERATIONS SCIENCE & TECHNOLOGY (POST) CONFERENCE

Dr. James W. Weber
Principal Director, Hypersonics
Office of the Assistant Secretary of Defense for Critical Technologies (OASD(CT))
February 2024

STRATEGIC APPROACH

- Hypersonics is one of 14 Critical Technology Areas (CTAs) for the Department of Defense.

- The Department's Hypersonics approach accelerates development and transition of transformational warfighting capability based on hypersonic systems to our Armed Forces and into the hands of the warfighter.

- The Department's development of hypersonic technology will deliver additional cutting-edge capabilities and strategic options to our Armed Forces, supplementing our existing unparalleled capabilities.

- Developing and delivering hypersonic capabilities, along with other advanced technologies and new operating concepts, will ensure the Department maintains the ability to deter potential adversaries and to defeat aggression, if necessary.

DoD has an integrated strategy to accelerate development and delivery of hypersonic systems to the warfighter.
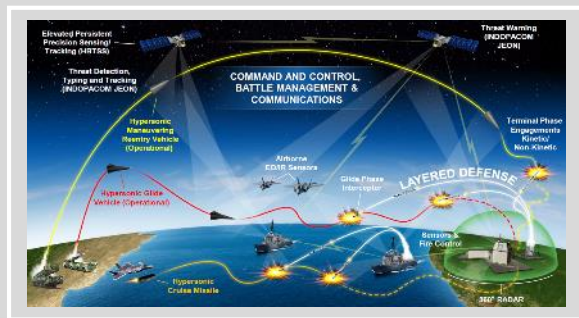
DEFENSE CAPABILITY AREAS

- Defeat time critical and heavily defended land and sea targets from survivable standoff range

