DEFENSE INNOVATION UNIT

ANNUAL REPORT 2020



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The Global Strategic Warning and Space Surveillance System Center at Cheyenne Mountain Air Force Station, CO (U.S. Air Force photo by Airman 1st class Krystal Ardrey). Read about DIU's Air Threat Response project with the North American Aerospace Defense Command on page 13.

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Cover photo: Skydio

EXECUTIVE SUMMARY

Five years ago, the Defense Innovation Unit (DIU) opened its doors in Silicon Valley as "Defense Innovation Unit Experimental." What began in 2015 as an experiment to lead Department of Defense (DoD) outreach to commercial innovators has become a gateway for business between leading-edge companies and the U.S. military. Today, DIU's mission to strengthen U.S. national security by increasing the military's adoption of commercial technology and to grow the national security innovation base is critical not only to maintaining a strategic advantage over our adversaries but also to the strength of our economy.

In 2020, DIU, in collaboration with DoD partners seeking commercial solutions to national security challenges, initiated 23 new projects (a 35% year-over-year increase), bringing our total project count up to 95. Every year, we see a stronger response from commercial companies to DIU solicitations: In 2020, we received a total 944 commercial proposals and increased the average number of proposals per solicitation by 52% compared with 2019. As a result, we awarded 56 Prototype Other Transaction (OT) agreements to companies, the majority of which are considered small businesses or nontraditional defense contractors. Since DIU began prototype activities in 2016, we have awarded more than 200 Prototype OT agreements to companies across 28 U.S. states and six foreign countries to solve the Department's national security challenges.

This past year, we facilitated the transition of 11 completed, successful commercial prototypes to our DoD partners for large-volume procurement. Overall, DIU has transitioned a total of 26 commercial solutions, and 43% of our projects to date have yielded at least one, if not more, prototypes that have transitioned to production. Additionally, 51 DIU projects have ongoing prototypes that will be eligible for transition to production if successfully completed. In 2020, DIU helped deliver to the warfighter technologies spanning artificial intelligence, autonomy, cyber, human systems, and space. The following are a few key achievements:

- Adapted the ongoing Rapid Analysis of Threat Exposure (RATE) project to include pre-symptomatic, early warning of COVID-19 infection to cue earlier testing, isolation, and treatment to improve force readiness;
- Deployed winning computer vision algorithms from the xView2 prize competition to assist first responders in conducting post-disaster damage assessment and coordination of humanitarian assistance during the Australia bushfires, California wildfires, and coastal hurricanes;
- Released five new secure, trusted, small unmanned aerial systems (sUAS) for interagency procurement on the GSA schedule as part of our Blue sUAS initiative. These sUAS are the first DIU-facilitated product made available not only across DoD but also across the U.S. government;
- Scaled the Predictive Maintenance solution to additional Air Force and Army partners and aircraft, adding the HH-60 Pave Hawk;
- Transitioned the Air Threat Response solution to DoD partners at the North American Aerospace Defense Command and United States Northern Command in record speeds of 364 days from prototype award to production contract;
- Launched a sixth technology portfolio, Advanced Energy and Materials, which will focus on leveraging proven advancements in energy and materials technology to enhance U.S. military capabilities and strengthen resilience across installations and distributed operations.



West Point participants receive their RATE wearables (Defense Innovation Unit)

We owe much of our achievement in 2020 to the growth of the DIU team, the DoD partners that continue to choose DIU and bring us "wicked" problems, and the extraordinary entrepreneurship and creativity of the commercial companies that work with us. DIU has come a long way in our first five years and, in the years to come, we look forward to providing even more high-impact solutions that will bolster our military's strategic, operational, and tactical advantage to help deter future conflicts.

FIVE YEARS OF DIU

ORGANIZATIONAL MILESTONES: 2015 – 2020

2015

APRIL 2015: Secretary of Defense Ash Carter delivers Drell Lecture at Stanford University, announcing the establishment of the Defense Innovation Unit Experimental in Silicon Valley.

AUG. 2015: DIUx opens its doors in Mountain View, CA, for the first time and establishes an office in the Pentagon.



Secretary Carter greets DIU Director Raj Shah in Mountain View in 2016 (DoD photo by Alun Thomas)



(DoD photo by SFC Clydell Kinchen)

" ... first-of-its-kind unit for us ... They'll strengthen existing relationships and build new ones; help scout for new technologies; and help function as a local interface for the Department. Down the road, they could help startups find new work to do with DoD."
—Secretary of Defense Ash Carter

2016

MAY 2016: Secretary Carter expands the leadership team with top military and private sector talent empowers DIUx to leverage flexible authorities for prototyping.

JUNE 2016: DIUx pioneers the Commercial Solutions Opening (CSO) process in partnership with Army Contracting Command — New Jersey and posts its first competitive solicitation online.

JULY 2016: DIUx and ACC-NJ award the first Prototype OT in response to a DIUx solicitation.

JULY 2016: DIUx opens new office in Boston, MA.

SEPT. 2016: DIUx opens its fourth office in Austin, TX.



DIU participates in SXSW 2017.

2017

APRIL 2017: DIUx delivers the Tanker Planning Tool to the Air Operations Center at the Al Udeid Air Base in Qatar. The delivery of this single application led to further agile software development projects between DIUx and the Air Force Lifecycle Management Center, which culminated in the establishment of Kessel Run.

OCT. 2017: DIUx facilitates its first transition from Prototype OT to Production OT agreement, delivering Tanium's endpoint management solution-as-a-service to the Army.

2018

AUG. 2018: DoD leadership removes "experimental" from DIU's original name, signaling its permanence within the Department.

FEB. 2018: DIUx assumes a new home in the Office of the Under Secretary of Defense for Research and Engineering.

NOV. 2018: The Office of the Under Secretary of Defense for Acquisition and Sustainment grants DIU authority to award OT agreements, allowing DIU to set up internal contracting capabilities for the first time.

2019

JULY 2019: DIU executes its first Prototype OT agreement with internal contracting authority.

2020

"The Defense Innovation Unit ... has played a critical role in bringing new processes, methodologies, and technologies to the Department. In light of this, I congratulate DIU on its fifth anniversary."
—Secretary of Defense Mark Esper

FEB. 2020: Rogue Squadron, a team that develops hardware and software to cyber harden small drones and build counter-drone capabilities, transitions from DIU to a permanent institutional home at the Defense Digital Service.

OCT. 2020: Advanced Energy and Materials is launched as DIU's sixth technology portfolio.

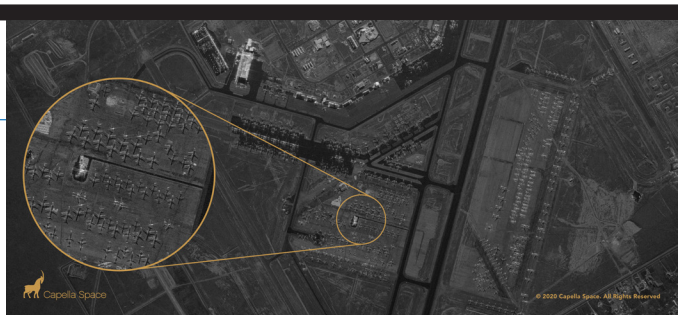
2020 IN REVIEW

The Defense Innovation Unit (DIU) strengthens our national security by accelerating the adoption of leading commercial technology throughout the military and by growing the national security innovation base (NSIB). During a year of challenging economic circumstances across the United States and the globe, it has become even clearer that the health and strength of our economy is essential to our prosperity as a nation and to our national security. The startups, established companies, venture capital firms, investors, and traditional defense contractors that DIU works with to deliver the best commercial technology to the Department of Defense (DoD) are not only fundamental sources of dual-use technologies but also the foundation of a strong U.S. economy and NSIB.

Throughout 2020, the DIU team leveraged its strength as an agile DoD organization to start 23 new projects (a 35% year-over-year increase) and rapidly responded to emerging challenges.

