Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Office of the Secretary Of Defense	Date: April 2022
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603618D8Z / *Joint Electronic Advanced Technology*

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	14.773	18.164	19.218	0.000	19.218	20.141	20.718	21.170	21.593	Continuing	Continuing
245: *EW Enterprise Exploration and Innovation*	-	14.773	18.164	19.218	0.000	19.218	20.141	20.718	21.170	21.593	Continuing	Continuing

Note

New Start (Y/N): No

A. Mission Description and Budget Item Justification

This program supports the Department's initiatives to Deter Aggression and Prevail in Conflict, Build Sustainable and Long-Term Advantage, and Building a Resilient Joint Force and Defense Ecosystem.

The electromagnetic spectrum (EMS) environment (EME) is the largest and most complex warfighting environment. It is universally pervasive, largely unseen, and can only be perceived through the use of advanced electronic technologies. Understanding and addressing EME warfighting challenges is essential to all military operations. It is through the use of EMS technologies that we perceive operational realities, the state and disposition of all military and nonmilitary forces and groups within operational environments, and coordinate all actions of our military forces.

Historically, the United States has had significant technological advantages in EMS warfighting technologies, specifically sensors, communications, and countermeasures. This superiority is being challenged due to the rapid commercialization of advanced electronic systems and components, the broad proliferation of these technologies, and the concurrent rise of cyber-related EMS technologies. Potential adversaries have leveraged these advances to develop and field competing and asymmetric capabilities to offset historic U.S. advantages. These efforts have made U.S. operations in the EMS and cyberspace significantly more difficult, and they continue to do so at an accelerating rate. Adversary radars are evolving from fixed analog systems to programmable digital variants with agile waveforms and unknown behaviors making preprogrammed electronic countermeasure less effective. Foreign developments include new generations of challenging threats ranging from small unmanned air systems and easily transportable Man-Portable Air Defense Systems (MANPADS) to dedicated anti-access area denial (A2/AD) military systems including integrated air defense systems and increasingly capable cruise and ballistic missiles that have incorporated the most advanced sensors, communication and electromagnetic warfare (EW) technologies.

Because the accelerating pace of technological innovation has increased the rate at which new EMS and cyber threats are appearing, the effective operational lifetime of many advanced technologies has decreased. For all of these reasons, the Department of Defense (DoD) must develop and field new EW and EW-Cyber capabilities faster, at much lower costs, to be broadly integrated and employed across the entire force structure.

The Joint Electronic Advanced Technology (JEAT) program was established to address these challenges through efforts designed to substantially accelerate the development and maturing of innovative technologies in order to: (1) address new EW and EW-Cyber warfighting challenges; and (2) provide new, leap-ahead EMS

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warfighting capabilities to ensure U.S. warfighters will always have decisive EW and EW-Cyber overmatch capabilities. The JEAT program specifically focuses on EW and EW-Cyber-related technologies that fall outside the Services' purviews or are developed synergistically with a transition to the Services post maturation.

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	15.152	18.221	0.000	0.000	0.000
Current President's Budget	14.773	18.164	19.218	0.000	19.218
Total Adjustments	-0.379	-0.057	19.218	0.000	19.218
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.376	-			
• SBIR/STTR Transfer	-	-			
• Other Reprogramming	-0.003	-	-	-	-
• FFRDC	-	-0.057	-	-	-
• Adjustments to Budget Year	-	-	18.555	-	18.555
• Economic Assumption	-	-	0.663	-	0.663

Change Summary Explanation

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense											Date: April 2022	
Appropriation/Budget Activity 0400 / 3					R-1 Program Element (Number/Name) PE 0603618D8Z / *Joint Electronic Advanced Technology*				Project (Number/Name) 245 / *EW Enterprise Exploration and Innovation*			
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
245: *EW Enterprise Exploration and Innovation*	-	14.773	18.164	19.218	0.000	19.218	20.141	20.718	21.170	21.593	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Electromagnetic Warfare Enterprise Exploration and Innovation (EW E&I) research efforts identify, explore, and accelerate the maturing and demonstration of new EW-related and EW-Cyber-related technologies. Technologies enabling and facilitating electromagnetic attack (EA), electromagnetic protection (EP), and electromagnetic support (ES) are covered, including technologies enabling "over-the-air" algorithmic warfare utilizing existing and new generations of EW, radiofrequency (RF) and optical systems. To address increasingly sophisticated evolving threats, EW E&I efforts also seek to accelerate the development of non-traditional EMS sensing and ultra wideband approaches (greater than a decade of frequency) to enable continuous radiofrequency (RF) surveillance and distributed phase synchronous RF sensing. EW E&I research products are explored and developed in state-of-the-art laboratories and validated side-by-side with numerous competing technologies and systems from the Services, industry, academia, and National laboratories in live/virtual/constructive (LVC) experimentation environments and in complex field experimentation events under real-world conditions. This approach significantly accelerates the identification and development of the most effective EW technologies while concurrently reducing developmental costs.