- Defeat adversary hypersonic threats

Deter and defend by 2025 and beyond

- Conduct responsive strike and ISR missions

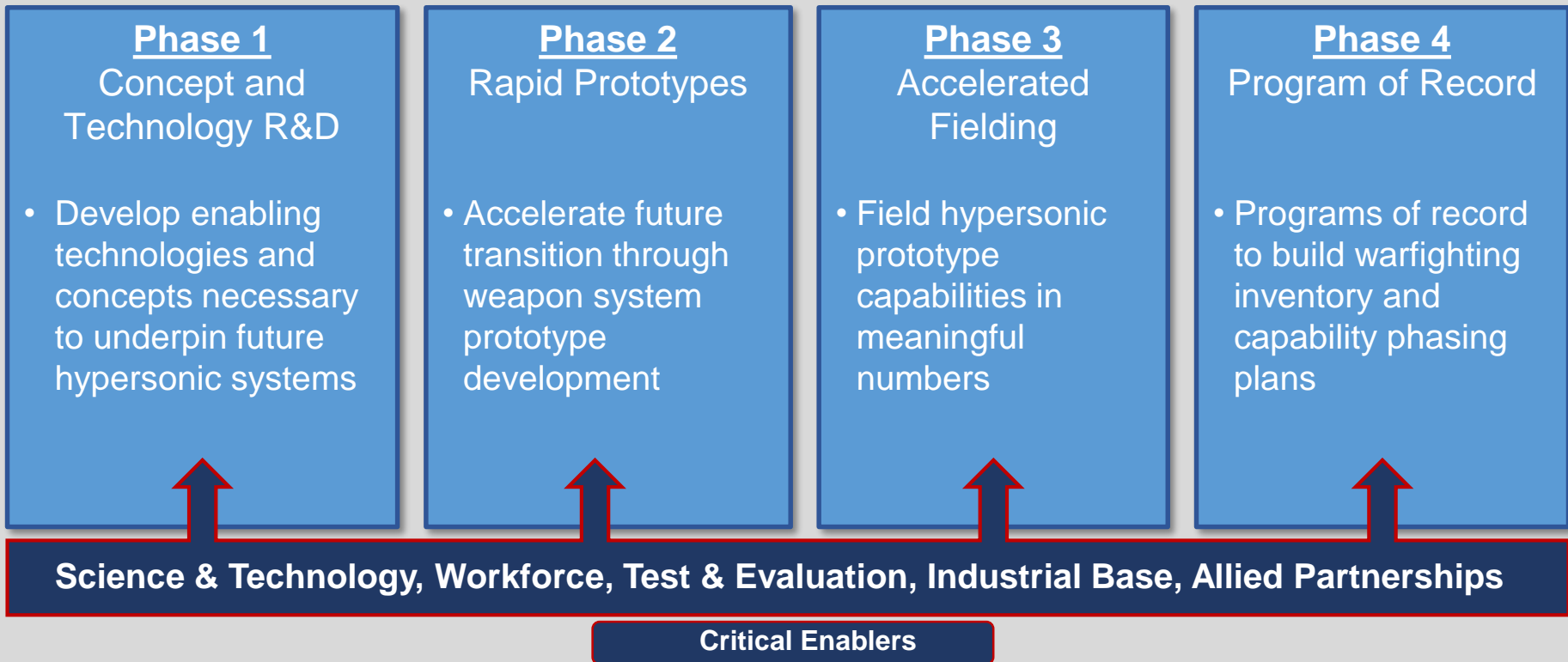Notional aircraft image is UNCLASSIFIED

ACCELERATED DELIVERY

- Accelerated development and transition of transformational warfighting capability based on hypersonic systems
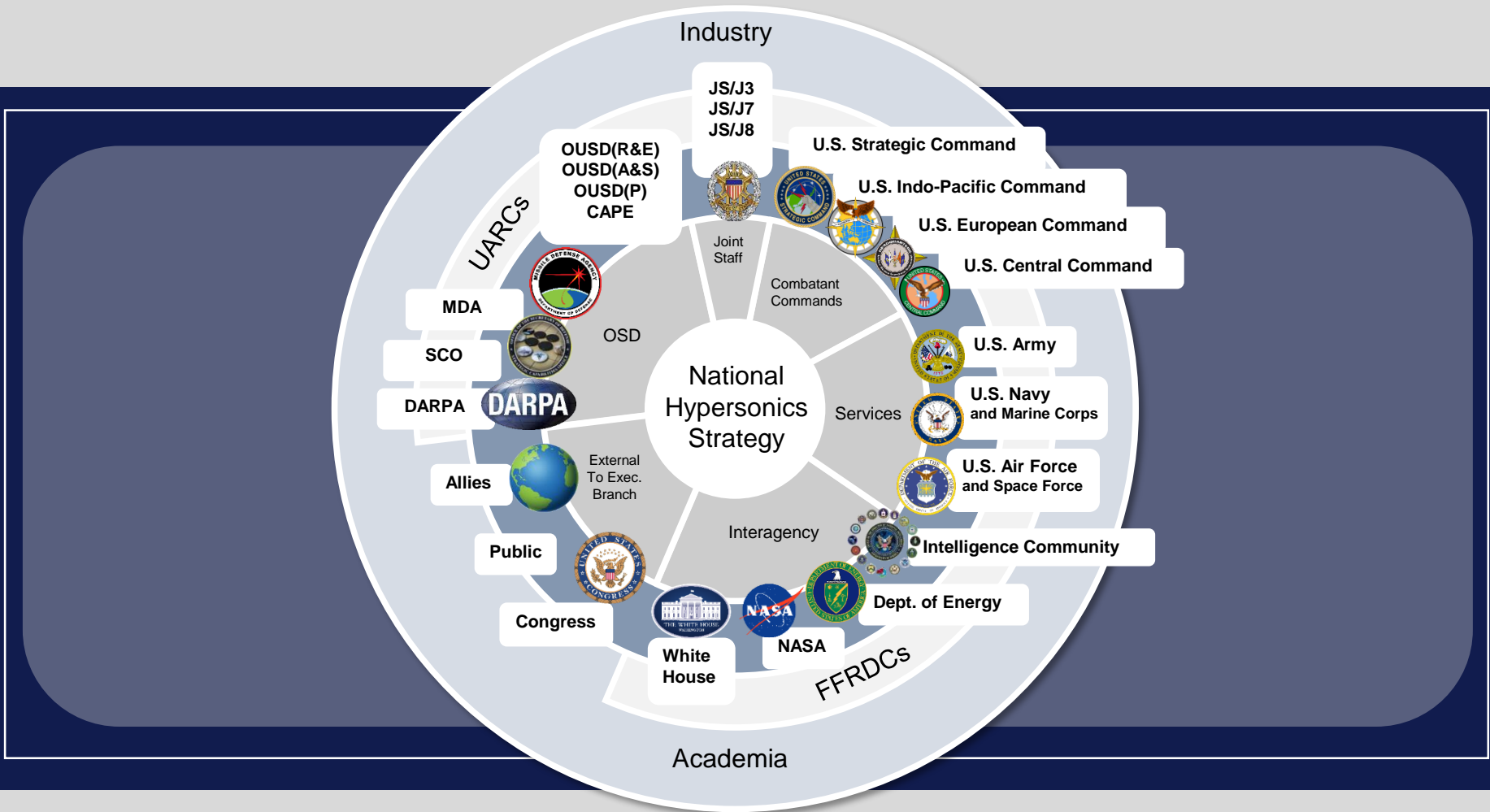
OUSD R&E / Services → **OUSD A&S / Services**

