



DEFENSE  
INNOVATION UNIT

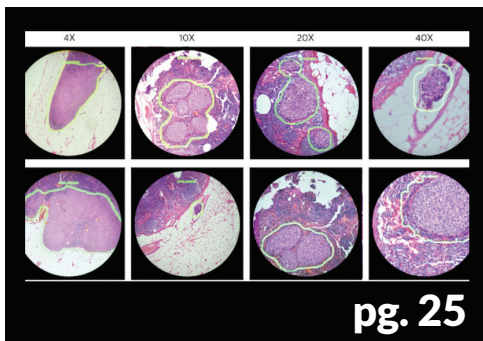
# ANNUAL REPORT 2019



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# From the Director



**The Defense Innovation Unit's** mission is to strengthen U.S. national security by increasing the military's adoption of commercial technology and growing the national security innovation base. Emerging commercial technologies are as necessary for global economic competitiveness as they are critical to maintaining America's military-technical advantage.

DIU ensures the military has access to these technologies and lowers barriers to entry for companies to do business with DoD. Yet, access is only meaningful so long as it also expedites DoD technology adoption at the speed of relevance. The 2018 National Defense Strategy crystallizes why this is important: "success no longer goes to the country that develops a new technology first, but rather to the one that better integrates it and adapts its way of fighting." DIU leverages flexible contracting authority and rapid prototyping to field advanced commercial technology to the U.S. military at commercial speeds.

Throughout 2019, DIU's driving focus was to generate outsized impact. In the closing months of 2018, we made significant organizational changes that set the stage for success by increasing our contracting capacity; focusing project selection criteria on transformative impact; and increasing the transition and fielding

rates of commercial solutions. Since we began contracting with companies in June 2016, DIU has facilitated over 160 contracts, welcomed 60 first-time vendors to DoD, and transitioned 16 new commercial solutions to end users across the Services, combatant commands, and defense agencies.

Additionally, DIU has deepened institutional relationships with venture capital firms and private investors, and built trust with commercial companies by establishing a clear, proven path to large-volume defense contracts. With our growing network of DoD partners and American entrepreneurs, we are delivering capabilities that save lives, inspire new operational concepts, increase efficiency, and scale across the Department while saving taxpayer dollars.

In this annual report, I am excited to share DIU's successes from the past year and the promising commercial technologies we've transitioned to DoD partners across the defense enterprise.

**Michael Brown**  
Director, Defense Innovation Unit

# Generating Outsized Impact

The Defense Innovation Unit (DIU) is the only Department of Defense (DoD) organization focused exclusively on fielding and scaling commercial technology across the U.S. military to help solve critical national security problems. We partner with organizations across DoD—from the Services and components to combatant commands and defense agencies—to rapidly prototype, deliver, and scale advanced commercial solutions that save lives, inspire new operational concepts, increase efficiency, and save taxpayer dollars.

## Elements of DIU's Mission

**Accelerate DoD adoption of commercial technology.** Speed is essential; U.S. service members should have access to the best technology as soon as it is safe to adopt. DIU relies on agile acquisition processes leveraging Other Transaction (OT) authority under 10 U.S.C. § 2371b and our Commercial Solutions Opening to award prototype agreements and test, field, and scale commercial technology in less than 24 months.

**Transform military capacity and capabilities.** DIU is focused on solving national security challenges that will help maintain U.S. military-technical advantage in a new era of strategic competition. We are selective about our projects and partners as we look for opportunities to provide technologies and methodologies with the potential to scale across services, platforms, and domains.

**Strengthen the national security innovation base.** Our prosperity and security as a nation is greatest when partnerships between government, business, and academia are strong. DIU is establishing DoD relationships with leading commercial technology companies that have never before done business or rarely work with the Department.

In 2019, we executed our mission with a focus on generating outsized impact. Compared to many other DoD entities, DIU is relatively small both in terms of budget and manpower: our total fiscal year (FY) 2019 budget was \$44 million and we employ 65 full-time equivalent staff. Since we were established in 2015, DIU has grown to expand project throughput while keeping our organization lean. Headquartered in Silicon Valley with offices in Boston, Austin, and in the Pentagon, it's our job to be DoD's force multiplier when it comes to acquiring commercial solutions to enterprise or operational challenges.

Commercial innovators are operating at the leading edge in artificial intelligence (AI), machine learning, autonomy, cybersecurity, biotechnology, launch (space), and big data analytics, among other fields. These technologies are the subject of fierce global competition and are already having an impact on how we fight on and off the battlefield. DoD adoption of commercial technology has never been more critical as U.S. businesses are spending three times what the federal government does on research and development (R&D) and federal, defense-

related spending accounts for only 4% of global R&D (compared to 36% in 1960).<sup>1</sup> Leveraging commercial investment in R&D allows the Department to buy leading dual-use technology while optimizing DoD's non-recurring science and engineering resources for vital, uniquely military, modernization priorities. DIU exists to ensure DoD has a pathway to rapidly prototype, modify, and field the best commercial technologies that solve national security challenges. To generate outsized impact in 2019, we aligned organizational resources and refined internal processes to increase contracting capacity, enhance our DoD partnerships, strengthen ties to venture and founder communities, and coordinate within the defense innovation ecosystem to ensure that the solutions we deliver have the greatest possible impact.

## Increased Contracting Capacity

Prior to 2019, DIU awarded all contracts through third party contracting offices within DoD. Just a few weeks into 2019, we received all delegated authorities and designations required to begin awarding our own OT agreements under 10 U.S.C. § 2371b, streamlining the process for many of our projects. The Office of the Under Secretary of Defense for Acquisition and Sustainment delegated contracting authority to DIU and, in February 2019, selected our Senior Contracting Official. We augmented our Acquisition Team with additional agreements officers and awarded the first internally-managed prototype-OT agreement in July 2019.

DIU's Acquisition Team is responsible for managing the processes that allow us to operate at commercial speeds and field proven commercial solutions. This team works alongside our project managers from project inception, through the CSO process, to award, and finally, transition to production-OT agreements or procurement contracts.



Smartwatch being prototyped by DIU in partnership with commercial and DoD partners that can identify and warn an individual if they are contracting a virus before their symptoms appear (Department of Defense)

<sup>1</sup>The Global Research and Development Landscape and Implications for the Department of Defense," Congressional Research Service, November 8, 2018, 4, <https://fas.org/sgp/crs/natsec/R45403.pdf>; National Science Foundation, National Center for Science and Engineering Statistics 2019. National Patterns of R&D Resources: 2016-17 Data Update. NSF 19-309, <https://nces.nsf.gov/pubs/nsf19309>.