Significant advances in all areas impacting EW have resulted in new generations of threats that are challenging the U.S.'s traditional dominance in EW. EW E&I efforts address these challenges and also develop new technologies to ensure that U.S. warfighters maintain decisive overmatch offensive and defensive EW capabilities. EW E&I efforts specifically focus on areas where Service investments are lagging to accelerate the development and transition of multi-Service, multi-mission EW technologies.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: EW Enterprise Exploration and Innovation (EW E&I)	14.773	18.164	19.218
Description: Current EW E&I research thrusts include Passive Sensor Detection and Defeat (PSDD), Platform Self-Protection (PS-P), EW Technology Enablers (EW Tech), EW-Cyber Interface (EWCI), and EW Collaboration and Cognizance (EW C&C). Passive Sensor Detection and Defeat (PSDD): Modern integrated air defense systems (IADS) employ a variety of radar sensing technologies to detect, target and engage adversary aircraft. While classic IADS radars emitted radiofrequency radiation and collected the radiation that was reflected off targets within their field of view with the same aperture, computational advances have enabled passive (non-emitting) radar radiation receivers to capture and process the radar radiation reflected off targeted systems that was emitted by other radar emitters. Passive radar systems are thus capable of providing targeting solutions to engagement assets (missiles, aircraft, directed energy, etc.) even though they do not emit radar radiation. This makes these systems a much more complex threat to U.S. offensive systems because traditional EW countermeasures such as jamming cannot be employed			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
against these passive radars since they are largely undetected by our radar warning systems. This leaves U.S. aircraft confronted by IADS containing passive sensors vulnerable to unforeseen attacks. PSDD research identifies, explores and accelerates the maturing and demonstration of new technologies to provide defensive capabilities against passive detection/tracking/engagement sensor systems. Platform Self-Protection (PS-P): A wide variety of radiofrequency (RF) and electro-optical (EO) technologies are employed by modern militaries to detect, track, and engage attacking military systems. RF sensor systems including IADS radars, radars on ships, aircraft, ground, and naval vessels, and seekers on ballistic, cruise, air-to-air, surface-to-air missile are used to detect and provide targeting and engagement solutions to counter adversaries' military systems. EO systems have been incorporated into missile seekers and are also associated with high energy laser engagement systems for the same reasons. To ensure successful U.S. military actions, technologies that protect U.S. platforms and facilities against these new generations of much more capable RF and EO detection/targeting/engagement sensors and seekers are essential. This thrust identifies, explores, and accelerates the maturing and demonstration of new technologies to counter adversaries' advanced RF and EO sensor and seeker threats. Electromagnetic Warfare Technology Enablers (EW Tech): Significant advances in materials, electronics (including photonics, plasmonics, spintronics, magnetronics, etc.), RF and communications sciences, optical and laser sciences, information and computational sciences, and quantum sciences are enabling new generations of extremely powerful applications in a wide variety of fields. For example, artificial intelligence and machine learning (AI/ML) technologies are beginning to impact electromagnetic spectrum (EMS) operations. The advantages that AI/ML approaches can provide are considerable, but multiple runs addressing the same scenarios often provide disparate results for both the same assets in the same scenarios and for different assets in different locations within the scenarios. Ascertaining the optimal employment tactics and strategies using AI/ML thus becomes difficult for offensive and defensive operations in both proactive and reactive EW modes. EW Tech research seeks to leverage the latest advances in all of these areas to enable commensurate advances in the EW and EW-Cyber warfighting capabilities. EW-Cyber Interface (EWCI): The ability to impact system logic using EW and other RF systems provides powerful new options for EW application. EWCI research efforts thus identify, explore, and accelerate the maturing and demonstration of new EW-Cyber-related technologies. Significant advances in the application of digital EW have resulted in new generations of threat systems that are challenging the Unites States' traditional dominance in these areas. EW E&I efforts address these threats and develop new technologies to ensure U.S. warfighters maintain decisive overmatch EW capabilities. EW Collaboration and Cognizance (EW C&C): EW C&C efforts focus on maintaining an awareness of global research and development (R&D) efforts impacting EMS, EW and EW-Cyber warfighting technologies; guiding, facilitating, ensuring the maximum levels of developmental collaboration across DoD; providing Office of the Secretary of Defense (OSD) oversight of technology development efforts across the DoD EW and EW-Cyber developmental communities; and providing decisional			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023

insights to senior leaders and decision-makers so they can more effectively direct all Department EW and EW-Cyber technology development programs and processes.