Phase 1 Concept and Technology R&D	**Phase 2** Rapid Prototypes	**Phase 3** Accelerated Fielding	**Phase 4** Program of Record
• Develop enabling technologies and concepts necessary to underpin future hypersonic systems	• Accelerate future transition through weapon system prototype development	• Field hypersonic prototype capabilities in meaningful numbers	• Programs of record to build warfighting inventory and capability phasing plans

Science & Technology, Workforce, Test & Evaluation, Industrial Base, Allied Partnerships

Critical Enablers

STAKEHOLDERS AND PARTNERS

USD(R&E)

DOD RESEARCH AND ENGINEERING ENTERPRISE

CREATING THE TECHNOLOGIES OF THE FUTURE FIGHT
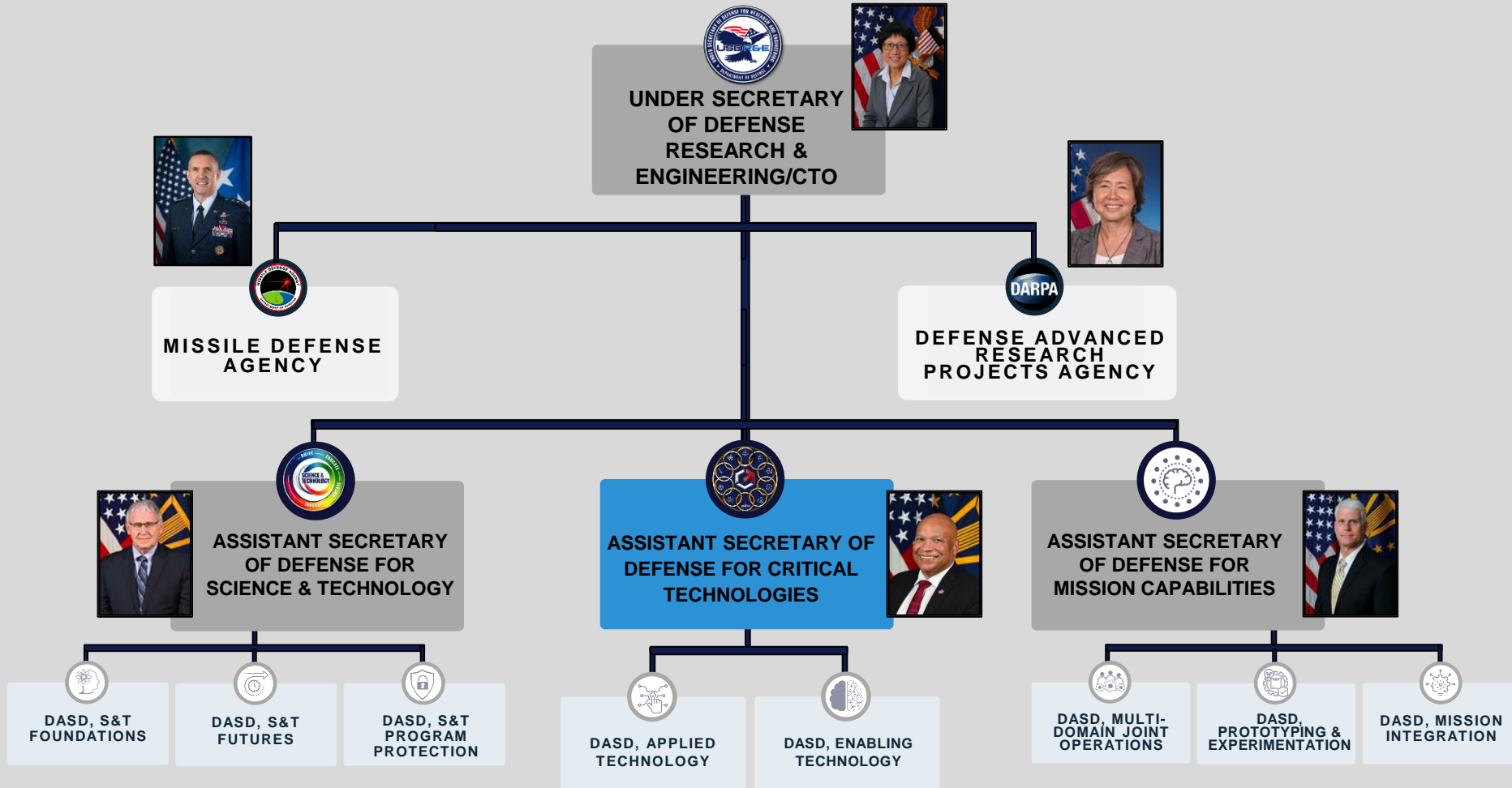
USD(R&E)