Expanding acquisition capacity is critical to support our increasing number of projects. Our partnerships with Army Contracting Command–New Jersey (ACC-NJ) and Washington Headquarters Services–Acquisition Directorate, which both award agreements on behalf of DIU, continue to be huge assets to our operation. The addition of our own authority and growing Acquisition Team not only increases our overall contracting capacity but also allows DIU to more flexibly manage new starts, projects in execution, and successful transitions.

## The Spread of the Commercial Solutions Opening

In 2016, DIU pioneered and launched the CSO process in partnership with ACC-NJ. The CSO process is designed to competitively award prototype-OT agreements on commercial terms at commercial speeds, focusing on outcomes over requirements and incentivizing new entrants to the defense market to do business with DoD. If a prototype agreement is successfully completed, OT authority allows for a noncompetitive, follow-on production-OT agreement. Combined, the CSO process and OT authority enable DIU to prototype, test, deliver, and scale advanced commercial solutions to national security problems.

The FY 2017 National Defense Authorization Act authorized the CSO process for use across DoD and its adoption as a competitive process was further propagated by a June 2018 Defense Federal Acquisition Regulation Supplement class deviation and the Department's 2018 OT Guide.

**As of the end of 2019, a number of other federal government organizations have embraced the CSO and implemented their own versions of the process:**

- Department of the Air Force
- Department of the Army
- Department of the Navy
- United States Special Operations Command
- United States Cyber Command
- General Services Administration
- Defense Intelligence Agency
- Washington Headquarters Services

## Strengthened Stakeholder Engagement

Over the past four years, DIU has built and strengthened relationships with the communities and companies across the United States that are at the forefront of innovation in dual-use technology. Our private sector partners trust us to provide opportunities to solve “wickedly-hard” challenges and a fast, transparent, and easy-to-navigate path to large-volume defense contracts. The strength and quality of DIU's network enables us to help companies deliver leading technology-based solutions to our DoD partners and American men and women in uniform.

DIU actively seeks challenges and DoD partners that benefit from commercial solutions that transform how the Department does business or delivers new capabilities. However, DIU's role doesn't end when a prototype is complete; successful project transitions from prototype to production are critical to technology adoption and require careful coordination between operators, program offices, and leadership. We guide our DoD partners and commercial companies through this process to get solutions into users' hands as quickly as possible and scale them to others in DoD who face similar challenges.

Our Commercial Engagement and Defense Engagement Teams, who completed their first full year of operations in 2019, have improved DIU's ability to serve as a trusted advisor to innovative companies and DoD partners.



Major Zach Walker represents DIU at Carahsoft's 2019 Cybersmart conference in Austin, TX (DIU)

**The Commercial Engagement Team: DIU's Interface to Industry**

DIU's Commercial Engagement Team (CET) engages founders, early-stage companies, investors, and the traditional defense industry to illuminate opportunities in the defense market, signal areas of interest, share open DIU solicitations, and translate DoD contracting vehicles into commercial terms.

**Commercial Engagement Team Objectives:**

- Deliver seamless DoD acquisition experience to commercial companies
- Provide insight into DoD for venture capitalists and their portfolio companies
- Ensure a strong bench of suppliers for each solicitation
- Foster private investment into commercial companies that are relevant to national security

The CET has been instrumental to DIU's success in improving industry perceptions about doing business with DoD. Commercial companies and leading investors are often apprehensive about selling to DoD because the defense market is unfamiliar and the complexity of DoD acquisitions is discouraging. DIU's goal is to make decision processes speedier and more transparent to attract smaller, non-traditional businesses to engage with the Department. We aim to demonstrate that DoD organizations are an important customer segment that can increase company value such that investors encourage portfolio companies to pursue the Department as a customer.

In 2019, the CET reinvented the engagement experience for commercial companies. This improved experience focused on early communication, transparency, speed, and rapid scaling to address companies' concerns about entering the defense market. The CET understands the capabilities of companies leading innovation in dual-use areas, ensures they are familiar with the DIU process, and serves as an ongoing resource to scale their defense-related business. Successful DIU projects have positioned DIU solicitations as a reliable demand signal for investors. Renewed investor confidence in DoD opportunities has catalyzed broad-based participation in DIU-led projects by commercial companies and we are beginning to see a trend of companies returning to bid on multiple DIU projects over time.

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**“The team at DIU has dramatically reduced the friction for a startup to understand how to engage with and supply products to the government; we view DIU’s role in the DoD as a critical and highly valuable service.”**

— David Ulevitch, General Partner at Andreessen Horowitz

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#### **The Defense Engagement Team: Building a DoD Partner Pipeline**

The Defense Engagement Team (DET) works across the Department to shape new opportunities, build and maintain DoD relationships, and drive DIU’s successful, transformative projects through prototype execution to be transitioned, fielded, and scaled to additional DoD users.

#### **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 environment.

Getting technology into the field is no easy feat. First and foremost, the DET engages DoD partners to understand their most pressing needs and whether DIU can help meet these needs with commercial technology. In 2019, the DET worked to identify and implement project and DoD partner selection criteria that, if met, provide a strong foundation for prototype success and subsequent transition and technology adoption. DET members are either active duty military or have past military experience and represent each of the Services; they are well qualified to understand the complexities of engaging DoD as a customer.

Even if a technology is proven successful as a prototype, often, several DoD organizations must work together before that technology can be fielded. The DET team shepherds projects by engaging each of the relevant DoD stakeholders as early as possible, in parallel. By bringing together the end users, headquarters organizations, and acquisition organizations at the beginning of a project, the DET is increasing the likelihood of fielding a successful prototype.



## Aligned Defense Innovation Efforts

The broader DIU family grew last year with the addition of the National Security Innovation Network (NSIN), which was aligned to report through DIU in early 2019. NSIN is well known for their Hacking 4 Defense program that pairs top university students with DoD end users to collaboratively solve real-world defense problems over the course of a semester.