FY 2022 Plans:

Passive Sensor Detection and Defeat (PSDD):

• SILENT SWARM 22 (SS-22): Complete development and planning for the SS-22 field experimentation venue and conduct SS-22. SS-22 is a Naval Surface Weapons Center (NSWC) Crane led experimentation event focusing on small unmanned and semi-autonomous systems with advanced spectrum related capabilities. Specific emphasis is being placed on the evaluation of technologies for enhanced sensing, precision navigation and timing, and autonomy for both autonomous and semi-autonomous operations in SS-22. This includes developing and identifying Concepts of Operations (CONOPS), tactics, and other operational considerations for early technology readiness level (TRL) offerings will be a key component of this experimentation series. SS-22 will highlight Gray Zone operations as an initial focus. Government and industry technology inputs will be solicited for event participation.

- SS-22 builds upon approaches and lessons learned from previous events and scenarios to produce threat representative architectures for red threat laydowns along with considerations for blue sensor integration.
- SS-22 will be conducted in 4Q FY 2022.

Platform Self-Protection (PS-P):

• Next Generation (NextGen) Electro-Optical Countermeasures (EOCM) Study: Over the past decade, significant advances in optical sensors, processing, microelectronics, and systems integration have enabled new generations of extremely capable man-portable air defense system (MANPADS) and air-to-air (A2A) missiles to be developed. While U.S. countermeasures (CMs) to these classes of threats have advanced, foreign MANPADS and A2A missiles still pose significant threats to U.S. aircraft. The last comprehensive assessment of the EOCM area was completed in 2009, and the last major joint collaborative efforts were completed in FY 2010-2013 and FY 2015-2018. This effort will re-baseline Department aircraft self-protection EOCM development efforts and develop a roadmap to accelerate U.S. aircraft EOCM development efforts.

Electromagnetic Warfare Technology Enablers (EW Tech):

• Next Generation Fully Adaptive Radar (NG-FAR): The second and third proof-of-technology field demonstrations of NG-FAR will be completed in Q1 and Q4 of FY 2022. These demonstrations will get NG-FAR to TRL 6 and to buy down risk as an enabler for follow-on prototyping/validation and demonstration efforts by USD(R&E)/DDRE(AC).