Appendix

SUMMARY OF CTAs

Advanced Computing & Software	Includes supercomputing, cloud computing, data storage, computing architectures, and data processing. The speed at which software develops outpaces DoD's ability to stay up to date. We must rapidly modernize legacy software systems with resilient, affordable, and assured new software that has been designed, developed, and tested using processes that establish confidence in its performance.
Directed Energy	Directed energy systems will allow us to counter a wide variety of current and emerging threats with rapid responses & engagement at the speed of light. High-power lasers and high-power microwave technologies both offer new ways to counter diverse sets of threats.
Human-Machine Interfaces	Rapid advancements in this technology will have a multitude of benefits for our service members. Highly immersive realistic training environments provide real-time feedback to enhance warfighter performance. Intuitive interactive human-machine interfaces enable rapid mission planning and mission command by providing a common operational picture to geographically distributed operations.
Hypersonics	While strategic competitors are pursuing and rapidly fielding advanced hypersonic missiles, the DoD will develop leap-ahead and cost-effective technologies for our air, land, and sea operational forces.
Integrated Network Systems-of-Systems	An interoperable network that leverages emerging capabilities across the electromagnetic spectrum such as 5G, software defined networking and radios, and modern information exchange techniques will allow us to better integrate many diverse mission systems and provide fully networked command, control, and communication that is capable, resilient, and secure.
Integrated Sensing & Cyber	To provide advantage for the joint force in highly contested environments, we must develop wideband sensors to operate at the intersection of cyberspace, electronic warfare, radar, and communications. Sensors must be able to counter advanced threats and can no longer be stove-piped and single function.
Microelectronics	Diminishing microelectronics manufacturing in the U.S. and supply chain concerns have highlighted national economic and security risks. Working closely with industry, academia, and across the Government, we are addressing the need for secure microelectronics sources and will leverage state-of-the-art commercial development and production for defense microelectronic solutions.
Renewable Energy Generation & Storage	Renewable energy generation and storage promises to decrease warfighter vulnerability and deliver new operational capabilities for the Department. From more efficient batteries to diversifying energy sources and reduced fuel transportation risks, renewable energy generation and storage will add resilience and flexibility in a contested logistics environment.
Space Technology	Our space strategy must shift away from exquisite satellites to a more robust and proliferated architecture. Novel space technologies are necessary to enable resilient cross-domain operations. The space strategy must incorporate technologies that enhance our adaptive and reconfigurable capabilities in space situational awareness, space control, comms path diversity, on-orbit processing, and autonomy.
Trusted AI & Autonomy	Machine learning is an engineering subfield of AI that trains software models using example data, simulations, or real-world experiences rather than by direct programming or coding. Autonomy is the engineering discipline that expands robots' abilities to perform tasks while limiting the need for human interaction. Trusted AI with trusted autonomous systems are imperative to dominate future conflicts.