### NSIN Lines of Effort

1. Creating new opportunities for technologists and entrepreneurs to engage in national security service
2. Collaborating with academia and early-stage venture community to develop novel concepts and solutions to warfighter problems
3. Accelerating the adoption of those solutions by the Department through better DoD partner discovery

NSIN exceeded each of its organizational goals for FY 2019; its accomplishments included adding 596 individuals and 132 start-ups to the NSIB; achieving a 73% solution adoption rate by DoD partners for novel concepts and solutions developed through its programs; stimulating the launch of 43 new dual-use ventures through enhanced access to its DoD partners; and facilitating the launch of 14 new dual-use ventures using extant DoD lab technology. NSIN also broadened the infrastructure of its physical network by placing full-time, embedded personnel at Indiana University, Washington University at St. Louis, Arizona State University, and the University of California at Berkeley in addition to their existing work with more than 35 universities and five commercial incubators and accelerators throughout the country.




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**“NSIN is building a physical and virtual network that can connect universities, early-stage ventures, and our DoD partners for the express purpose of collaborative, project-based problem solving. Through the network, which is still nascent, we’re literally redefining what national security service can mean for individuals and start-ups by removing barriers like geography, lexicon, and access to end users from within DoD.”**


— Morgan C. Plummer, Managing Director of NSIN

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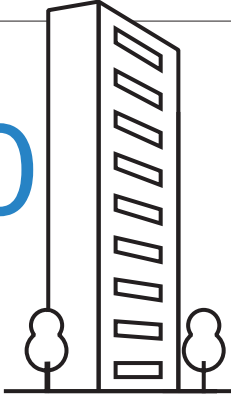

DIU and NSIN’s complementary missions help grow different communities within the NSIB by attracting talent, investing in new vendors, lowering barriers to entry into the defense market for new entrants, and commercializing cutting-edge technologies for our military. These combined efforts are an important counter-strategy to China’s civil military fusion initiative.

# Metrics & Performance

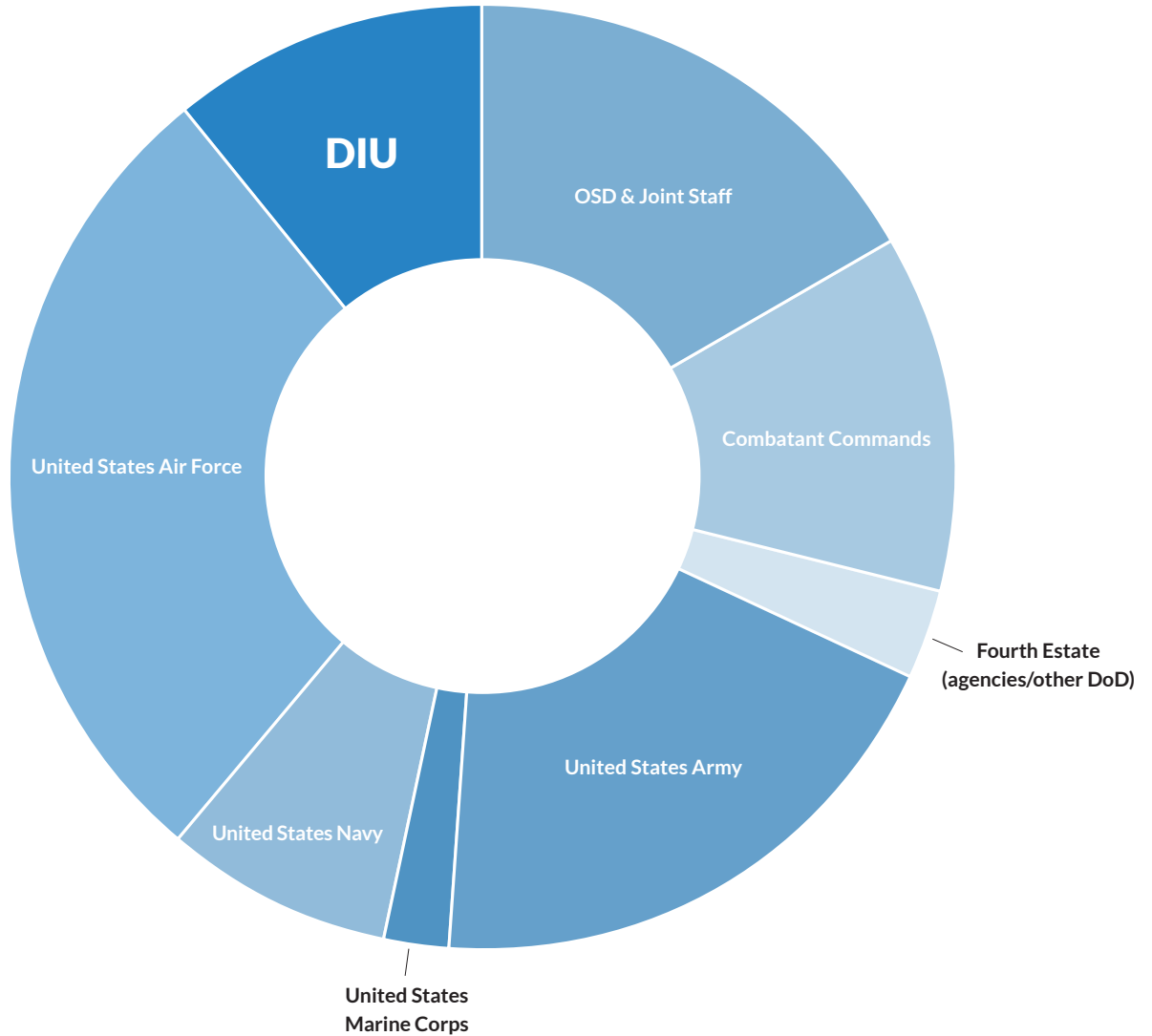
## 2019 Snapshot

|   |  |   |
|---|--|---|
| <p><b>17</b></p> <p>Solicitations for commercial solutions posted on diu.mil</p>  | <p><b>466</b></p> <p>Commercial proposals received</p> | <p><b>63</b></p> <p>Contracts awarded to commercial companies</p>   |
| <p> <b>8</b> Commercial solutions transitioned to DoD partners</p>                 |  | <p><b>\$114.2M</b></p> <p>has been obligated towards DIU agreements with commercial companies, and the ceiling for production-OTs amounts to...</p> |
| <p><b>127</b><br/>DAYS</p> <p>It took an average of 127 days to days make the first contract award after a solicitation closed. That's 42% faster than in 2018.</p> |  | <p><b>\$293M</b></p> <p>in sum total for OT transitions in 2019.</p>  |

