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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2022 Office of the Secretary Of Defense **Date:** May 2021

<b>Appropriation/Budget Activity</b> 0400: <i>Research, Development, Test &amp; Evaluation, Defense-Wide I BA 3: Advanced Technology Development (ATD)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0603699D8Z / <i>Emerging Capabilities Technology Development</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	437.475	105.998	0.000	0.000	-	0.000	-	-	-	-	-	-
795: <i>Emerging Capabilities Technology Development</i>	429.493	96.027	0.000	0.000	-	0.000	-	-	-	-	-	-
717: <i>Red Teaming</i>	7.982	9.971	0.000	0.000	-	0.000	-	-	-	-	-	-

**Note**

In FY 2021, all funding and project investment areas in the Emerging Capabilities Technology Development (ECTD) Program Element (PE) transitioned to PE 0603338D8Z Defense Modernization and Prototyping (DM&P).

A Congressional rescission of \$36.000 million was enacted as part of the FY 2021 Appropriation reducing the available FY 2020 budget to \$69.998 million.

**A. Mission Description and Budget Item Justification**

In alignment with the National Defense Strategy, the Emerging Capabilities Technology Development (ECTD) Program Element (PE) supports the Under Secretary of Defense for Research and Engineering (USD(R&E)) with experimentation and mid-term, mission-focused capability development that crosses functional domains and enhances warfighter lethality, technical superiority, adaptability, and resilience. ECTD funding supports joint prototype development, joint experimentation for concept of operations (CONOPs) development, and red teaming validations that enable disruptive innovation to sustain the United States' operational superiority. Joint demonstrations and ECTD-sponsored venues of defense-wide experiments provide opportunities for emerging technologies to succeed, or fail fast. Demonstration venues include: Stiletto, a maritime experimentation and demonstration platform; Thunderstorm, a multi-domain venue focused on small and non-traditional businesses; Silent Hammer, an advanced electronic warfare venue; and, other tailored experimentation and demonstration events. The red teaming funding line explores vulnerabilities in emerging technologies and enables USD(R&E), and the broader defense science and technology community, to make informed decisions before investing in new capabilities. Red teaming enables adaptation to unforeseen vulnerabilities or opportunities early in capability development when design changes are cost effective and programs can be re-directed if developmental dead ends are discovered. ECTD prototypes, demonstrations, experimentations, and red teaming validations enable developers to showcase new and maturing capabilities in realistic environments and against realistic threats with operational user involvement.

ECTD prototyping projects increase the speed of technology innovation by reducing technology risk for emerging capabilities. With an emphasis on joint and interagency partnerships, ECTD matures capability options to anticipate and inform new acquisition pathways in addition to formal requirements and acquisition processes. Project selection is guided by Department-level strategies and priorities, such as the National Defense Strategy, the Chairman's Capability Gap Assessment, and Department of Defense (DoD) modernization priorities.

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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>
Previous President's Budget	109.411	0.000	0.000	-	0.000
Current President's Budget	105.998	0.000	0.000	-	0.000
Total Adjustments	-3.413	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.394	-			
• Program Adjustment	-0.019	-	-	-	-

**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 795: *Emerging Capabilities Technology Development*

Congressional Add: *Air Base Resilience Sensor*

Congressional Add: *High-Altitude Optical Reconnaissance Unit and Sensor (HORUS)*

Congressional Add: *Open Source Intelligence*

Congressional Add: *Remote Advise and Assist (RAA) Technology Development*

Congressional Add: *Artificial Intelligence Enabled Sensor Network*

Congressional Add Subtotals for Project: 795

Congressional Add Totals for all Projects

	<b>FY 2020</b>	<b>FY 2021</b>
	5.000	-
	10.000	-
	3.000	-
	8.000	-
	10.000	-
Congressional Add Subtotals for Project: 795	36.000	-
Congressional Add Totals for all Projects	36.000	-

**Change Summary Explanation**

A Congressional rescission of \$36.000 million was enacted as part of the FY 2021 Appropriation reducing the available FY 2020 budget to \$69.998 million.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Office of the Secretary Of Defense										<b>Date:</b> May 2021		
<b>Appropriation/Budget Activity</b> 0400 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603699D8Z / <i>Emerging Capabilities Technology Development</i>				<b>Project (Number/Name)</b> 795 / <i>Emerging Capabilities Technology Development</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
<i>795: Emerging Capabilities Technology Development</i>	429.493	96.027	0.000	0.000	-	0.000	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

**Note**

In FY 2021, all resources in this project were transferred to the Defense Modernization and Prototyping Program Element (0603338D8Z). There were no new projects and only FY 2020 close out activities are reported.