- Adapted the ongoing Rapid Analysis of Threat Exposure (RATE) project to include pre-symptomatic, early warning of COVID-19 infection to cue earlier testing, isolation, and treatment to improve force readiness (read more on page 20);
- Deployed winning computer vision algorithms from the xView2 prize competition to assist first responders in conducting post-disaster damage assessment and coordination of humanitarian assistance during the Australia bushfires, California wildfires, and coastal hurricanes (read more on page 14);
- Broadened the span of DIU-facilitated commercial solutions across all USCYBERCOM (USCC) and national cyber lines of effort — including defend forward, election security, and human-machine augmentation — and doubled the number of DIU's active projects with USCC compared with 2019 (read more on page 17);
- Released five new secure, trusted small unmanned aerial systems (sUAS) for interagency procurement on the GSA schedule. These Blue sUAS are the first DIU-facilitated product made available not only across DoD but also across the U.S. government (read more on page 16);
- Successfully demonstrated the first U.S. commercial synthetic aperture radar smallsat with 0.5m resolution and co-sponsored a workshop that convened leaders from industry, academia, and government with the objective of identifying recommendations to sustain U.S. economic and military advantage in space. Several recommendations were subsequently implemented to build and grow the space industrial base (read more on page 21).

Additionally, DIU launched a sixth technology portfolio in October 2020: Advanced Energy and Materials (AE&M). AE&M joins DIU's Artificial Intelligence, Autonomy, Cyber, Human Systems, and Space Portfolios as an area in which commercial companies are at the forefront of innovation and DoD access to advanced capabilities is critical to maintaining U.S. military-technical advantage against our adversaries. DIU began exploring opportunities to expand into energy and materials as early as 2018 and, with the support of DIU's Joint Reserve Detachment (JRD), incubated an energy-focused project with the Space Portfolio as a proof of concept. AE&M will focus on leveraging proven advancements in energy and materials technology to enhance U.S. military capabilities and to strengthen resilience across installations and distributed operations.



Capella Space spot image Roswell International Air Center, New Mexico (SAR imagery provided by Capella Space)

Rogue Squadron Transitions to Defense Digital Service

Rogue Squadron is a small team that develops hardware and software solutions for small unmanned aerial systems (sUAS) and counter-UAS (C-UAS) missions. Leveraging modern software development practices, the team delivers cutting-edge software that helps the warfighter operate safely and securely in environments with unknown autonomous systems. Its products are in use by approximately 200 organizations across DoD and the federal government. Founded as part of DIU in 2017, Rogue Squadron transitioned to a permanent institutional home in the Defense Digital Service in February 2020.

None of our achievements in 2020 would have been possible without growing the DIU team and building partnerships across government. To increase our capacity and rapid cadence while maintaining a lean organization, we built up our Acquisitions Team and staffed our JRD to full operational capability, providing activated reservists in key billets. DIU also welcomed five United States Coast Guard Liaisons to the team and deepened collaboration with the Department of Homeland Security through a memorandum of understanding with the Cybersecurity and Infrastructure Security Agency. The Space and AE&M portfolios augmented their technical assessment capabilities through an expanded agreement with NASA and partnerships with the Department of Energy's National Renewable Energy Lab and MIT-Lincoln Laboratory. DIU and AFWERx also committed to more active coordination via co-locating and information sharing to better direct commercial companies toward the most suitable on- and off-ramps for doing business with DoD.

METRICS & PERFORMANCE

ACCELERATING DOD ADOPTION OF COMMERCIAL TECHNOLOGY

In 2020, we not only increased the number of new DIU projects compared with prior years but we also expanded our reach among commercial companies. We increased by 50% the average number of proposals per solicitation (41) compared with 2019. This level of growth is a result of the depth and breadth of DIU's relationships with U.S. innovation ecosystems, bolstered by a strong team of individuals with diverse commercial and military backgrounds; our offices in Silicon Valley, Boston, and Austin; and our ability to build a trusted, repeatable process to do business with DoD that yields annual recurring revenue.

Our competitive process lowers barriers to entry for companies seeking to do business with the Department by minimizing up-front costs: Initial proposals are a brief five written pages or a 15-slide deck. The average time from close of solicitation to contract award increased from 127 days in 2019 to 149 days in 2020. This slowdown is primarily attributed to increasing project throughput and the growing number of company proposals per solicitation. However, speed to award is important to us, and DIU will continue to strive toward a goal of 60 to 90 days to contract award. In addition to speed, transparent communications about our process and getting to "yes" quickly both assures our DoD partners access to advanced commercial technology and provides companies with a smooth and efficient path to doing business with the Department.

2020 SNAPSHOT

23 solicitations for commercial solutions posted to diu.mil

944 commercial proposals received

41 commercial proposals received per solicitation on average

1 procurement for experimental purposes contract awarded to a commercial company

56 Prototype OT contracts awarded to commercial companies

107 the most commercial proposals received in response to a single solicitation

JUNE 2016 – DECEMBER 2020

95 prototype projects initiated to solve DoD challenges

208 Prototype OT contracts awarded to commercial companies

36 projects have been completed (all prototyping efforts concluded)

2,381 commercial proposals received

$11.7B billion in private investment leveraged

DIU PROJECT LIFECYCLE

Problem Curation & Diligence

- Receive, understand, and evaluate warfighter requirements.
- Confirm a commercial market exists to address the requirements.

Commercial Solutions Opening (CSO)

Phase 1
- Solicit digital proposals in response to a problem statement posted to the DIU website.

Phase 2
- Evaluate proposals and invite a short list of bidders to deliver in-person pitches.

Phase 3
- Select contract awardee/s and negotiate agreement.

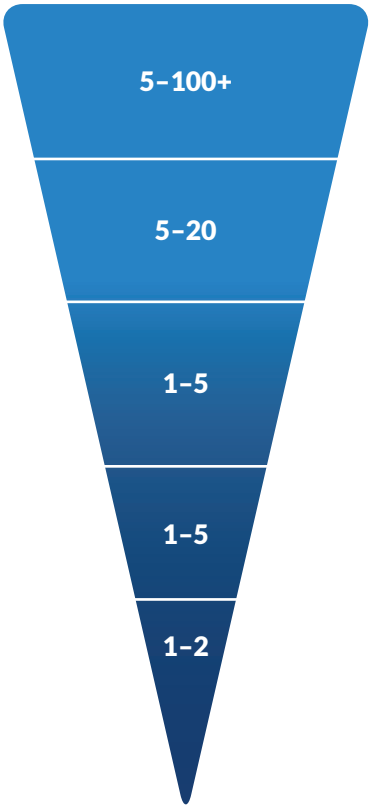
Prototyping

- Execute pilot project.

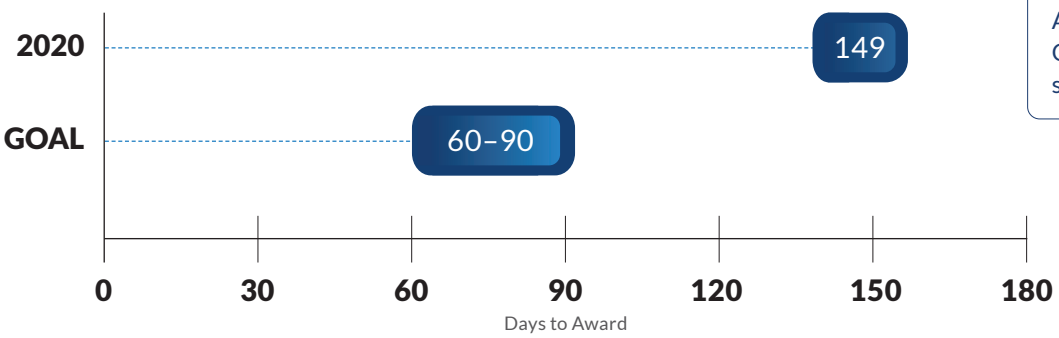
Transition

- Award non-competitive follow-on agreements to successful pilot performers.
- Deliver and scale products to DoD prototype partner/s and beyond.

Approximate Number of Vendors Participating



SPEED TO AWARD



Average days to Prototype OT contract award from solicitation closure.

TRANSFORMING MILITARY CAPABILITIES AND CAPACITY

DIU is an innovation organization focused on fielding and scaling commercial solutions to the Joint Force; we work across the Services, Components, Combatant Commands, Defense Agencies, and the Office of the Secretary of Defense. The DIU team itself is also joint: Our active-duty military and reservists represent each of the Services, and we continue to prioritize hiring individuals who increase the breadth of our collective experience across the DoD. As a result, we prioritize opportunities to solve defense challenges experienced by multiple DoD organizations.