OUSD(R&E) ORGANIZATIONAL STRUCTURE

UNDER SECRETARY OF DEFENSE RESEARCH & ENGINEERING/CTO

MISSILE DEFENSE AGENCY

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

ASSISTANT SECRETARY OF DEFENSE FOR SCIENCE & TECHNOLOGY

ASSISTANT SECRETARY OF DEFENSE FOR CRITICAL TECHNOLOGIES

ASSISTANT SECRETARY OF DEFENSE FOR MISSION CAPABILITIES

DASD, S&T FOUNDATIONS

DASD, S&T FUTURES

DASD, S&T PROGRAM PROTECTION

DASD, APPLIED TECHNOLOGY

DASD, ENABLING TECHNOLOGY

DASD, MULTI-DOMAIN JOINT OPERATIONS

DASD, PROTOTYPING & EXPERIMENTATION

DASD, MISSION INTEGRATION

CRITICAL TECHNOLOGY AREAS & TRANSITIONS

Effective Adoption Areas

- Trusted AI & Autonomy
- Microelectronics
- Space
- Integrated Network System-of-Systems
- Human Machine Interfaces
- Renewable Energy Generation & Storage
- Advanced Computing & Software

310+ transitions tracked in last 3 years

60% already delivered to COCOM & Components direct from innovation unit or as commercial-off-the-shelf (COTS)

40% baselined in acquisition programs for future delivery to COCOMs & Components

20% to multiple COCOMs

15% COCOM unique

65% to IC and whole-of-US government support to COCOMs & Components

Defense-Specific Areas

- Integrated Sensing & Cyber
- Hypersonics
- Directed Energy

TRUSTED AI & AUTONOMY (TAI&A)

83+ successful transitions. Machines with logic, rules, knowledge bases and/or learning algorithms to assist human decision-making or performing autonomously. Focus on trusted AI and autonomous systems.

Already delivered to COCOMs directly from innovation unit or as commercial purchase:

Automatically detect, attribute, and characterize falsified media disinformation attacks via DARPA Semantic Forensics (SemiFor)

Persistent maritime surveillance from wind-powered Sail Drones via the DIU Persistent Maritime ISR project

Networked manned-unmanned aircraft and munitions via AFRL's Skyborg and Golden Horde

Low-cost kinetic strike capability from UAV swarms launched from long-endurance UUVs via ONR's LOCUST launcher tube

Baselined in acquisition programs for future delivery as/or part of weapon system:

Accelerated kill chain for mine countermeasures when DIU/NAVSEA AI-enabled automated target recognition delivered via Navy LIONFISH small class UUV in FY24
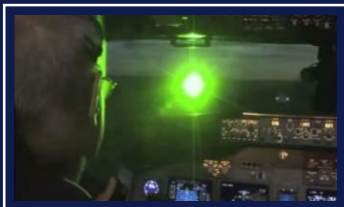
DIRECTED ENERGY

9+ successful transitions. Rapid responses and engagement at the speed of light to counter wide variety of current and emerging threats. Focus on high-power lasers and high-power microwave technologies.

Already delivered to COCOMs directly from innovation unit or as commercial purchase:

Protect munitions from Directed Energy countermeasures and weapons using AFRL's Directed Energy Survivable Standoff Munitions (DESSM) JCTD

Defeat UAVs by pairing surface-to-air missiles with 10 kW High Energy Laser (HEL) delivered by Air Force HEL Weapon System (HELWS)

Characterize laser lethality effects on targets using Laser Vulnerability Models developed by multiple services and R&E

Real-time alerts to prevent fratricide and avoid collateral damage from R&E's predictive Deconfliction Safety Software (DSS) available in industry

Baselined in acquisition programs for future delivery as/or part of weapon system:

Offense and defense capability from 300 kW HEL with R&E High Energy Laser Scaling Initiative (HELSI) lasers delivered by Army, Navy and Air Force Programs beginning FY24

INTEGRATED NETWORK SYSTEM-OF-SYSTEMS (INSS)

15+ successful transitions. Integration of diverse systems for resilient and secure command, control & communications. Focus on interoperability across electromagnetic spectrum, software defined systems, and information exchange layer.

Already delivered to COCOMs directly from innovation unit or as commercial purchase:

Commercial software defined radios with reduced latency/power that use the DARPA Software Defined Radio 4.0 open-source code

Disseminate tactical C2 across variety of heterogenous radio systems from ONR's Communication as a Service (CaaS)

Reduced power/weight by collapsing disparate EW, EO, radar into single RF system from DARPA's Converged Collaborative Elements for RF Task Operations (CONCERTO)

Capability to connect any sensor in any domain to any shooter with a machine-to-machine messaging standard from SCO & Several Components FNC3 Universal C2 (UC2)

Improved Link 16 tactical data link resilience through the Link 16e software developed by R&E & Air Force PEO C3IN

INTEGRATED SENSING & CYBER (IS&C)

59+ successful transitions. Wideband sensors that operate at intersection of cyberspace, electronic warfare, radar, and communications in highly contested environments. Focused on elimination of stove-piped and single function sensors.