\$31.000 million of the Congressional rescission was applied to Project Code 795 Emerging Capabilities Technology Development reducing the available FY 2020 budget to \$65.027 million.

**A. Mission Description and Budget Item Justification**

ECTD funding supports projects that reduce technology risk; create capabilities across functional domains; and, deliver increased lethality, resiliency, and adaptability through prototyping, demonstrations, experimentation, and red teaming. Individual projects typically cost less than \$6.000 million and focus on rapid prototyping, experimentation, and demonstration of emerging technologies. ECTD funding also supports complementary demonstration venues that develop and mature emerging technologies.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> FY 2020 Congressional Rescission	31.000	-	-
<b>Description:</b> Congressional rescission applied to Project Code 795 Emerging Capabilities Technology Development.			
<b>Title:</b> Tactical High-speed Offensive Ramjet for Extended Range (THOR-ER)	1.380	-	-
<b>Description:</b> The THOR-ER project will develop and demonstrate a full-scale missile prototype incorporating advanced solid fuel ramjet technologies culminating in a series of operationally relevant flight demonstrations. THOR-ER is a co-development effort partnering with the U.S. Navy; the Norwegian Defence Research Establishment; and the Norwegian industrial base partner, Nammo, to enable leap-ahead gains in missile range and cruise speed while maintaining form factors similar to currently fielded solid fuel rocket motor systems. Technology developed as part of the THOR-ER project will enhance the affordability and survivability of next generation weapon systems. In FY 2020, THOR-ER completed the preliminary design and testing of initial proof-of-concept test articles in preparation for FY 2021 flight tests. In FY 2021, THOR-ER transitions to Program Element 0603338D8Z Defense Modernization and Prototyping for further development.			
<b>Title:</b> SCIFIRE Aircraft Integration	1.400	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p><b>Description:</b> The SCIFIRE Aircraft Integration project conducted system engineering activities to include conceptual systems analysis, modeling and simulation, and wind tunnel test preparations to validate compatibility of the proposed hypersonic weapon system prototype on a fourth-generation fighter aircraft. SCIFIRE Aircraft Integration is a co-development effort partnering with the U.S. Air Force, U.S. Navy, and a partner nation to prototype and demonstrate a hypersonic weapon system. In FY 2020, early-stage activities required to support store separation wind tunnel testing in the partner nation were completed. In FY 2021, SCIFIRE Aircraft Integration activities will transition to Program Element 0604331D8Z Rapid Prototyping Program for further development. Additional details are classified.</p>				
<p><b>Title:</b> Fully Networked Command, Control, and Communications (FNC3) Universal Command &amp; Control (UC2)</p> <p><b>Description:</b> The FNC3 UC2 project addresses the Secretary of Defense priority for integrated communications and networking. UC2 will provide an interface that enables future commanders to dynamically connect any sensor in any domain to any shooter. By focusing on a DoD-wide standard for the data layer of machine-to-machine (M2M) Command and Control (C2), the project will develop and demonstrate an efficient, evolvable, and broadly applicable standard to increase the interoperability, flexibility, and resiliency of FNC3 systems. Aligned with the Joint All-Domain Command &amp; Control (JADC2) concept, UC2 compliant systems will dynamically respond by forming new systems and system combinations to address unanticipated, asymmetric, and evolving threats. The FNC3 UC2 project will provide warfighters faster access to new capabilities, while simplifying development and sustainment lifecycles, and lower operating and training costs.</p> <p>In FY 2020, the FNC3 UC2 project, in coordination with the Joint Staff, Services, Defense Agencies, and Combatant Commands, completed development of the baseline UC2 standard language and began initial planning and preparation for a FY 2021 demonstration. In coordination with the Executive Agent of the Joint Counter small Unmanned Aircraft Systems (C-sUAS) Office, C-sUAS was selected as the initial capability area to demonstrate the utility of UC2 compliant systems. As stated in Section 164 of the FY 2021 NDAA, C-sUAS requires the flexibility to continuously integrate different types of sensors and mitigation solutions to adapt to the different demands of particular military installations, physical geographies, and threat profiles. In FY 2021, the FNC3 UC2 project transitions to PE 0603338D8Z Defense Modernization and Prototyping for further development.</p>		2.119	-	-
<p><b>Title:</b> Self Forming Kill Chains (SFKC)</p> <p><b>Description:</b> The SFKC project developed and demonstrated autonomous decision aids leveraging artificial intelligence/machine learning (AI/ML) to optimize the employment of Intelligence, surveillance and reconnaissance (ISR) and effects resources across domains at machine speed for combat units at the tactical level. In FY 2020, SFKC developed initial decision aides and began implementation in a realistic modeling and simulation environment to assess effectiveness in Joint All Domain Command and Control (JADC2) and U.S. Army Multi-Domain Operations (MDO) scenarios. Work continues in FY 2021 using FY 2020 funds to finalize the development of the autonomous decision aides, and demonstrate them in a modeling and simulation environment.</p>		1.509	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
The developed source code will transition to the U.S. Army and other Department of Defense partners in FY 2021. Additional details are classified.				