## June 2016 – December 2019

|   |   |  |
|---|---|--|
| <p><b>72</b></p> <p>Projects have been initiated to solve DoD challenges and...</p> | <p><b>362</b><br/>DAYS</p> <p>On average, DIU prototypes spend 362 days in execution before they are eligible for transition.</p> |  |
| <p><b>33</b></p> <p>Projects have been completed.</p>                               | <p><b>\$9B</b></p> <p>Private investment leveraged</p>  | <p><b>120</b></p> <p>Nontraditional vendors and...</p>                          |
| <p><b>16</b></p> <p>Commercial solutions transitioned to DoD partners</p>           | <p><b>166</b></p> <p>Contracts awarded to commercial companies</p>  | <p><b>60</b></p> <p>First-time DoD vendors have been awarded DIU contracts</p>  |

## Prototype Funding Breakdown: June 2016 – December 2019



*DoD Partner Share of Prototype Funding: 89%*

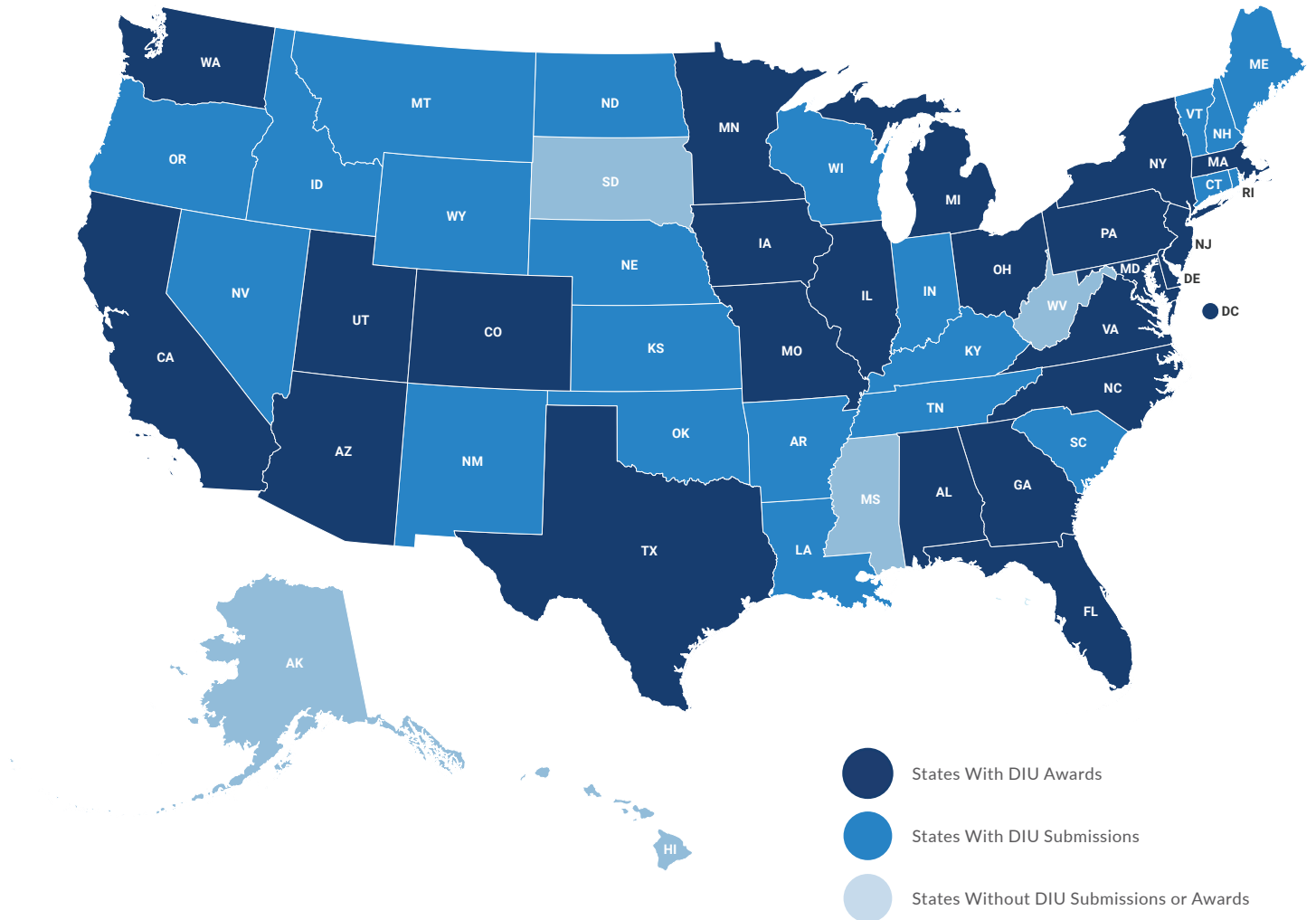
- OSD & Joint Staff
- Combatant Commands
- Fourth Estate (agencies/other DoD)
- United States Army
- United States Marine Corps
- United States Navy
- United States Air Force

**DIU** } *DIU Share of Prototype Funding: 11%*

**TOTAL: \$451.9M**

## Growing the National Security Innovation Base

As of December 2019, DIU has welcomed proposals from more than 1,400 companies across 45 states and the District of Columbia. We have awarded prototype agreements to more than 140 companies from 23 U.S. states, the United Kingdom, Canada, France, and Israel.



### DIU does the most work with...

**California:** 69 Awards; \$232.7M  
**Virginia:** 15 Awards; \$77.9M  
**Missouri:** 3 Awards; \$58.5M  
**Arizona:** 3 Awards; \$41.7M  
**New York:** 5 Awards; \$21.7

**Pennsylvania:** 5 Awards; \$20.3M  
**Florida:** 9 Awards; \$19.5M  
**Massachusetts:** 10 Awards; \$16.9M  
**Washington:** 5 Awards; \$14.6M  
**Texas:** 6 Awards; \$5.4M

# Technology Focus Areas

## Artificial Intelligence

*Applying artificial intelligence and machine learning to accelerate critical decision making and operational impact.*



The DoD collects and analyzes vast amounts of data from a wide variety of sensors; AI and machine learning help optimize data-driven decision making. MQ-9 flight simulator (Airman 1st Class Quion Lowe/U.S. Air Force)

### About

The AI Portfolio is focused on applying commercially viable artificial intelligence and machine learning solutions to accelerate critical decision making and operational impact for DoD's mission. To date, DIU has applied AI to improving air and land vehicle readiness across the Army, Air Force, and Marine Corps, bringing the full force of imagery detection and analysis algorithms to fighting wildfires at home and abroad, and developing multi-sensor analytics at speed for increased air threat response capabilities.