• Innovative Low-Cost Experimentation (LCE): Develop plans and conduct the first of a new series of LCE event at the Playas, New Mexico experimentation range. The initial LCE events will utilize and enhance the predictive and assessment capabilities of the JEAT PE-developed Digital Attack Surface Execution Environment (DASEE) nonkinetic battlespace comprehension and management tool to facilitate concepts of operations (CONOPS) development and exploratory wargaming.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• CONCEAD Maturation: Cooperative and Networked Controlled Electronic Attack Development (CONCEAD) is a multi-Service (NSWC CRANE, AFRL/RY, ARL/USA DEVCOM) prototyping and demonstration effort to demonstrate coherent multi-platform, multi-aperture EA capabilities for multiple Combatant Command users. CONCEAD was proposed but not selected as a FY 2022 Joint Capabilities Technology Demonstration (JCTD) effort because the initial capabilities demonstrated within CONCEAD were deemed to be too simplistic. This effort will mature and advance CONCEAD technologies and experiment within very complex field environments to enable CONCEAD to be selected as a JCTD effort in FY 2023. • Digital Attack Surface Execution Environment (DASEE) Transition: This effort will complete final development actions to enable the successful transition of the JEAT Program's DASEE capability to operational users. It includes the development and validation of new containers for wargaming and modeling and simulation. - DASEE Graphical User Interface (GUI) Upgrade: This effort will mature and integrate the Jupyter Notebook upgrade into DASEE to enhance DASEE's GUI and facilitate increased data access/assessment/utilization. • VIRTUAL STINGRAY 22: The complexity and highly classified nature of EW and EW-Cyber technologies and approaches severely limits their exploration in real-world highly complex congested-and-contested EMS environments. This significantly increases both developmental and validation costs for these important capabilities. This multi-Service effort will develop and employ an extremely advanced classified simulation environment to facilitate the exploration and advancement of new EW and EW-Cyber technologies. Utility will be maximized by anchoring simulated effects to physics-level codes and comparing results to laboratory and field measurements. EW-Cyber Interface (EWCI): • Precision RF-enabled Access & Effects for the IoT Environment (PRAETOR): The "internet of things" (IoT) environment controls a significant amount of extremely important day-to-day operations and capabilities including event monitoring, power management and data transfer and storage. Loss of IoT capabilities can thus significantly degrade a potential adversary's capabilities to generate and employ forces in both preemptive and responsive manners. This effort will begin exploring over-the-air RF-enabled cyber-attacks on IoT devices to negate or compromise their operation to enhance deterrence operations by U.S. forces. EW Collaboration and Cognizance (EW C&C): • Several hundred million dollars are spent each year to develop better EW and EW-Cyber capabilities for U.S. warfighters. EW C&C efforts supporting the OUSD(R&E)/Electronic Warfare and Countermeasures (EW&C) Directorate facilitate greater collaboration across these initiatives through work with planners and developers across the Services, National Laboratories, Industry, academia, and international defense partners. Participation in the EW Community of Interest facilitates these efforts and provides insights for decision-makers within OSD and the Services and the EW Executive Committee.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• EW C&C efforts also enable the identification and development of collaboration opportunities, via JEAT's live, virtual and constructive experimentation venues. ***FY 2023 Plans:*** Passive Sensor Detection and Defeat (PSDD): • SILENT SWARM 23 (SS-23): Complete assessment and final reports for SS-22 and begin planning and development the SS-23 field experimentation venue. SS-23 will be conducted in 4Q FY 2023. • Characterization of Passive Systems (COPS) – Classified project in collaboration with PMR 51 and the FFRDCs. Electromagnetic Warfare Technology Enablers (EW Tech): • Magnetic Field Sensing (MFS): Assess the Josephson junction magnetic sensor to recreate the EMS from the magnetic field component thereby bypassing the need for an aperture enabling ultra wideband sensing. • Reconfigurable Intelligent Surfaces (RIS): Assess the feasibility of applying meta-surface materials to modify the radar scattering of surfaces for EW applications across multiple domains. • Dynamically Configurable Apertures (DCAs): Leverage the advances in additive manufacturing technology to dynamically adapt to changes in the EMS by dynamically controlling the size, frequency, gain and polarization of the RF front end and affiliated components. • Innovative Low-Cost Experimentation (LCE): Develop plans and conduct the second and third LCE event at the Playas, NM experimentation range. Continue leveraging EW capabilities in these events to explore CONOPS development and wargaming applications. • Spectrum Access Sensor for Situational analYsis (SASSY): Congestion within the EMS significantly impacts military operations in a variety of important ways. Most importantly, frequencies that provide significant amounts of militarily-valuable information are coincident with civilian-use frequencies. To utilize this important information without adversely affecting civilian operations is thus extremely important for operational situational analysis. This effort will begin exploring cognitive RF technologies to enable cognitive radar applications within this congested EMS environment. • VIRTUAL STINGRAY 23 (VS-23): Building upon the results of VS-22, VS-23 will expand the numbers of users and capabilities involved and increase levels of anchoring of EW and EW enabled cyber effects in a secure virtual and constructive setting to real-world offensive EW and Cyber effects in a distributed and networked laboratory environments. EW-Cyber Interface (EWCI): • Preventing Blue Force Fratricide (PBFF): Applying AI/ML algorithms to more accurately identify signal in the EMS and discerning between blue systems from red systems in real time.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
• Precision RF-enabled Access & Effects for the IoT Environment (PRAETOR): Advancement and refinement of initial capabilities developed in FY 2022 will continue, culminating in several real-world in-the-field assessments of PRAETOR effects and their efficacy. EW Collaboration and Coordination (EW C&C): • Continue FY 2022 OUSD(R&E) efforts to guide, shepherd, and oversee all EW and EW-Cyber technology development across the DoD. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The increase in funding will allow the JEAT program to address new EW and EW-Cyber warfighting challenges and provide new, leap-ahead EMS warfighting capabilities to ensure U.S. warfighters will always have decisive EW and EW-Cyber overmatch capabilities.			
Accomplishments/Planned Programs Subtotals	14.773	18.164	19.218

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A