Already delivered to COCOMs directly from innovation unit or as commercial purchase:

Autonomously merge EW, cyber & info ops into courses of action (COAs) from Army SMDC's Digital Attack Surface Execution Environment (DASEE)

Prevent adversary censorship of websites from commercial VPN providers from NRL's Sauteed Onions

Find, report, & eliminate adversary activities on non-U.S. infrastructure from Hunt Forward Operational Kits developed by USCYBERCOM/Services

Baselined in acquisition programs for future delivery as/or part of weapon system:

Autonomous decision-making engine to improve cyber decisions for network defense when Army DEVCOM's Autonomous Cyber is delivered by Army PEO C3T

Detect, analyze & disrupt RF communications on small UAS when AFRL's Ninja Counter UAS is delivered by the Air Force Counter UAS Program

HYPERSONICS

22+ successful transitions. Overmatch against strategic competitors pursuing and rapidly fielding advanced hypersonic missiles. Focus on leap-ahead cost-effective technologies for air, land, and sea operational forces.

Baselined in acquisitions programs as/or part of weapon system

Land-launched intermediate range hypersonic strike when OSD's Common Hypersonic Glide Body (CHGB) delivered via the Army Long-Range Hypersonic Weapon (LRHW)

Air-launched medium-range hypersonic strike when the DARPA/AFRL's Tactical Boost Glide (TBG) delivered via the Air Force AGM-183 Air Launched Rapid Response Weapon (ARRW) Program

Sea-launched intermediate range hypersonic strike when OSD's Common Hypersonic Glide Body (CHGB) delivered via Navy Conventional Prompt Strike (CPS) weapon

Air-launched medium-range stand-off strike hypersonic capability when DARPA/AFRL's Hypersonic Air-Breathing Weapons Concept (HAWC) delivered via Air Force Hypersonic Attack Cruise Missile (HACM) Program

SPACE TECHNOLOGY

34+ successful transitions. Robust, proliferated architectures for resilient cross-domain operations. Focus on adaptive/reconfigurable space situational awareness/control, communications, on-orbit processing and autonomous capabilities.

Already delivered to COCOMs directly from innovation unit or as commercial purchase:

Automated real-time alerts from space assets via AFRL's Space Domain Characterization and Control System (SDCCS)

Low cost, high cadence commercial launch capabilities provided by DIU Small Responsive Launch program

Day/night, all-weather commercial SAR imaging from DIU's Peacetime Indications & Warnings.

Baselined in acquisition programs for future delivery as/or part of Weapon System:

Better detection & warning of ballistic missile events when AFRL's large format focal plane array of 4 million pixels is launched by Space Force Next-Gen Overhead Persistent Infrared Program in FY25

More affordable, secure, higher bandwidth communication from SDA & DARPA's Optical Intersatellite Link & processor when launched in FY26

MICROELECTRONICS

43+ successful transitions. Secure microelectronic sources for defense needs that leverage state-of-the-art (SOTA) commercial development and production. Focus on restoring diminished manufacturing in the U.S. and supply chain.

Already delivered to U.S. Industrial Base ensuring secure DoD and commercial supply chains for all COCOMs:

Defense primes Boeing and Northrop-Grumman Corps. leading physical design testing of Intel's 18A chip via R&E's Rapid Assured Microelectronics Prototypes – Commercial (RAMP-C)

Advanced communications, EW, and other applications from ONR's domestic large diameter Radio Frequency (RF) Gallium Nitride (GaN) semiconductors and DARPA's millimeter-wave GaN fabrication process

Security enhancements via AFRL and Intel's FPGA Security Enhancements effort to develop new cryptographic logic features for improved symmetric key encryption and asymmetric key authentication
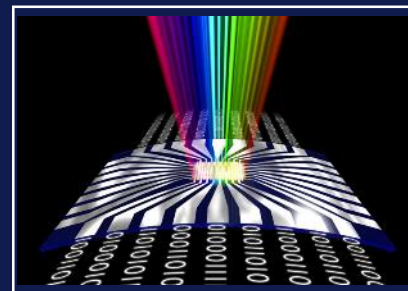
Enhanced sensor capabilities via NRL & DoD Manufacturing Innovation Institute (MII) Ultra-Low Loss Silicon Nitride Photonics Platform