<b>Title:</b> Project 7905 <b>Description:</b> This is a classified program. Additional information is available upon request. In FY 2021, Project 7905 transfers to PE 0603338D8Z Defense Modernization and Prototyping.		2.000	-	-
<b>Title:</b> Mission Engineering for Optimized Warfighting <b>Description:</b> Mission Engineering for Optimized Warfighting leverages modeling and simulation, wargaming, intelligence forecasts, mission design, and mission engineering activities to rapidly assess future Joint Warfighting Concepts. Mission Engineering for Optimized Warfighting deconvolves Joint Warfighting Concepts into core capabilities assessing how each capability aligns to achieve the overall mission objective. Results of these analyses inform future technology and capability investment decisions.		3.153	-	-
<b>Title:</b> Polar Skywave Radar (PSR) <b>Description:</b> PSR directly supports the National Defense Strategy's priority for increased lethality through persistent long range sensors to address the limitations of the current North Warning Systems and emerging threats. PSR matured radio frequency (RF) hardware and advanced radar processing algorithms to validate that over-the-horizon skywave radar is viable for a future surveillance system in the polar region. PSR focused on ten major tasks to extend skywave radar to the polar region including deployment of high frequency (HF) radar hardware for a scaled model and refinement of signal processing techniques. In FY 2020, PSR continued data collection, radar signal processing refinement, HF communication experimentation, and evaluated predicted operational performance. Work continues in FY 2021 using FY 2020 funds to complete data collection, and radar signal processing refinements. In FY 2021, PSR transitions to the U.S. Air Force Life Cycle Management Center (LCMC) for further development.		1.250	-	-
<b>Title:</b> Blast Mitigation in Composite Structures <b>Description:</b> The Blast Mitigation in Composite Structures project is a co-development effort partnering with the U.S. Navy and India to explore and develop novel blast mitigation techniques for the protection of U.S. Navy vessels and U.S. Marine Corps vehicles. In FY 2020, modeling and simulation (M&S) was performed to evaluate and predict the response of novel composite structures when exposed to blast loading. Work continues in FY 2021 with FY 2020 funds to validate the response of numerous novel blast mitigating techniques through additional M&S and experimentation. In FY 2021, the project transitions to the U.S. Navy for further development.		1.650	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p><b>Title:</b> FNC3 Communications &amp; Networking Infrastructure (C&amp;NI) BAA Task Area #3</p> <p><b>Description:</b> This project executes prototyping activities to mature communication concepts that enable multi-domain communications. Prototyping activities focus on increasing communications resiliency to tactical and strategic assets. Prototype systems will inform the development of Service-specific solutions required to provide fully-networked, command, control, and communications (FNC3). In FY 2020, six concepts were explored prior to down-selection for rapid maturation. In FY 2021, work continues with FY 2020 funds to continue maturing the system design and begin initial prototype development. Prototype development transitions to the U.S. Navy in FY 2021 to complete prototype development and demonstration by FY 2024. Additional details are classified.</p>		4.566	-	-
<p><b>Title:</b> Multi-domain Experimentation and Demonstration Venues</p> <p><b>Description:</b> Agile and flexible experimentation and demonstration capabilities and venues that support the National Defense Strategy's priority to increase the rate of innovation and enable Service, Combatant Command, and Agency user evaluation of emerging novel technologies in relevant environments. Demonstration venues include the Thunderstorm venue for small and non-traditional businesses; the Stiletto maritime technology platform; and, other tailored multi-domain venues and ad-hoc demonstrations. These experimentation and demonstration venues support the rapid discovery and transition of emerging technologies across the range of military operations. The venues provide the Department of Defense (DoD) and interagency partners with an opportunity to identify and evaluate new and emerging technologies both from commercial and government sectors through a series of technology demonstrations, experiments, vignettes, and related activities. The venues also offer a streamlined experimentation and demonstration process that encourages system developers to engage directly with the warfighter. These engagements enable rapid innovation and adoption of new technologies to meet operational needs through the exploration of military utility, and identification of potential risks of emerging technologies.</p> <p>In FY 2020, Thunderstorm, Stiletto, and other venues conducted ten demonstration and experimentation events which featured 187 innovative technologies from focus areas including, near-field communications systems, machine learning on unmanned systems, and cyber security on maritime vessels. Seven of the technologies transitioned directly to DoD operational users or were leveraged by formal programs of record, including, vertical takeoff and landing unmanned autonomous vehicles (UAVs), virtual reality training for aircrew, and a sense-through the-wall radar system. The demonstration and experimentation venues also provided 72 small businesses and non-traditional innovators with warfighter feedback critical to rapidly mature their technologies into viable prototypes.</p> <p>In FY 2021, Multi-domain Experimentation and Demonstration Venues transfers to the Defense Modernization and Prototyping (DM&amp;P) Program Element, 0603338D8Z.</p>		5.000	-	-