### Lines of Effort

#### Machine Learning Predictions

Whether it is understanding three or 30 years of historical data or tracking real-time performance from millions of sensors across an electrical grid, AI powers mission readiness and reduces costs. However, with data-enabled trending and predictions not only can things be fixed before they break, so can people.

### Big Data Analysis

The sheer amount of data that is generated from sensors on a daily basis makes human processing and analysis impossible, let alone identifying the critical signal amidst the noise. Our portfolio is tapping into commercial big data analysis capabilities to understand adversarial positioning.

### AI-Enhanced Decision Making

Managing disparate data feeds from various sensors slows our ability to provide decision options at speed. Harnessing commercial capabilities such as financial modeling and insurance risk projections can inform target identification, tracking classification, real-time threat assessment, mission maps, and post-disaster damage assessments.

## Autonomy

*Adopting and countering autonomous systems with a focus on human-machine interaction and scalability.*



Autonomous  
Tactical Airborne  
Drone prototype  
transitioned to  
production in 2019  
(Shield AI)

### **About**

Unmanned and autonomous systems are a demonstrated force multiplier for DoD. The Autonomy Portfolio leverages commercial industry to prototype systems on land, in the air, and at sea. The commercial unmanned systems industry enables DoD to rapidly field leading-edge technology to operate more effectively and in spaces that may be inaccessible to legacy systems used today.

Recent fielded capabilities include multidisciplinary counter-unmanned aerial systems (C-UAS) employed today both in and outside the continental United States, autonomous quadcopters designed for indoor flight and tactical early warning, remotely operated underwater explosive disposal robots, and software to harden commercial drones against cyber vulnerabilities.

### **Lines of Effort**

#### Maritime Autonomy

The collection of maritime surface and subsurface data is often expensive and dangerous. DIU's maritime autonomy efforts act as a force multiplier by fielding faster, cheaper, and more effective autonomous, unmanned, or remotely operated vehicles that remove divers from minefields and displace manned vessels from hazardous waters.

### Unmanned Aerial Systems

The DoD's current unmanned aerial system (UAS) inventory does not provide adequate tactical intelligence, surveillance, and reconnaissance options for small units. U.S. Service members don't have the ability to employ small UAS (sUAS) for tactical applications while our adversaries are free to employ cheap but effective consumer drones. DIU is working with the commercial sUAS industry to field new systems that enhance our military's sUAS capabilities.

### Counter-UAS

Small UAS pose unique threats to DoD and other government agencies. These drones are typically inexpensive and easy to use. They can serve as effective out-of-the-box intelligence collection platforms and can be weaponized. DIU is engaged in a number of projects that deliver low-cost detect and defeat solutions for both mobile and fixed site security.

### Ground Autonomy

Our ground autonomy efforts are primarily focused on fielding additive manufacturing capabilities and unmanned ground vehicles. Ongoing projects aim to reduce the costs of DoD infrastructure construction both domestically and in expeditionary missions.

## Cyber

*Making enterprise combat information open, accessible, and secure for defense personnel across the globe.*



Cyberspace  
Operations  
Specialists (Steven  
Stover/U.S. Army)

### **About**

To help DoD improve cybersecurity capabilities that protect the U.S. military and defend the nation, the Cyber Portfolio delivers transformative cybersecurity and enterprise information technology solutions that aid cyber warfare operators and analysts projecting cyber power for national security. Recent prototype projects include a deception network to observe, deceive, disorient, and disrupt malicious cyber activities and mobile endpoint security for on-device threat detection and remediation for enterprise security. Recent fielded projects include the procurement of commercial threat data to reduce man hours searching deep and dark web for threat and intelligence information.

## Lines of Effort

### Assess Threats

Identify and assess cyber threats to help secure DoD systems, enhance situational awareness, and better understand adversaries.

### Secure

Secure systems to ensure DoD can continue operations in the face of disruptive or destructive cyber attacks.

### Defend

Defend DoD systems from cyber attacks that attempt to adversely affect the confidentiality, integrity, or availability of these systems.

### Enable

Field capabilities that enable DoD to attack and exploit the weaknesses of an adversary's military and related networks.

## Human Systems

*Optimizing the human system and its enabling platforms through enhanced equipment, innovative training, and novel health applications.*



A U.S. Marine secures an oxygen mask (Lance Cpl. Jesse Carter-Powell/ U.S. Marine Corps)

### About

American men and women in uniform are the cornerstone of U.S. military strength. The Human Systems Portfolio is focused on bringing cutting edge commercial technologies to the warfighter that optimize readiness, survivability, and lethality through the introduction of innovative training, novel health applications, and enhanced equipment. The portfolio spans numerous commercial industries and products ranging from biotechnology, wearable technology, digital health, and diagnostics to virtual reality, healthcare, communications and networking, 3D printing, and assistive tech, among others.



Recent prototype projects include medical imagery tools that assist in the diagnosis of cancer for improved medical outcomes; smart watches containing algorithms that can identify and warn an individual if they are contracting a virus before their symptoms appear; and wearable biometric sensors that monitor military pilots during flight for early detection and warning of a physiological episode.

**Lines of Effort**

Lethality

Optimizing current capabilities and introducing new technology to continuously improve the warfighters 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.

**Space**

*Rapidly fielding on-demand access to space, persistent satellite capabilities, and broadband space data transfer.*



Rocket Lab launch in May 2019 as part of DIU's Small, Responsive Launch project (Rocket Lab)

**About**

The Space Portfolio facilitates DoD partners' access to new and emergent commercial space technology to address capability gaps, increase situational awareness to improve decision making, strengthen the U.S. space industrial base, improve interoperability with partners and allies, and contribute to the preservation of U.S. dominance in space.