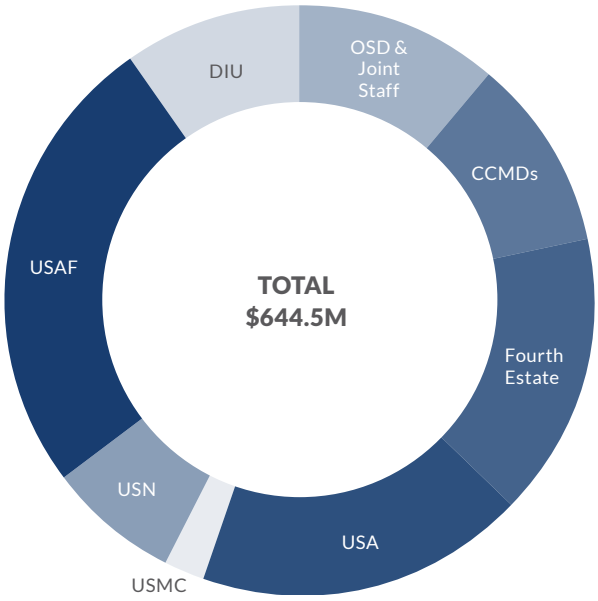
Whereas new projects reflect potential impact, transitions indicate the successful completion of a prototype project and occur when a DoD partner organization signs a follow-on agreement or contract or formally assumes management of a technology or innovation. Importantly, 50% of our transitions are Production OT agreements, which are available for use by one or more DoD organizations, enabling impactful commercial solutions to scale beyond prototype project partners to wherever there is a need. Ultimately, DIU is focused not only on transitioning commercial technologies but also on fielding and scaling solutions: Widespread technology adoption (in addition to procurement) is necessary to transform military capabilities and capacity.

OBLIGATED PROTOTYPE FUNDING BREAKDOWN

The average duration of a DIU prototype is 13 months, and approximately 43% of projects yield at least one successfully transitioned commercial solution. In 2020, DIU continued to steadily increase the number of commercial solutions transitioned year-over-year, improving upon 2019 figures by 22%. Solutions transitioned in 2020 benefitted DoD partners in the Air Force, Combatant Commands, and the Fourth Estate (read more about specific capabilities on pages 11–22). Since DIU began facilitating prototype projects, a total of 26 commercial solutions have been transitioned to DoD partners.

DIU = Defense Innovation Unit
CCMDs = Combatant Commands
USA = United States Army
USMC = United States Marine Corps
USN = United States Navy
USAF = United States Air Force

June 2016 – December 2020

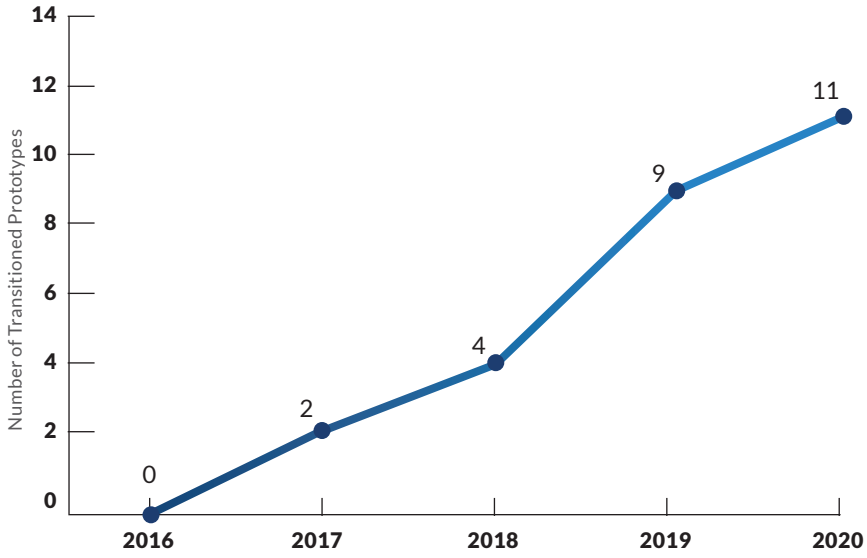


TRANSITIONED PROTOTYPES 2016-2020

What Is Transition and Fielding?

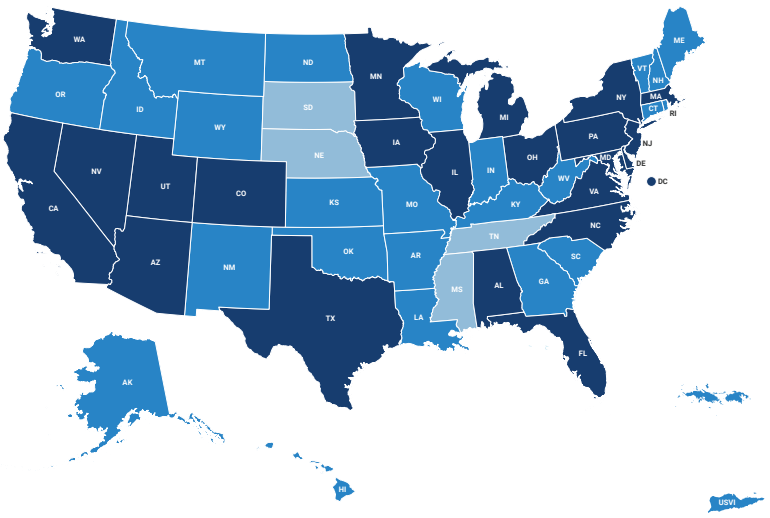
A commercial solution is transitioned when a DoD organization signs a follow-on agreement or contract, such as a Production OT agreement or procurement contract, or formally assumes management of a technology or innovation.

A commercial solution is fielded when a DoD organization employs a technology or innovation in an operational or environment.



STRENGTHENING THE NATIONAL SECURITY INNOVATION BASE

United States



Location with DIU Awards

Locations with DIU Submissions Only

Locations without DIU Proposals or Awards

International Awards



Canada
France
Israel

New Zealand
Spain
United Kingdom

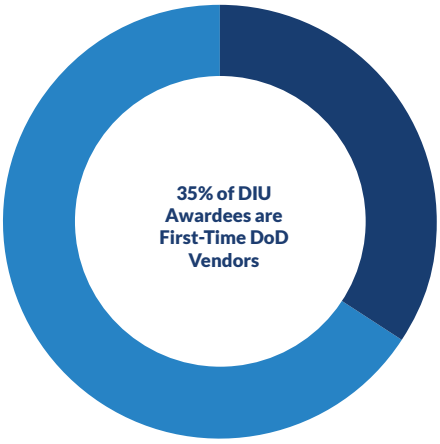
As of December 2020, DIU has welcomed more than 2,300 proposals from companies across 46 states, the District of Columbia, the U.S. Virgin Islands, and 20 foreign countries. We have awarded 225 contract agreements to 189 unique companies from the United States, Canada, France, Israel, New Zealand, Spain, and the United Kingdom.

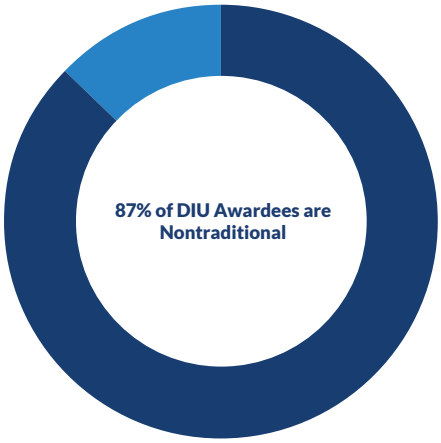
DIU does the most work with:

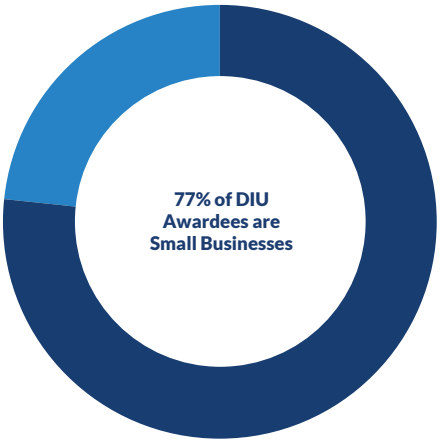
State	Awards	Amount
California	91	$322.6M
Virginia	28	$99.9M
Massachusetts	11	$29.4M
Florida	11	$26.6M
Texas	11	$16.1M
New York	9	$31M
Pennsylvania	8	$26.2M
Washington	7	$24.4M
Arizona	4	$42.6M
Colorado	4	$16.2M
Missouri	3	$60.6M

CONTRACT AWARD RECIPIENTS BY BUSINESS TYPE

The majority of companies that receive DIU awards are considered nontraditional vendors and small businesses, and 34% of awardees are first-time DoD vendors. DIU also does business with traditional defense contractors and large businesses.