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2020	FY 2021	FY 2022
<p><b>Title:</b> Silent Hammer (SH)</p> <p><b>Description:</b> SH is a multi-year, multi-agency, series of field experimentation activities. SH explores and demonstrates new electronic warfare (EW) and cyber technologies and approaches through the use of large-scale, dynamic field experiments. SH includes scripted and dynamic scenarios to experiment with the efficacy of both existing and new capabilities to engage emerging electromagnetic spectrum threats. The EW Community of Interest, Executive Committees, and warfighters are involved in the selection of follow-on experimentation topics, technology demonstrations, and scoping of these efforts to ensure their maximum relevance and value. The Joint Electronic Advanced Technology (JEAT) Program Element, 0603618D8Z supports the experiment concept development and planning efforts for SH events, while the Emerging Capabilities Technology Development (ECTD) Program Element, 0603699D8Z supports SH experiment execution efforts. In FY 2020, SH completed the concept development and experimenter outreach phases; conducted the Concept Development Meeting; and prepared for the experiment-planning phase by coordinating efforts for the Initial Planning Meeting. In FY 2021, SH transfers to the Defense Modernization and Prototyping (DM&amp;P) Program Element, 0603338D8Z for further development.</p>	5.000	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	60.027	-	-

	FY 2020	FY 2021
<p><b>Congressional Add:</b> Air Base Resilience Sensor</p> <p><b>FY 2020 Accomplishments:</b> The Air Base Resilience Sensor project directly supports the National Defense Strategy's priority for increased lethality prototyping and integrating an advanced sensor system concept to enhance detection and tracking of threat systems. Previous resources provided above the President's budget in FY 2016, FY 2017, FY 2018, and FY 2019 developed an advanced sensor chip assembly (SCA) and prototype test unit incorporating the SCA to enable experimentation and validation of expected performance in maritime environments, targeting a FY 2022 system demonstration in an operationally relevant environment. In FY 2020, prototyping activities integrated the SCA into multi-function test units to validate expected performance for other operational concepts. Work continues in FY 2021 using FY 2020 funds to identify planned FY 2022 exercises and test events that can be leveraged to validate expected performance for operational concepts of interest to the Services and Combatant Commands. This technology area is a congressional interest item and additional resources were provided above the President's budget. Details of this project are classified.</p>	5.000	-
<p><b>Congressional Add:</b> High-Altitude Optical Reconnaissance Unit and Sensor (HORUS)</p> <p><b>FY 2020 Accomplishments:</b> The HORUS prototype supports day or night operations by providing multi-spectral, high-definition full motion video from extreme slant ranges. In FY 2020, the sensor design was completed and fabrication of two prototype HORUS units began in early September. The HORUS system is</p>	10.000	-