Projects launched in 2019 include Orbital Outpost, which seeks to provide an on-orbit autonomous platform-as-a-service for experimentation and concept of operations development. Through our Peacetime Indications and Warning project, we also helped facilitate preparatory contracts between the National Reconnaissance



Launch Complex 2  
at Wallops Island  
(Rocket Lab)

Office and commercial GEOINT-as-a-service providers: Planet Federal and Capella Space. Additional accomplishments include launching three Air Force experimental satellites to low Earth orbit with Rocket Lab USA; the opening of Launch Complex 2 at Wallops Island, VA; and the transition of ExoAnalytic Solutions commercial space situational awareness services to the U.S. Space Force through the Space and Missile Systems Center.

### **Lines of Effort**

#### *Peacetime Indications & Warning*

Improve situational awareness and support decision makers by leveraging small, low-cost imaging satellites with a range of sensing modalities (such as commercial synthetic aperture radar for day/night, all weather reconnaissance) combined with advanced computer vision algorithms to build capacity and broaden our focus for pattern-of-life analysis for early indications and warning of imminent threats.

#### *Responsive Access to Mission-Designated Orbits*

Adopt commercial launch-as-a-service to improve flexibility to launch spacecraft and various payloads from air, land or sea; enable precision delivery of payloads to prescribed orbits with minimal delay; and increase launch cadence and capacity to ensure resiliency through responsive access to space.

#### *Reduced Latency Communications & GPS Resiliency*

Provide a scalable means to meet the future needs of DoD satellite control networks and enable Service members to navigate on the ground through GPS denied or degraded signal environments.

#### *Hardware-to-Software Transformation Modernization*

Modernize critical legacy hardware systems using new, adaptable approaches, such as software-defined systems, that extend the life of hardware, improve capabilities, and eliminate the challenge of parts obsolescence.

#### *Multi-Orbit Operations & Logistics*

Provide low-cost, responsive access to geostationary and other exotic orbits as well as new nodes for logistics and in-space developmental tests using new and emergent commercial space capabilities as a service.

# Select Projects

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## Predictive Maintenance

2019 saw transformative potential realized in several of our ongoing projects, but none more so than in Predictive Maintenance. DIU opened the Predictive Maintenance solicitation in July 2017 on behalf of the U.S. Air Force (USAF) and, as of November 2019, the solution prototyped by C3.ai transitioned to a production-OT agreement and is scaling across the Services to change the Department's approach to condition-based maintenance.

The goal of the prototype effort was to increase aircraft readiness and availability through a reduction in the frequency and duration of unscheduled maintenance. Providing maintainers with the tools to understand, prior to failure, when to change key components (and ensure component availability) would also decrease the number of maintenance related mission aborts. DIU and the USAF supported four prototype implementations of the C3.ai readiness application to over 920 aircraft including the E-3 Sentry, C-5 Galaxy, and F-16 Fighting Falcon aircraft.

### DIU Solicitation: Predictive Maintenance

The DoD is seeking software for predictive or condition-based maintenance. Solution must be capable of integrating both historical structured (e.g. sensor reports) and unstructured (e.g. maintenance logs) datasets. Solution will need to apply machine learning to optimize maintenance schedules and provide analysis and recommendations at both a component and system level. Companies must have previously delivered predictive maintenance platforms to commercial customers, preferably in the aviation sector.

The prototype effort was successful in demonstrating AI and machine learning techniques to improve readiness. Specifically, in advance of failures, supervised machine learning can accurately predict the probability of failure of various subsystems over different time horizons. As a result, maintenance technicians are able to identify component-level failures before they occur, pre-position parts in anticipation of failures, and replace components with a high potential for failure.

Prototype implementations of C3.ai technology in partnership with the USAF demonstrated the potential for a 3-6% improvement in mission capability; up to a 35% reduction of base-level occurrences of aircrafts sitting on the ground awaiting parts; and up to a 40% reduction in unscheduled maintenance events. The prototype also demonstrated minimal impact to component part supply chains and identified 80-90 parts (out of more than 1000) that are responsible for 90% of total aircraft downtime. Additionally, the potential readiness benefits from adopting predictive maintenance tools are achievable across aircraft types, data quality, and data source.



Maintainers  
troubleshoot electrical  
faults on a C-5 Galaxy  
(Staff Sgt. Devin  
Nothstine/U.S. Air Force)

**“DIU is changing everything about U.S. Department of Defense procurement, allowing DoD to immediately access breakthrough technologies as they are developed in the private sector. This is a critical requirement for the DoD to continue to succeed in the rapidly changing 21st century technology landscape.”**

— Thomas Siebel, CEO of C3.ai

As an OUSD organization, DIU can scale successful prototype efforts across DoD through production-OT contracts. DIU sponsored the current up-to-\$95 million production-OT agreement that allows all Services and other federal agencies to procure C3.ai’s software for aircraft predictive maintenance. 2020 goals include increased use by U.S. Army Aviation for its UH-60 Blackhawk and AH-64 Apache helicopter platforms and adoption by the F-35 Joint Strike Fighter Lightning II Joint Program Office. When fully implemented across all DoD aircraft, Predictive Maintenance has the potential to save the Department up to \$5 billion annually.

## Cyber Threat Intelligence

In 2017, DIU began working with U.S. Cyber Command (USCYBERCOM) to find a commercial technology solution that would allow the government to analyze commercial and open source data about cybersecurity threats and malicious activity. In September 2019 USCYBERCOM awarded a follow-on production-OT agreement to Recorded Future to provide real-time commercial threat reporting in support of specified cyber threats to the Department.

**DIU Solicitation: Cyber Threat Intelligence**

DoD lacks visibility into the vast amount of public, private, and open source data associated with cyber intrusions. Combined, this data is necessary for maintaining situational awareness and understanding threat actors. DoD seeks a solution that incorporates commercial cyber threat data into intelligence analysis and production, training, and operations. Additional information regarding threat data source, data timeliness, global insights, and access to subject matter experts for further analysis is desirable. Solutions will only be accepted from companies who directly provide the product or solution. Companies must demonstrate commercial viability.

The goal of the prototype was to improve DoD visibility into the vast amount of public, private, and open source data associated with cyber intrusions. Recorded Future provided a solution that empowers USCYBERCOM to understand the characteristics of malicious cyber activities and actors by combining commercial and government data for real-time analysis and decision making. The effort led to a reduction in man hours previously spent searching deep and dark web for threat intelligence, allowing operators to focus on exclusively government capabilities or classified information.