A first-time DoD vendor has never before worked with the Department of Defense.

A nontraditional defense contractor is defined in 10 U.S.C. § 2302(9) as an entity that is not currently performing and has not performed, for at least the one-year period preceding the solicitation of sources by the DoD for the procurement or transaction, any contract or subcontract for the DoD that is subject to full coverage under the cost accounting standards prescribed pursuant to 41 U.S.C. § 1502 and the regulations implementing such section.

A small business is defined under Section 3 of the Small Business Act in 15 U.S.C. § 632.

Technology Focus Areas



ARTIFICIAL INTELLIGENCE

APPLYING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TO ACCELERATE CRITICAL DECISION-MAKING AND OPERATIONAL IMPACT.

Page 12



AUTONOMY

ADOPTING AND COUNTERING AUTONOMOUS SYSTEMS WITH A FOCUS ON HUMAN-MACHINE INTERACTION AND SCALABLE TEAMING.

Page 15



CYBER

MAKING ENTERPRISE COMBAT INFORMATION OPEN, ACCESSIBLE, AND SECURE FOR DEFENSE PERSONNEL.

Page 17



HUMAN SYSTEMS

OPTIMIZING THE HUMAN SYSTEM AND ITS ENABLING PLATFORMS THROUGH ENHANCED EQUIPMENT, INNOVATIVE TRAINING, AND NOVEL HEALTH APPLICATIONS.

Page 19



SPACE

DEVELOPING ON-DEMAND ACCESS TO SPACE, PERSISTENT SATELLITE CAPABILITIES, AND BROADBAND SPACE DATA TRANSFER.

Page 21

ARTIFICIAL INTELLIGENCE

APPLYING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TO ACCELERATE CRITICAL DECISION-MAKING AND OPERATIONAL IMPACT.



LINES OF EFFORT

Mission Forecasting and Planning
Leveraging mission-relevant data to predict system failures, anticipate malfunction, and optimize overall performance.

Anomaly Detection
Isolating critical signals from massive datasets to help human analysts focus their limited bandwidth and take effective action.

Complex System Control
Improving the efficiency of complex enterprise systems that manage logistics, manpower, and financial accounting.

Operational Decision Support
Analyzing complex, real-time inputs at scale, allowing operators to make the best decisions in the least time.

ONGOING PRIORITY PROJECTS

PREDICTIVE MAINTENANCE

The DoD operates fleets of vehicles and aircraft from hundreds of global bases and requires year-round maintenance to ensure vehicle readiness and availability. However, maintenance and repair activities are often determined by time-based schedules rather than the condition of the vehicle, which can increase both the rate and duration of unscheduled maintenance due to unforeseen failures and a lack of appropriate parts. Machine learning (ML) solutions that leverage operational performance and maintenance records can anticipate system failure and automate inventory management. These condition-based predictive models reduce the frequency and duration of unscheduled maintenance, increasing vehicle availability by proactively scheduling repairs and decreasing the number of missions aborted because of maintenance-related breakdowns.

In 2019, DIU transitioned a commercial predictive maintenance solution for aircraft, developed by C3.ai, to Air Force and Army customers. Since adopting the predictive maintenance solution, the Air Force has observed a 40% reduction in unscheduled maintenance on high-priority aircraft subsystems, and the Army, in addition to reductions in unscheduled maintenance, has recorded a 24% reduction in severe in-flight malfunctions. In 2020, DIU worked with the Air Force and C3.ai to scale predictive maintenance to more platforms, recently adding the HH-60 Pave Hawk. DIU continues to work with other Services to make predictive maintenance available to more fleets of aircraft.

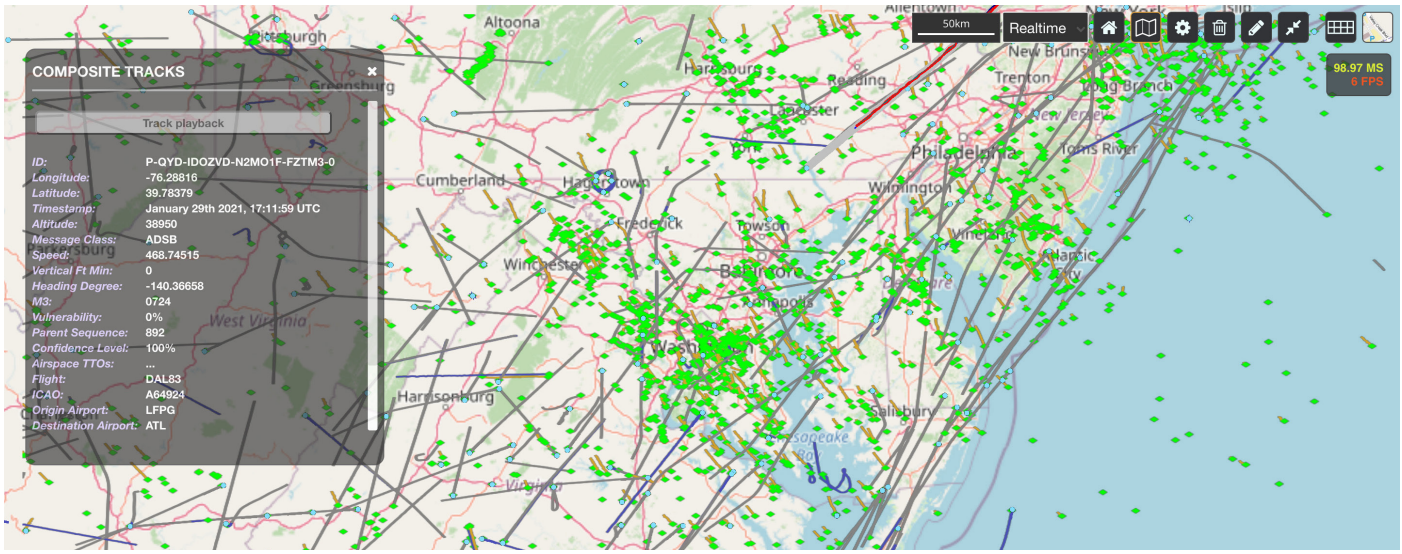
Separately, DIU is also partnered with the Marine Corps and another artificial intelligence company to prototype and test a commercial predictive maintenance solution for ground vehicles.

> **"C3.ai's proven technology has demonstrated success across multiple industries with its AI-based readiness application for predictive maintenance and logistics planning, making C3.ai an ideal partner to implement RSO's vision to increase mission readiness. By partnering with C3.ai, RSO's CBM+ Program Office will be able to accelerate scaling AI and ML capabilities across the Air Force enterprise and combine data science with Air Force operational maintenance to digitally transform how we maintain our global fleet."**
> — Nathan Parker, Deputy Program Executive Officer, U.S. Air Force Rapid Sustainment Office

INTELLIGENT BUSINESS AUTOMATION

The DoD spends millions of labor hours tracking and resolving unmatched transactions in financial, logistics, and payroll accounting systems. Robotic process automation (RPA) tools support these efforts in enterprise resource management systems but require well-defined rules and logic processes that must be manually updated and refined on a continuous basis to be effective. DIU partnered with the Joint Artificial Intelligence Center (JAIC), Army Financial Management and Comptroller, the Office of the Under Secretary of Defense (Comptroller), and commercial companies to prototype an ML-based system that enhances existing RPA tools for handling unmatched transactions by automatically routing them to the correct RPA process without human intervention. These improvements have the potential to save millions of dollars in unmatched transactions; identify potential fraud, waste, and abuse; enable more productive use of human analyst time; and identify redundancies in logistics, travel, and payroll accounting systems.

Capabilities Transitioned or Fielded in 2020



Dashboard view of aerial tracks in the Mid-Atlantic United States (Kinetica DB, Inc.)

AIR THREAT RESPONSE

TRANSITIONED 23 SEPTEMBER, 2020

Problem: The North American Aerospace Defense Command (NORAD) is tasked with defending the homeland from airborne threats. The success of this mission is dependent on time-consuming, manual data fusion and analysis that leaves minimal time for commanders to respond to potential threats.

