Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Office of the Secretary Of Defense	Date: March 2024
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 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
Total Program Element	32.483	23.289	19.793	20.188	-	20.188	20.638	21.068	21.528	21.958	Continuing	Continuing
245: *EW Enterprise Exploration and Innovation*	32.483	23.289	19.793	20.188	-	20.188	20.638	21.068	21.528	21.958	Continuing	Continuing

Note

New Start (Y/N): No

A. Mission Description and Budget Item Justification

The Electromagnetic Operating Environment (EMOE) spans the terrestrial and space domains. It is the largest and most complex warfighting environment because it is universally pervasive, largely unseen, and can only be perceived through the use of advanced electronic technologies. Understanding and addressing warfighting challenges in the EMOE is essential to all military operations because it is through the use of Electromagnetic Spectrum (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. And it is through Electromagnetic Spectrum Operations (EMSO) that adversarial use of the EMOE can be impacted and potentially denied.

EMS-enabled cyber capabilities have linked the cyber and EMOE domains in such a way that the two domains often enable each other. Independently, and sometimes in concert with each other, they will be used to deliver or enable non-kinetic effects. It is important that the two domains be considered in terms of their many potential synergies and not in isolation of one another. Cyberspace and the EMOE can and will overlap in operationally significant ways.

Adversary radars are evolving from fixed analog systems to programmable digital variants with agile waveforms and unknown behaviors making preprogrammed electronic countermeasure less effective. Cognitive, adaptive, and passive technologies figure prominently. 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. Non-kinetic exploits against the Command and Control (C2) networks in the cyber domain or at an EMS/cyber interface are also relevant.

The Joint Electromagnetic Advanced Technology (JEAT) Program was established to address these challenges through efforts designed to substantially accelerate the development and maturing of innovative technologies to (1) address new EW and EW/Cyber warfighting challenges and (2) provide new, leap ahead EMSO 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 not being developed rapidly enough.

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B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	24.155	19.793	20.146	-	20.146
Current President's Budget	23.289	19.793	20.188	-	20.188
Total Adjustments	-0.866	0.000	0.042	-	0.042
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.866	-			
• Program Adjustment	-	-	0.042	-	0.042

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: 245: *EW Enterprise Exploration and Innovation*		
Congressional Add: *Photonically Distributed Antenna System*	5.000	-
Congressional Add Subtotals for Project: 245	5.000	-
Congressional Add Totals for all Projects	5.000	-

Change Summary Explanation

A reduction of -$0.204 was applied to meet DoD overall funding reductions, which were spread to mitigate impact.

Funding increase of $0.042 million for Economic Assumptions.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Office of the Secretary Of Defense											Date: March 2024	
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 2023**	**FY 2024**	**FY 2025 Base**	**FY 2025 OCO**	**FY 2025 Total**	**FY 2026**	**FY 2027**	**FY 2028**	**FY 2029**	**Cost To Complete**	**Total Cost**
245: *EW Enterprise Exploration and Innovation*	32.483	23.289	19.793	20.188	-	20.188	20.638	21.068	21.528	21.958	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Electronic Warfare (EW) Exploration and Innovation (E&I) research efforts focus on the Electromagnetic Spectrum Potations (EMSO) capabilities of electronic warfare (EW), sensing, communications; cyber capabilities, and the delivery platforms that are associated with them. The scope of the EW E&I research efforts is from a joint, multi-domain perspective over the broad range of potential non-kinetic effects. The non-kinetic effects can overlap into the Electro-Optical and Infrared (EO/IR) phenomenologies and potentially, integration with directed energy subsystems.

New EW-related and EW/Cyber-related technologies are identified relative to current and projected EMSO challenges informed by the most current threat intelligence and from a joint and multi-domain perspective. Service operational perspectives are obtained through participation or facilitation of joint Communities of Interest (COIs). Potential solutions and technological synergies are explored through interaction with the research and practitioner communities. Considerable efforts are expended to avoid the potential for redundant efforts.

The Joint Electronic Advanced Technology program element (JEAT PE) supports large-scale, operationally-relevant scenario driven multi-domain experimentation events. The purpose of the events is to observe and highlight the most current and promising capabilities available – or under development by- the commercial, academic, federal, and defense sectors of the U.S. and select international partners. The experiments are conducted in an operationally relevant Electromagnetic Operating Environment (EMOE) with relevant blue, red and grey spectrum dependent systems such as radars, EW systems, decoys, communication devices and networks as well as cyber-dependent systems. The experiments provide the Science and Technology (S&T) and research communities the opportunity to meet with Department of Defense (DoD) experts and refine their technologies on a test-fix-test basis. The experiments allow the system developers to prepare for technology transition- either to a service or to a successive stage of DoD sponsored experimentation such as the Rapid Defense Experimentation Reserve (RDER) program. Typically, the Technology Readiness level (TRL) is advanced which improves commercial viability and the potential for transition. The experiment also offers a venue to demonstrate capabilities to potential transition partners.

Technologies enabling and facilitating electromagnetic attack (EA), Radio Frequency (RF) penetration of cyber systems, electromagnetic protection (EP), and electromagnetic support (ES) are covered. Technological advancements in materials, miniaturization, improved size, weight, power and cost (SWAP-C) and cognitive systems are considered, as are technologies that will allow for sensing and/or non-kinetic effects in denied areas or that bring computational capabilities to the tactical edge.