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		<b>FY 2020</b>	<b>FY 2021</b>
being designed, built, and evaluated as a prototype capability for a high-altitude sensor system with military utility for the joint warfighter. HORUS is an electro-optical prototype system designed to support pattern of life analysis at extreme distances. In addition, its modular design will allow for HORUS to be adaptable to evolving mission needs and new sensor technologies. HORUS is designed to interface with manned or unmanned platforms. In FY 2020 prototype development continued with procurement of the majority of long lead items, and completion of the Critical Design Review. Work continues in FY 2021 using FY 2020 funds to complete prototype fabrication and testing prior to transitioning to USSOCOM for final evaluation and operational use.			
<b>Congressional Add:</b> Open Source Intelligence		3.000	-
<b>FY 2020 Accomplishments:</b> This project directly supports the National Defense Strategy for increased lethality through targeted application of DoD Joint Mission Capabilities. The project leverages emerging tools and techniques to rapidly winnow down open source data to actionable intelligence. In FY 2020, the project demonstrated a novel Open Source Intelligence capability to support DoD modernization areas. The capability developed transitioned to the U.S. Army and U.S. Special Operations Command for further development. This technology area is a congressional interest item and additional resources were provided above the President's budget.			
<b>Congressional Add:</b> Remote Advise and Assist (RAA) Technology Development		8.000	-
<b>FY 2020 Accomplishments:</b> RAA directly supports critical decision and coordination processes enabling increased survivability for the joint warfighter and partners. In FY 2020, the RAA project developed and validated system performance for RAA prototypes to provide threat detection and classification of airborne and ground-based threats in operationally relevant environments. The prototypes developed transitioned to the U.S. Army and U.S. Special Operations Command for further development. This technology area is a congressional interest item and additional resources were provided above the President's budget.			
<b>Congressional Add:</b> Artificial Intelligence Enabled Sensor Network		10.000	-
<b>FY 2020 Accomplishments:</b> This project directly supports the DoD Artificial Intelligence (AI) and Machine Learning (ML) modernization area. In FY 2020, the project developed and demonstrated an AI-based architecture reducing warfighter cognitive burden and streamlining decision-making at the tactical edge. Leveraging a network of state-of-the art digital sensors and real-time signal and image processing, the prototype demonstrated how expedient processing and distribution of data at the tactical edge reduces latencies, improves data reliability, and enhances the data-to-decision workflow at the warfighter level providing unparalleled informational advantages and decision-making capabilities. The prototype transitioned to the U.S. Army and			

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	<b>FY 2020</b>	<b>FY 2021</b>
U.S. Special Operations Command for further development. This technology area is a congressional interest item and additional resources were provided above the President's budget.		
<b>Congressional Adds Subtotals</b>	36.000	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

ECTD leverages the Services' and Defense Agencies' most efficient and effective acquisition approach for rapid prototyping. This includes using Other Transaction Authorities and new or existing contract vehicles.

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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>717: Red Teaming</i>	7.982	9.971	0.000	0.000	-	0.000	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

**Note**

In FY 2021, all resources in this project are transferred to the Defense Modernization and Prototyping Program Element (0603338D8Z).

\$5.000 million of the Congressional rescission was applied to Project Code 717 reducing the available FY 2020 budget to \$4.971 million.

**A. Mission Description and Budget Item Justification**

The Red Teaming project supports assessments and demonstrations to stress and assess emerging systems with the intent of gaining or maintaining overmatch earlier in the life cycle. The project helps assess the susceptibility and vulnerability of emerging technologies and newly developed systems, and helps identify unanticipated disruptive opportunities and technological dead ends. The project improves systems by reducing vulnerabilities and providing a holistic understanding of employment risks in operationally-representative environments and against potential threats prior to full funding commitments. The Red Teaming project supports three broad types of red teaming: 1) Early stage horizon scanning and assessments of weaknesses and opportunities of pre-development technologies from an adversary perspective; 2) Targeted, low-fidelity prototypes to assess utility and inform design choices prior to funding commitments; and 3) Red teams, war games, and field experiments with maturing technology to understand how to implement new technologies and adapt to adversary responses. This effort leverages the innovative capabilities of other defense red teaming organizations within the Department, Federally Funded Research and Development Centers (FFRDCs), government laboratories, and academia. Deliverables will inform requirements, new concepts of operations (CONOPS), and help accelerate technology acquisition pathways for joint missions.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2020	FY 2021	FY 2022
<b>Title:</b> FY 2020 Congressional Rescission	5.000	-	-
<b>Description:</b> Congressional rescission applied to Project Code 717 Red Teaming.			
<b>Title:</b> Red Teaming to Support DoD Modernization Priorities	2.221	-	-
<b>Description:</b> Red Teaming to Support DoD Modernization Priorities funds efforts to explore new capabilities in a competitive environment. Efforts include: 1) Early investigations and red teaming to identify and understand potential vulnerabilities and opportunities from emerging and conceptual technologies. Projects will help define and anticipate impacts from new technologies, including current DoD investments and external technologies, to understand operational utility and identify threats from tangentially related sectors that can have significant negative impacts on current DoD investments. 2) Maturation of Service and Defense Agency identified prototypes to enable red teaming, demonstrations, experiments, and CONOPS earlier in the development cycle. These prototypes increase agility and rate of innovation for emerging capabilities, while reducing cost and risk. 3) Exploring unconventional approaches to counter current DoD and adversary technologies through red teams, war games,			