Vendor: Kinetica DB, Inc.
Original Prototype Value: $2M
Transition Agreement: Production OT with a ceiling of $100M
Transition Partner: NORAD and U.S. Northern Command

Solution: In 2019, DIU partnered with Kinetica, an active analytics database management provider, to develop a situational awareness platform to help operators and commanders identify and swiftly respond to radar tracks that represent threats to North American airspace. Kinetica built a data ecosystem that aggregates incoming feeds from hundreds of sources — including radar, aircraft beacons, flight plans, and weather data — into a common operational picture. The solution enables operators and analysts alike to identify, disaggregate, and resolve aerial tracks involving potential threats.

> **"This effort is a technology leap forward for Homeland Defense command and control systems."**
> — General VanHerck, Commander, North American Aerospace Defense Command and United States Northern Command

PREDICTIVE MISSION CONFIGURATION

TRANSITIONED 04 MARCH 2020

Problem: The Air Force relies on historical test and simulation data to train models that can accurately predict whether an aircraft can operate safely when loaded with new sensors, weapons, electronic warfare equipment, and other devices. This data is held in millions of records locked in disparate silos, is manually processed, and is rarely used to its full potential, all of which slows down the certification process while increasing workforce constraints.

Vendor: Tamr, Inc.
Original Prototype Value: $1.5M
Transition Agreement: Production OT with a ceiling of $60M
Transition Partner: U.S. Air Force

Solution: In 2018, DIU partnered with Tamr, a leading machine learning and data mastering company, to develop analog testing models that speed up the configuration assessment process and reduce engineers' manual workloads. Tamr accomplished this task by leveraging databases of previous configuration information to build models that could identify promising new configurations that met mission parameters. In doing so, Tamr was able to reduce both the time required for and the cost of test flights and simulations for new aircraft configurations, ultimately increasing the utilization of aircraft. The initial prototype focused on the F-16 Fighting Falcon and has since expanded to other aircraft platforms as part of the production contract.

xVIEW2 PRIZE COMPETITION

FIELDED THROUGHOUT 2020



xView2 satellite imagery assessment of a location (right) identifies damaged structures after California's 2020 Valley Fire.

Problem: The time it takes to properly assess damage in the wake of a major event can be the difference between life and death. However, emergency responders must often navigate disruptions to local communication and transportation infrastructure, making accurate assessments dangerous, difficult, and slow. While satellite and aerial imagery offer a less risky alternative that covers more ground, analysts must still conduct manual, time-intensive assessments of images.

Prize Competition Sponsors:
Defense Innovation Unit (DIU)
National Security Innovation Network (NSIN)
Joint Artificial Intelligence Center (JAIC)
Carnegie Mellon University Software Engineering Institute (SEI)
Total Payouts to Winners: $400,000
End Users:
Federal Emergency Management Agency (FEMA)
National Geospatial-Intelligence Agency (NGA)
National Aeronautics and Space Administration (NASA)
California Department of Forestry and Fire Protection (CAL FIRE)
California Air National Guard
California Governor's Office of Emergency Services (OES)

Solution: In 2019, DIU, NSIN, JAIC, and SEI worked with partners including FEMA, NGA, NASA, CAL FIRE, and the California Air National Guard to run a prize competition focused on automating the geo-location of objects and assets during and after natural disasters. Automated algorithms for post-disaster damage assessment would allow response agencies and personnel to more swiftly coordinate and direct the delivery of humanitarian assistance in the aftermath of a crisis. The competition resulted in more than 2,000 submissions and multiple winning solutions with an 80% damage assessment success rate. The top solutions have since been deployed to assist with the 2020 California wildfires, coastal hurricanes, and the 2019-2020 Australia Bushfires. xView2 has also yielded substantial positive engagement with the AI community via open-source releases of model code and a machine learning dataset called xBD that continues to be a resource to the humanitarian assistance and disaster response community. DIU will look to expand these efforts in 2021 to incorporate additional remote sensing modalities (e.g. synthetic aperture radar) and problem sets.



Teal Golden Eagle (Teal)



Parrot Anafi-USA-Gov/mil (Parrot)



Altavian ION M440C (Altavian)

AUTONOMY

ADOPTING AND COUNTERING AUTONOMOUS SYSTEMS WITH A FOCUS ON HUMAN-MACHINE INTERACTION AND SCALABLE TEAMING.

LINES OF EFFORT

Counter Unmanned Aerial Systems (C-UAS)
Delivering autonomous low-cost detect and defeat solutions against incursions of adversarial UAS for mobile and fixed-site security.

Small Unmanned Aerial Systems (sUAS)
Providing secure, trusted, inexpensive tactical sUAS options to enhance intelligence, surveillance, and reconnaissance options for small units.

Maritime Systems
Fielding autonomous, unmanned, or remotely operated vehicles to support the collection of maritime surface and subsurface data and displace manned vessels and divers from hazardous waters.

Additive Manufacturing
Leveraging advanced manufacturing, automation, and materials science to enable the creation of new components, structures, and systems in never-before-achievable circumstances.

ONGOING PRIORITY PROJECTS

INSTALLATION C-UAS

Both military and commercially available, inexpensive, sUAS pose threats to our service members when they are deployed for intelligence, surveillance, and reconnaissance and when they are weaponized. Defensive systems must detect, track, and defeat adversarial UAS and distinguish them from friendly systems. DIU's priority prototyping efforts include the development of two solution sets for defending against C-UAS at installations. In partnership with United States Special Operations Command (USSOCOM) and Anduril, DIU is facilitating one prototype focused on testing an autonomous AI-enabled integration of sensors including radar, radio frequency (RF) detect and defeat, electro-optical/infrared, and interceptors for a full kill-chain capability. DIU is facilitating another prototype with additional DoD organizations and commercial companies to prototype a non-RF-based defeat capability that leverages high-speed UAS equipped with a variety of payloads to intercept and defeat sUAS with low collateral damage. Credible C-UAS technologies that can be acquired and tailored to local conditions will allow military installations to develop more mature concepts of operation for handling drone incursions and strengthening force protection measures.

AI FOR SMALL UNIT MANEUVER

Conventional military and commercial drones are designed to provide overhead coverage of a location from a safe altitude; they are not optimized to navigate interiors such as tunnels, underground facilities, or parking structures. Yet the complexity of urban battlefield conditions requires sUAS capable of navigating a variety of terrain and of working collaboratively to achieve an objective in support of small units on the ground. DIU is partnered with USSOCOM to prototype and test a commercial, platform agnostic, maneuver autonomy stack that enables multi-agent, cooperative autonomy among teams of up to three or more sUAS.

RESILIENT EXPEDITIONARY AGILE LITTORAL LOGISTICS (REALL)

The U.S. military relies heavily on foreign basing infrastructure for global force projection. Our aircraft need permissive locations to land, refuel, and rearm, but bases are expensive to sustain, and opening or closing bases requires significant monetary and political capital. DIU is partnered with the Marine Corps Warfighting Lab, the Navy, and the Office of the Secretary of Defense to prototype mobile, remotely operated, optionally manned, oceanic-capable barges large enough to land vertical-takeoff and -landing aircraft coupled with ship-to-ship and ship-to-shore refueling capabilities. If successful and adopted at scale, REALL platforms could frustrate adversaries' operational concepts and tools for countering American carrier strike group formations and preserve the U.S. military's ability to conduct global operations.

Capabilities Transitioned or Fielded in 2020

BLUE sUAS

TRANSITIONED 30 SEPTEMBER 2020

Problem: The DoD is not positioned, organized, or resourced to keep pace with the speed or scale of commercial sUAS development. Without access to secure, trusted, and reliable sUAS, operators are losing out on an on-demand, tactical resource for intelligence, surveillance, and reconnaissance missions. Despite the growing demand for sUAS, DoD often relies on either less capable, more expensive government-developed systems or on cyber vulnerable commercial sUAS.

Vendors: Altavian, Inc., Skydio, Inc., Vantage Robotics LLC, Teal Drones, Inc., and Parrot
Original Prototype Value: $18M
Transition Vehicle: GSA Schedule
*Available for DoD and Federal Government procurement.