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**“From prototype to production, DIU’s partnership on the USCYBERCOM contract helped not only reinforce bridges between public and private organizations, but allows us to better secure federal government infrastructure by giving those on the front lines of cyber defense the context they need to make critical decisions.”**

— Dr. Christopher Ahlberg, Co-Founder and CEO, Recorded Future

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The successful transition of Recorded Future’s threat intelligence platform is enabling DoD cyber operators and threat analysts to leverage real-time threat intelligence data and curated reports. In addition to the increased speed of data accumulation and analysis, this solution demonstrates a successful model for safely sharing intelligence that would otherwise be deemed classified.

## **Next Generation Explosive Ordnance Disposal Underwater Response Vehicle**

In July 2019, the U.S. Navy (USN) Explosive Ordnance Disposal (EOD) Program Office awarded two production-OT agreements—one to Video Ray LLC and the other to Strategic Robotic Systems—for remotely operated vehicles (ROVs) for next generation EOD underwater response. DIU opened the EOD underwater response vehicle solicitation in January 2018 on behalf of the Navy and, today, two of the three ROVs that were a part of the DIU prototype are now in use by the Fleet, improving countermeasures and reducing the risks faced by EOD service members.

Maritime mines, explosives, and other hazards can disrupt the Navy’s ability to project power and maintain open sea lines of communication, threatening freedom of movement for DoD, our allies, and global commerce. The USN EOD technician community is tasked to render safe all types of explosive threats, including underwater mines and improvised

explosive devices. In some situations, EOD divers were required to physically approach unidentified devices in the water. The goal of DIU's prototype efforts was to provide the Navy with a modern ROV countermeasure that was safer for technicians, more portable, modular, and compatible with other technologies and platforms used for EOD missions.



Task Group 56.1 operates the Video Ray unmanned underwater vehicle (Mass Communication Specialist 2nd Class Taylor M. Smith/U.S. Navy)

#### **DIU Solicitation: Next Generation Explosive Ordnance Disposal Underwater Response Vehicle**

The Department of Defense is seeking a demonstration-ready, remotely-operated system to detect at distance, accurately navigate to and reacquire based on a geo-reference, and optically and acoustically inspect explosive threats located in maritime and littoral environments at sea, and in ports and harbors. The system must be man-portable, deployable from a small rubber/inflatable boat within one-half of the available deck space with a minimal setup time, and operable for extended periods in an expeditionary environment. The system must have automated control capabilities, and a physical and operating architecture capable of hosting compatibly designed third party payloads and autonomy engines that can be reconfigured in the field.

The ROVs tested incorporate new levels of autonomy providing station keeping, way point planning and navigation, and other features, which allow the ROVs to be operated from a distance as opposed to actively controlled in dynamic water conditions. The intuitive ease of use greatly reduces training time for operators, decreases the rate of accidents, and improves mission functionality. The size, weight, and portability of the ROVs also allow them to be transported and deployed by one or two people where legacy systems had been too large to fit into the small boats used by EOD technicians. As a result of their smaller form factor, the ROVs leveraged state-of-the-art sonar and manipulator systems, improving the Navy's countermeasure toolkit.

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**“Working with DIU was an incredibly refreshing experience; they renewed our faith in the process.”**

— Jesse Rodocker, SRS President

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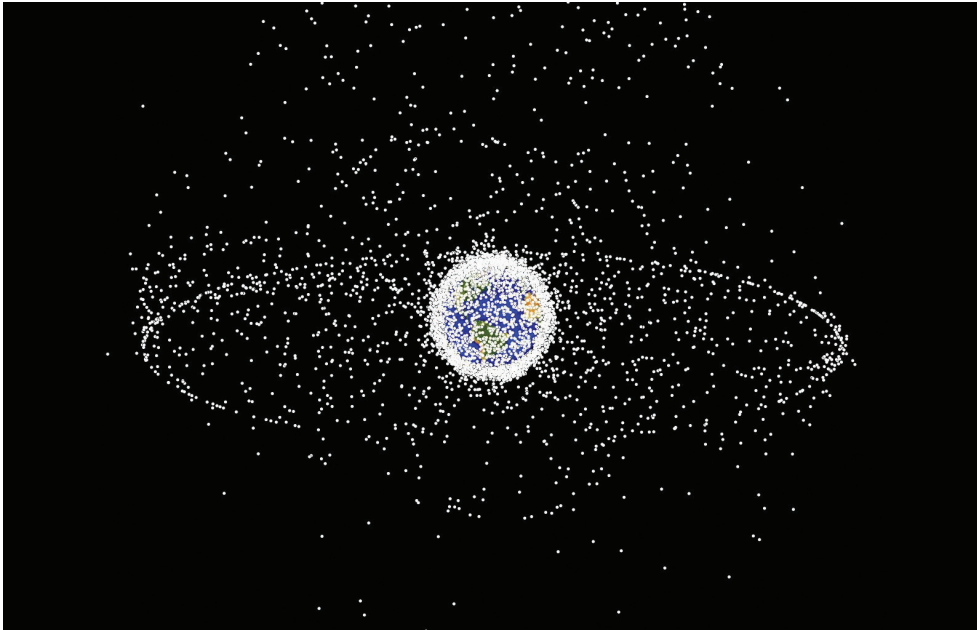
Today, both the Video Ray and Strategic Robotic Systems maritime EOD robots are being fielded by the USN. These ROVs allow EOD technicians to safely and immediately investigate unidentified devices in the water, whereas prior operational procedures required divers to approach devices after a 24-hour waiting period. Furthermore, faster EOD mission response times allow for straighter vessel courses and fewer unscheduled changes to ship deployments. In approximately 18 months after soliciting commercial proposals, DIU helped the USN identify, prototype, and deploy commercial solutions that help keep divers out of minefields and increase maritime mobility. This represents a tactical capability with strategic implications for the Navy and U.S. power projection.

## Commercial Space Situational Awareness

Space debris moving at over 22,000 miles per hour threatens to damage military satellites, spacecraft, and personnel. DIU prototypes augmented the U.S. Air Force’s current Space Situational Awareness architecture with a commercial layer, leveraging machine learning to view, characterize, and predict the changing physical location of natural and manmade objects in orbit around the Earth. In July 2019, Space and Missile Command (SMC) issued a FAR-based production contract to ExoAnalytic Solutions after they successfully demonstrated these capabilities through a DIU prototype; SMC is in the initial stages of transitioning additional successful prototypes in 2020.