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<b>Appropriation/Budget Activity</b> 0400 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603699D8Z / <i>Emerging Capabilities Technology Development</i>	<b>Project (Number/Name)</b> 717 / <i>Red Teaming</i>

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>simulation exercises, and studies that employ government laboratory scientists; subject matter experts; and, students of science, technology, engineering, and math disciplines. Red teaming events range from distributed table-top games to simulated and live field exercises with non-traditional and operationally experienced participants. Deliverables include characterizations of future prototypes, requirement definitions, recommendations on system operational employment, potential vulnerabilities, and likely countermeasures that could be taken by the threat as well as potential counter-countermeasures to increase functionality or operational effectiveness of the system. The USD(R&amp;E) will leverage these products to inform how technologies and integrated systems can perform in hostile environments and develop new CONOPS.</p> <p>In FY 2020, red teaming efforts were conducted to support the National Defense Strategy’s priority for increased lethality and forward force maneuver, and the Department of Defense’s modernization priorities for cyber, artificial intelligence, and contested logistics. A prototype was developed and assessed for cyber vulnerabilities by an associated red teaming event with operationally-experienced participants. Exploit chains were developed to inform stakeholders of real-world security impacts of deploying a system. An experiment was conducted using a low-altitude, low-speed aircraft and sensor helmet to assess radar vulnerabilities for personnel recovery. Maturing technologies, in support of artificial intelligence and contested logistics, were red teamed to, either understand how best to implement and adapt the technology into CONOPS, or determine how best to counter adversary responses to the technology.</p>			
<p><b>Title:</b> “Hack the Sat” Satellite Hacking Event</p> <p><b>Description:</b> The “Hack the Sat” project challenged public teams to compete and hack their way through a ground station and satellite to recover a simulated stolen space vehicle. The event was designed to attract a large, non-traditional performer base to consider cyber security challenges as they relate to space systems. In FY 2020, the project executed sensor development, data collection, integrity management, and tactics analysis for the Hack the Sat Capture the Flag event. During the event, all data generated within the competition environment was collected and analyzed to ensure fair play, create a public record of the event, and enable future analysis of novel tactics, techniques, and procedures. Work continues in FY 2021, using FY 2020 funds, to plan and execute a government-only, red-team vs blue-team event to explore additional attack pathways and defensive mitigations in a controlled environment. In FY 2021, the project plans to enhance the realism of the competition infrastructure, including the ground segment and flatsat, and transition the infrastructure to the Persistent Cyber Training Environment. After the red-team vs blue-team event, draft tactics manuals for red teaming space systems and conducting defensive cyberspace operations on space systems will transition to the United States Space Force. Additionally, recommendations on mitigations of cyber vulnerabilities in space systems will transition to the Joint Federated Assurance Center.</p>	2.750	-	-
<b>Accomplishments/Planned Programs Subtotals</b>	9.971	-	-

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2022 Office of the Secretary Of Defense		<b>Date:</b> May 2021
<b>Appropriation/Budget Activity</b> 0400 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603699D8Z / <i>Emerging Capabilities Technology Development</i>	<b>Project (Number/Name)</b> 717 / <i>Red Teaming</i>

**C. Other Program Funding Summary (\$ in Millions)**  
N/A

**Remarks**

**D. Acquisition Strategy**  
N/A