Operational Range	3+ kilometers
Flight Endurance	30+ minutes
Environmental Rating	Flies through dust and rain (IP53)
Assembly Time	2 minutes or less
Takeoff Weight	Less than 3lbs
Payload	High Resolution Day/Night Stabilized Optics
Architecture	Built around an open source protocol

Solution: DIU partnered with five commercial companies to develop five new, domestically produced, cyber tested sUAS platforms available for DoD and interagency procurement. Each of the sUAS feature vertical takeoff and landing capabilities, are rucksack portable, and are certified to fly in DoD and national airspace. Each system has a variation of the below specifications and additional attributes to offer DoD and Federal Government customers:

Blue sUAS platforms were designed using an open architecture. This approach removes vendor lock, allowing for iterative upgrades to keep pace with commercial industry development cycles and granting operators consistent access to the best technology. The Blue sUAS program provides the DoD and Federal government with trusted sUAS capabilities at commercially comparable unit costs on the General Services Administration (GSA) Schedule to ensure ease of procurement and signals aggregate government demand to strengthen the domestic sUAS industrial base.



"Blue sUAS is a great example of DoD acquisition reform by lowering the barrier to entry for non-traditional companies to rapidly iterate shoulder to shoulder with warfighters to deliver highly capable sUAS tailored to mission needs."
— Ellen Lord, Under Secretary of Defense for Acquisition and Sustainment



Skydio X2D in flight (Skydio)

CYBER

MAKING ENTERPRISE COMBAT INFORMATION OPEN, ACCESSIBLE, AND SECURE FOR DEFENSE PERSONNEL.



U.S. Air Force Tech. Sgt. Karen White shares images on her phone of maintenance equipment during a Leadership Rounds visit (U.S. Air Force photo by Tech. Sgt. James Hodgman)

LINES OF EFFORT

Persistent Engagement
Engaging with adversaries in the cyber domain to update and improve DoD's cyber defense toolkit in response to real-world offensive measures.

Persistent Presence
Monitoring and analyzing adversary's activities in the cyber domain to improve DoD's situational awareness and facilitate information sharing with allies and partners.

Persistent Innovation
Expanding the DoD's cyber toolkit to leverage the most advanced capabilities, tools, and techniques and maintain military-technical advantage over our adversaries.

ONGOING PRIORITY PROJECTS

AUTOMATED NETWORK DETECTION AND PATCHING

DoD must be able to recognize vulnerabilities to patch each of its systems including a growing array of devices, internet of things (IoT) sensors, and cloud-connected solutions. Moreover, the extended timeframe between patch release and implementation leaves the DoD network vulnerable to attack or exploitation. DoD must reduce timelines to address vulnerabilities in each of its systems across a variety of defense end points, including workstations, servers, mobile devices, peripherals, infrastructure, IoT, and platform IT systems. To address this challenge and reduce DoD network vulnerabilities, DIU is facilitating two prototype efforts: Cyber Asset Inventory Management (Axonius) and Post-Patch Testing (UiPath and Tricentis).

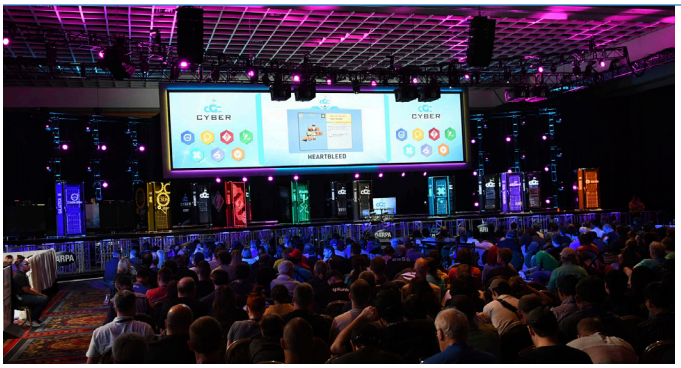
The Cyber Asset Inventory Management prototype project increases the comprehensiveness, speed, and accuracy of DoD inventory management on its network. A commercial inventory management solution integrates with the DoD network and existing inventory management tools to provide a more complete, timely, and accurate view across 11 million DoD endpoints and to profile each device to accelerate vulnerability remediation.

The Post-Patch Testing prototype project automatically tests the functionality of systems and applications after the installation of new security patches applied to assets across DoD. Currently, the cost and labor hours required to test systems after patch application increases lag between vulnerability identification and patching system vulnerabilities. The rapid post-patch testing product ensures that security patches, once installed, have no negative effects on systems' performance or stability and applications continue to function as baselined.

SECURE CLOUD MANAGEMENT

The DoD's cloud access architecture impacts DIU's ability to efficiently collaborate with entities outside of the government using cloud services. Today, DoD mandates the use of a cloud access point gateway to secure and control communication between endpoints and cloud service providers. That gateway makes it difficult to collaborate in real time and to securely share documents in line with standard private sector practices. DIU is prototyping three alternatives to DoD's cloud gateway using off-the-shelf technology from Zscaler, McAfee, and Google. The alternative cloud gateway solutions, if successful, should increase security, control, and real-time performance when accessing software-as-a-service applications directly over the internet, thereby enhancing our ability to efficiently engage with non-traditional technology vendors.

Capabilities Transitioned or Fielded in 2020



ForAllSecure participated in the 2016 DARPA Cyber Grand Challenge (DARPA)

AUTOMATED VULNERABILITY DETECTION AND REMEDIATION (VOLTRON)

TRANSITIONED 23 APRIL 2020

Problem: Current methods of finding unknown software vulnerabilities in military weapon systems do not scale, which is estimated to be a $1.795 trillion problem. Despite the magnitude of this threat, contemporary DoD software acquisition practices and priorities are roadblocks that slow the intake of innovative, commercially proven solutions to these problems. In addition, DoD lacks access to automation to augment the small cadre of experts on staff and verify their work. This gap leaves space for potential adversaries to find and exploit vulnerabilities in weapon systems and other critical software.

> **Vendor:** ForAllSecure, Inc.
> **Original Prototype Value:** $6.3M
> **Transition Agreement:** Production OT with a $45M ceiling
> **Transition Partner:** Test Resource Management Center (TRMC)

Solution: ForAllSecure's core product, Mayhem, is optimized for Linux-based systems and detects zero-day vulnerabilities through advanced fuzzing and generates cybersecurity tests without manual labor. Mayhem's autonomy reduces the cost and time to find and eliminate vulnerabilities, and its integration into agile software-development pipelines can provide assurances of the integrity of critical software components before they are pushed out into production systems. Without the need to manually investigate software components, this automation helps address the growing lack of cybersecurity expertise, removing the need for a fully staffed team of cybersecurity analysts.

Notably, DIU's Automated Vulnerability Detection and Remediation project also includes an additional ongoing prototype to develop similar commercial solutions optimized for other operating systems.

> **"VOLTRON is one of the most important things our nation is doing in cyber."** — Shawn Turskey, Former Executive Director, USCYBERCOM

MOBILE ENDPOINT SECURITY

TRANSITIONED 25 SEPTEMBER 2020

Problem: IT administrators use mobile device management (MDM) tools to track, manage, and secure mobile endpoints. They are widely used within DoD and can, for example, configure trusted Wi-Fi access, install and update sanctioned apps, or remotely lock and wipe a lost or stolen device. However, MDM tools do not typically protect mobile endpoints against attacks such as phishing, malicious or risky apps, operating system exploits, or network attacks.

DoD's mobile endpoints are targets for nation-state attacks because breaches can lead to the loss of confidential information and credentials. Mobile endpoint security technology fills that security gap. Previous methods aimed at addressing this gap in security have been minimally successful.