### **DIU Solicitation: Commercial Space Situational Awareness**

DIU is seeking mature commercial solutions from U.S. companies to address the ability to view, characterize, and predict the changing physical location of natural and manmade objects in orbit around the Earth. This initiative will explore augmenting the U.S. Air Force’s current Space Situational Awareness/Battle Management, Command, & Control (SSA/BMC2) architecture with a commercial layer. Areas of interest include catalog maintenance; routine and/or dynamic sensor tasking; conjunction assessment; processing of events such as launches, maneuvers, anomalies, and breakups; and any other SSA/BMC2 mission. Proposed solutions should be offered in the form of a commercial business model (e.g., commercial services, subscription, or software license) and be capable of a functional demonstration within 90 days of award. Proposals should address the use of, and requirements for, any commercial or other data, describe any additional network access requirements, and include an initial high-level operational concept and a construct for prototype demonstration.



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

The ExoAnalytic prototype demonstrated significant operational utility to the national security space enterprise, specifically including the ability to maintain a catalog, dynamically task sensors, perform conjunction assessment, and provide custody during events such as launches, maneuvers, and relocations. This effort delivered over 80,000,000 observations and 100,000 orbits to over 90 consumers; the volume of observation data was roughly three times that delivered by existing Air Force electro-optical sensors at a cost of \$0.04 per correlated observation. Several successful classified operational use cases were also demonstrated using the orbit data. Finally, the large number of data consumers, enabled by leveraging the Unified Data Library, validated the utility of an “Open Architecture SSA Data Repository” as described by the June 2018 Presidential directive, Space Policy Directive-3: National Space Traffic Management Policy.

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**“This is what I’ve been asking for for four years.”**

— General Raymond, Commander of Air Force Space Command

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The ability of commercially-provided data services to detect and track space-based resident space objects is growing in scale and capability. The scope and magnitude of the Space Situational Awareness mission ranges from safety of flight to providing protection and defense of national space capability, in an area surrounding the Earth at altitudes equal to or greater than 100km. Due to the vastness of the space domain and associated challenges of maintaining domain control, DoD believes the aggregated sensing capacity of the U.S. Government, the Intelligence Community, Allied partners, academia, and commercial industry will all be necessary to satisfy the operational demands.



# Looking Ahead to 2020



Soldiers testing UAVs at Joint Base Cape Cod during the 2019 Patriot Crucible field exercise (DIU)

DIU will continue to rapidly prototype innovative commercial technologies to fill critical capability gaps identified by the Services, combatant commands, and other DoD organizations. As a vote of confidence from Congress, our FY 2020 budget was increased by 55% to \$70 million. DIU will use newly appropriated 6.4 (technology readiness level) funding to demonstrate more defense applications for proven commercial technology and scale successful prototypes to more users across the Department. DIU is also strengthening relationships across DoD such as with the Joint AI Center (JAIC), U.S. Cyber Command and the emerging Space Force.

**“A close partnership between the JAIC and the DIU is crucial to ensure the JAIC takes advantage of cutting-edge commercial AI technologies. DIU’s relationships across the AI community provide a vital bridge to the JAIC and the DoD components and military services, helping advance our goal of scaling AI’s impact across DoD.”**

— Director of JAIC, USAF Lt. Gen. John “Jack” Shanahan

Looking ahead to 2020 and beyond, DIU has prioritized a number of projects with the potential to provide new, transformative capabilities to the warfighter. Here is a snapshot of some of the commercial solutions we are currently prototyping for transition to the Department within the next two years:

**Air Threat Response**

Applying machine learning to classify objects and predict threats more quickly, allowing the operator to shift focus to decision-making rather than data and signal analysis.

**Blue sUAS**

Building a U.S. and allied commercial drone industry to provide secure, trusted, and reliable UAS systems not only to a U.S. Army program of record but to all of the U.S. government by placing vendors on the General Services Administration schedule.

**Installation Counter-UAS**

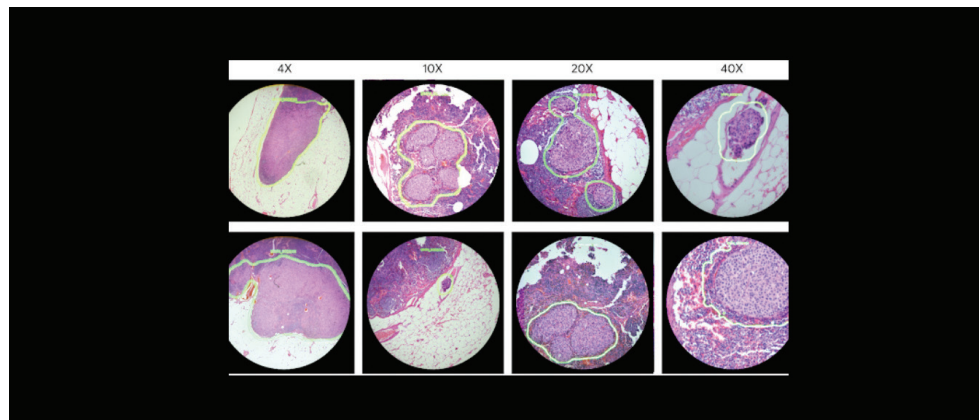
Identifying the best-in-class C-UAS solutions by prototyping multiple technologies in parallel and conducting operational assessments on hard-kill technologies. This project may transition to a program of record in FY 2021.

**Rapid Patching**

Accelerating patch inventory and testing to address critical vulnerabilities throughout DoD's network of 3 million users and 11 million endpoints impacting all service members and agencies.

**Secure Cloud Management**

Providing fast, secure access to commercial cloud services such as video conferencing and document sharing and storage. This capability will allow DoD organizations to securely and more efficiently collaborate with private sector entities using familiar methods and tools.



Sample views through the lens of an augmented reality microscope (Google)

**Predictive Health**

Building machine learning applications to help the Defense Health Agency and the Department of Veteran Affairs diagnose diseases such as cancer quicker and with reduced false positive and negative rates to improve medical outcomes and reduce healthcare costs.

**Multi-Orbit Logistics**

Demonstrating low cost, responsive access to the geosynchronous Earth orbit, where significant commercial and national strategic capabilities requiring servicing reside, extending into cislunar space. This effort, in concert with DIU's Space Outpost initiative, seeks to enable the commercial logistics infrastructure necessary to assure sustained U.S. economic and military power in space.



# **Accelerating Commercial Technology for National Security**

[www.diu.mil](http://www.diu.mil)