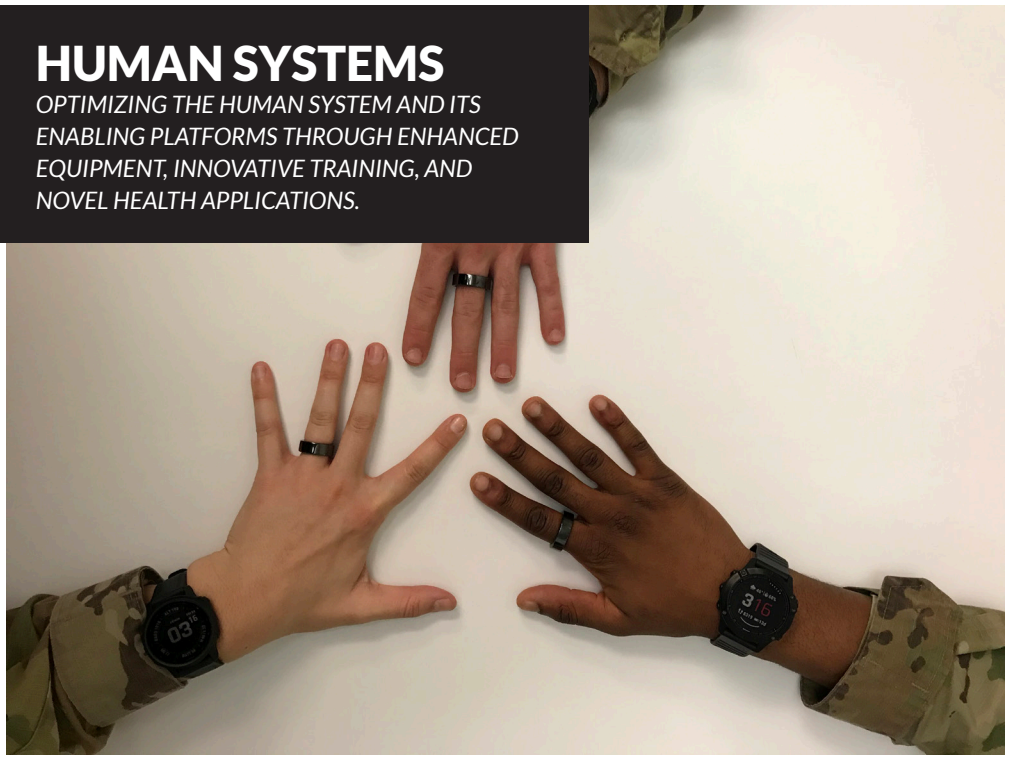
> **Vendor:** Zimperium, Inc.
> **Original Prototype Value:** $181,500
> **Transition Agreement:** Production OT with a $16.7M ceiling
> **Transition Partners:** Defense Information Systems Agency (DISA) and the Defense Information Technology Contracting Organization (DITCO)

Solution: Mobile endpoint security solutions manage security from a central portal, reducing security risks to mobile devices, networks, and individuals. Zimperium's solution combines a global sensor network with machine learning to predict and identify complex patterns that indicate risk overlooked by human analysts. Additionally, it provides autonomous, on-device threat detection and remediation for mobile devices, ultimately reducing adversaries' ability to successfully attack mobile devices or compromise DoD networks, even when the mobile devices are not on a network. The Zimperium solution was adopted by the Defense Information Systems Agency to protect up to 205,000 government-provided mobile devices.

> **"Zimperium is proud to be working with DISA and DIU to help protect the Department of Defense from adversaries threatening national security. Our mobile threat defense (MTD) solution will protect DoD mobile endpoints against phishing, malicious/risky apps, OS exploits and network attacks. This is an important milestone for Zimperium and the mobile security industry as a whole."** — Shridhar Mittal, CEO, Zimperium

HUMAN SYSTEMS

OPTIMIZING THE HUMAN SYSTEM AND ITS ENABLING PLATFORMS THROUGH ENHANCED EQUIPMENT, INNOVATIVE TRAINING, AND NOVEL HEALTH APPLICATIONS.



West Point participants receive their RATE wearables (Defense Innovation Unit)

LINES OF EFFORT

Lethality
Optimizing current capabilities and introducing new technology to continuously improve the warfighter's ability to shoot, move, and communicate.

Survivability
Leveraging biotechnology and biomedical applications to enhance warfighter performance, recovery, and detection capabilities.

Readiness
Introducing technology that advances warfighter training, personnel management, and testing capabilities to enhance force readiness.

ONGOING PRIORITY PROJECTS

CLEAN SWEEP

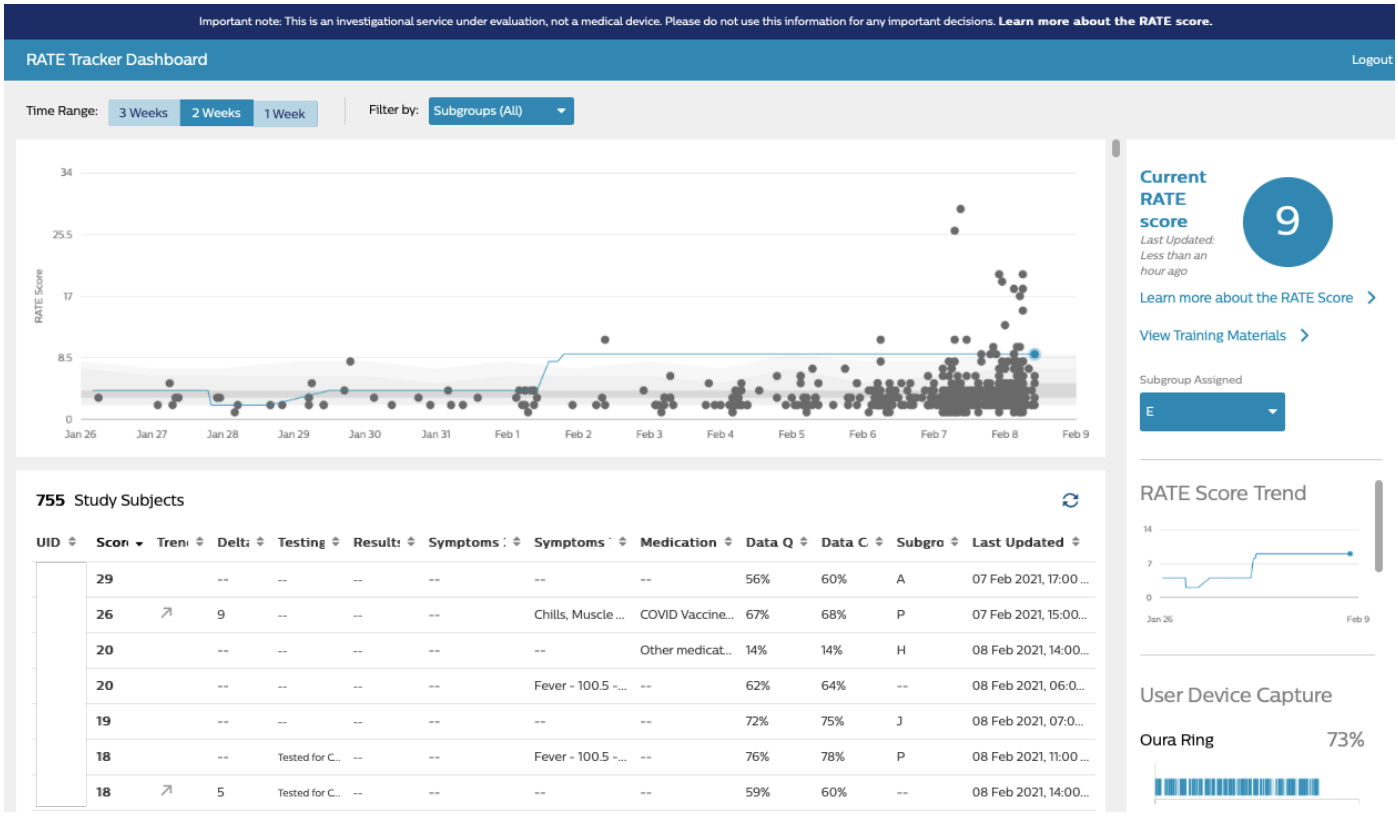
The COVID-19 crisis highlights the need for rapid decontamination and disinfection of rooms and spaces in shipboard environments to mitigate the spread of respiratory disease or infection. DIU is working with the Naval Medical Research Center's Advanced Medical Development Program Office (on behalf of the Defense Health Agency) to prototype repeatable, automated, and industrial solutions that significantly reduce the spread of infectious disease in these spaces while promoting the continuity of military operations, mission readiness, and individual warfighter survivability. During summer 2020, selection teams and subject matter experts supported the selection of four commercial vendors that leverage three main technology areas: antimicrobial surface coatings, ionized H2O2 plasma, and (mobile) UVC 254nm. Prototyping efforts with Navy laboratory and systems integration leads are planned through 2021.

PREDICTIVE HEALTH

Standard diagnostic procedures require healthcare practitioners to manually review large volumes of data to provide quality patient care. Though necessary, the process is time-consuming and frequently delays critical follow-on care. In extreme cases, when there is a shortage of clinicians, it can result in misdiagnosis, impacting servicemember readiness while increasing the cost of healthcare. DIU is partnered with the Defense Health Agency, the Veterans Health Administration, the Joint Artificial Intelligence Center, and several commercial companies to develop and test prototypes that combine clinical AI applications and augmented reality technology with current medical imagery platforms to assist practitioners in the diagnosis of abnormalities such as cancer. This type of solution has the potential to improve medical outcomes, reduce healthcare costs, and increase readiness.

**Predictive Health is co-managed by DIU's Human Systems and Artificial Intelligence portfolio.*

Capabilities Transitioned or Fielded in 2020



The RATE Commander's dashboard provides an anonymized overview of participant scores and symptoms to aid in decision making that reduces the community spread of communicable illnesses (Defense Innovation Unit).

RAPID ANALYSIS OF THREAT EXPOSURE (RATE)

TRANSITIONED 09 APRIL 2020

Problem: Non-battle related infectious diseases still account for the majority of illnesses encountered by warfighters in modern campaigns. Moreover, COVID-19 highlights the DoD's difficulty in operating in pandemics. Detecting potential illness before symptoms arise is critical to maintaining readiness in headquarters and operational environments.

Vendors: Philips, Garmin Ltd., Empatica Inc., and Oura Health Ltd.
Original Prototype Value: $1.8M
Transition Agreement: FAR-based contract
Transition Partner: Defense Threat Reduction Agency (DTRA)

Solution: RATE applies algorithms trained on longitudinal datasets of hospital infections to biometric data from commercial off-the-shelf wearables for early warning of infection up to 48 hours before symptoms appear. Early warning allows commanders to shift to a predictive medicine model when sick individuals are still in a pre-symptomatic window and capable of transmitting a virus. This model facilitates earlier diagnostic testing and treatment, earlier isolation of sick individuals to reduce community spread of communicable illnesses, and increases force readiness.

In April 2020, DIU leveraged our flexible Commercial Solutions Opening process to pivot ongoing RATE development to include early warning of COVID-19 infection. Within days of the physical rollout of wearables for the DIU-led effort, the team had their first successful detection of COVID-19; within six months, DIU scaled from 400 rollout participants to more than 7,000. Philips and Texas A&M University continuously refined the RATE algorithm based on the data received from the growing population group and collected more than 250 COVID-19 cases to achieve a precision rate of over 65% for COVID-19 detection as of the writing of this report.

SPACE

DEVELOPING ON-DEMAND ACCESS TO SPACE, PERSISTENT SATELLITE CAPABILITIES, AND BROADBAND SPACE DATA TRANSFER.



Capella Space image Palm Jumeirah in Dubai (SAR imagery provided by Capella Space).

LINES OF EFFORT

Persistent Reconnaissance for Peacetime Indications and Warning
Improving situational awareness with less-expensive, day/night, all weather imaging satellites capable of filling gaps in space-based reconnaissance.

Low Cost, Responsive Access to Mission-Designated Orbits
Precisely launching low-cost, commercial spacecrafts up to low Earth orbit (LEO) on demand.

Reduced Latency, Secure Hybrid, Communications, and Assured PNT
Addressing communication bottleneck of space assets, deliver timely and assured information to users on the ground.

Hardware to Software Transformation and Modernization
Modernizing and sustaining aging defense infrastructures at a fraction of the cost.

High Specific Energy Batteries and Power Management
Significantly increasing the duty cycle of space systems with high specific energy batteries.

On-Orbit Persistence, Logistics, and Operations Beyond LEO
Leveraging modular and scalable solutions to gain low-cost, responsive access to geosynchronous equatorial orbit (GEO), cislunar, and other exotic orbits beyond LEO and to constitute an in-space logistics infrastructure.

ONGOING PRIORITY PROJECTS

PEACETIME INDICATIONS AND WARNING

DoD has a critical need for improved situational awareness across all levels of operation during peacetime and contingencies when tactical or national capabilities are otherwise unavailable or prioritized to other key tasks. Joint, coalition, and allied forces require timely information derived from persistent reconnaissance capabilities that can be used for wide area patterns-of-life analysis, anomaly detection, or situational awareness. This problem is complicated by two conditions: Two-thirds of the Earth is covered in clouds, and half of the planet is always in darkness. Low-cost, commercial radar-imaging and small-satellite imagery, processed with advanced computer vision algorithms, can be leveraged to build peacetime indications and warnings during day, night, and all-weather conditions at the scale required to allow frequent revisits. This capability will help facilitate timely analysis of emerging threats, allowing the Joint Force to respond quickly, optimize the deployment of exquisite capabilities, and share unclassified data and insights with allies and partners. In 2020, DIU successfully demonstrated cloud-based, commercial synthetic aperture radar data and imagery for applications such as arctic monitoring, maritime domain awareness, and disaster relief.

MULTI-ORBIT LOGISTICS

Sustained U.S. superiority in space requires maneuvering with speed, precision, and efficiency in multiple orbits. Low-cost, responsive, routine access to GEO, cislunar, and other orbits beyond LEO will improve the flow of commerce and bolster power projection. Logistics commodities that can be transported include propellant, functional modules, repair parts, and ultimately commodities to support human operations in space. Commercial companies are beginning to develop reusable in-space transportation capabilities that can be leveraged for DoD needs while contributing to space economic development. DIU has engaged some of these companies to develop the first instantiations of a multi-orbit logistics infrastructure. The result should enable emerging Space Force missions such as cislunar space domain awareness, protection of geostationary assets, and operation in non-standard orbits.

Capabilities Transitioned or Fielded in 2020

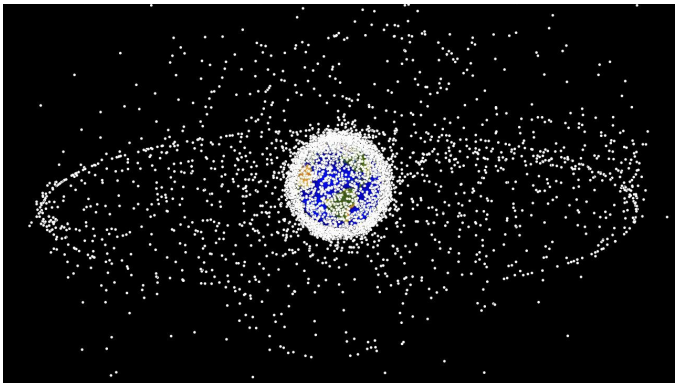
COMMERCIAL SPACE SITUATIONAL AWARENESS

TRANSITIONED 22 JUNE 2020

Problem: Currently, there are more than 1,500 satellites, 17,000 objects greater than 10 centimeters in diameter, and more than 150 million smaller objects orbiting Earth. With debris traveling in excess of eight kilometers per second, even the smallest of these objects can cause significant damage and potentially disable a spacecraft in orbit. Moreover, space control and traffic management are manpower-intensive activities, requiring automation to improve capacity and safety.

Vendor: LeoLabs, Inc.
Original Prototype Value: $3.7M
Transition Agreement: Technology Investment Agreement
Transition Partner: Space and Missile Systems Center

Solution: This DIU project augments the U.S. Air Force's current Space Domain Awareness/Battle Management, Command and Control (SDA/BMC2) architecture with a commercial layer. Focus areas include catalog maintenance; routine and dynamic sensor tasking; conjunction assessment; processing of events such as launches, maneuvers, anomalies, and breakups; and any other SSA/BMC2 mission. The LeoLabs solution is one of multiple prototypes pursued as a part of this project and is focused on delivering a real-time information feed about satellite activities in low Earth orbit (LEO) derived from a commercially provided network of phased-array radars. This information expands awareness of the LEO regime to facilitate the U.S. Space Command's mission of monitoring on-orbit threats and rapidly responding to changes in the threat environment.



Computer-generated image of objects in Earth's orbit, 95% of which are orbital debris (NASA).

Notably, the LeoLabs commercial solution is the second prototype against this problem set that DIU has helped to transition to the Space and Missile Systems Center. In 2019, ExoAnalytic Solutions delivered key electro-optical space object observation capabilities and successfully integrated commercial sector data into the Air Force's Open Architecture SDA Data Repository to localize debris and plan maneuvers.



ACCELERATING COMMERCIAL TECHNOLOGY FOR NATIONAL SECURITY

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