EW E&I efforts also seek to accelerate the development of non-traditional EMS sensing and ultra-wideband (UWB) approaches (greater than a decade of frequency) to enable continuous (RF) surveillance and distributed phase synchronous RF sensing. Photonic applications to signal distribution and processing are being explored. The EW E&I efforts are considered holistically in the context of the EMS complete from low frequency RF through the Info Red (IR) and photonic bands. EW E&I

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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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: EW Enterprise Exploration and Innovation (EW E&I)	18.289	19.793	20.188

Description: EW E&I research efforts identify, explore and accelerate the maturation and demonstration of new EW- and EW/Cyber-related technologies. Current EW E&I initiatives research thrusts include Passive Sensor Detection and Defeat (PSDD), Platform Self-Protection (PS-P), RF/Photonic applications, EW Technology Enablers (EW Tech), EW/Cyber Interface (EWCI) and EW Collaboration and Cognizance capabilities.

Passive Sensor Detection and Defeat (PSDD): Modern integrated air defense systems (IADS) employ a variety of radar sensing technologies to detect, classify, track, target and engage adversary aircraft. Classic IADS radars are active and emit RF radiation and collect the component of their radiation that reflects off of their targets. Radar Warning Receivers (RWRs) can readily detect the radiation of active radars and pilots can take mitigating measures to avoid potential threats.

Platform Self-Protection (PS-P): A wide variety of RF and Electrical 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 adversarial military systems. EO systems have been incorporated into missile seekers and are 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 more capable RF and EO detection/targeting/engagement sensors and seekers are essential. This thrust identifies, explores, and accelerates the maturation and demonstration of new non-kinetic approaches and technologies to counter adversarial advanced Radio Frequency (RF) and EO sensor and seeker threats. To begin identifying the most significant developmental opportunities, Joint Electronic Advanced Technology issued a Request for Information (RFI) call in FY 2022.

Electromagnetic Warfare Technology Enablers (EW Tech): Significant advances in materials, electronics (including photonics, plasmonics, spintronics, magnetronics, quantum technology, etc.) in the context of RF and communications sciences, optical and laser sciences, and information and computational 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 have great relevance in EMSO. They can be used to enhance signal classification accuracy, determine optimal non-kinetic effects through adaptive waveform selection, enhance data fusion of very large datasets, control autonomous systems and make optimal use of dynamic spectrum access capabilities. In order to maintain capability and function of spectrum-dependent systems within the EMOE,

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
U.S. Forces need to be able to rely on AI/ML or cognitive systems to respond as fast or faster than threat cognitive and adaptive systems can decide or maneuver spectrally within the EMOE. EW Cyber Interface (EWCI): The ability to impact system logic through utilizing EW and other RF systems provides powerful new options for EW application. EWCI research efforts identify, explore, and accelerate the maturation 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 U.S.'s traditional dominance in these areas. As Internet of Things (IoT) technologies become more widely adopted, in particular, for networked sensing systems, the technology space shared by RF and cyber will gain importance. EW E&I efforts address emerging cyber-enabled threat systems and work towards developing new technologies and approaches that will ensure that all relevant avenues of attack, sensing or protection are considered and potentially exploited on behalf U.S. warfighters. 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. EW E&I thrusts include Passive Sensor Detection and Defeat, Platform Self-Protection, RF/Photonic applications, EW Technology Enablers, EW/Cyber Interface (EWCI), and EW Collaboration and Cognizance capabilities. ***FY 2024 Plans:*** Passive Sensor Detection and Defeat (PSDD): • SILENT SWARM 24 (SS-24): Complete development and planning for the SS-24 field experimentation venue and conduct SS-24. SS-24 is a Naval Surface Weapons Center (NSWC) Crane led experimentation event focusing on small unmanned and semi-autonomous systems with spectrum related capabilities. Specific emphasis is being placed on the evaluation of technologies for enhanced sensing, precision navigation and timing (PNT), delivery and resilience to non-kinetic effects, autonomy and EW-enabled cyber operations for both autonomous and semi-autonomous operations in SS-24. Early state implications to Concepts of Operations (CONOPS), TTPs, and other operational considerations are often uncovered through these experimentation events. SS-24 will highlight Gray Zone operations that can include cyber and non-kinetic effects. Government and industry technology inputs will be solicited for event participation. SS-24 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. The date and location of SS-24 has yet to be determined. The potential for holding the event at the facilities of one of our AUKUS partners is under consideration.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
• SILENT SWARM 23 (SS-23): Complete assessment and reports for SS-23 and begin planning and development of the SS-24 field experimentation venue. Platform Self-Protection (PS-P): • Joint Aircraft Survivability (JAS) 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 JAS study brings together an alliance of experts that span the Services and includes participation from industry, academia and government laboratories. This effort is expected to address historically ongoing collaboration issues and ultimately re-baseline Department Infrared Countermeasures (IRCM) development efforts. Electromagnetic Warfare Technology Enablers (EW Tech): • JEAT will continue to explore cutting edge Electro Magnetic Warfare (EW) Technology enablers to advance department spectrum superiority objectives. Outreach will continue with industry, academia, and government and service laboratories. EW Cyber Interface (EWCI): • Continue Electronic warfare & Cyber (EW&C) efforts to find synergistic relationships between cyber and Electronic warfare (EW), including EW-enabled cyber effects and non-kinetic approaches. • 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 Office of the Under Secretary of Defense (Research and Engineering), EW and Countermeasures (OUSD(R&E),EW&C) 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. EW C&C efforts also enable the identification and development of collaboration opportunities. ***FY 2025 Plans:*** Passive Sensor Detection and Defeat (PSDD):			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
• SILENT SWARM 24 (SS-24): Complete assessment and reports for SS-24. • SILENT SWARM 25 (SS-25): Begin planning and development of the SS-25 field experimentation venue. Platform Self-Protection (PS-P): • Joint Aircraft Survivability-Electro-optical/Infrared (JAS-EO/IR) Study. Investigation into EO & IR countermeasures and protections. Electronic warfare Cyber Interface (EWCI): • Continue Electronic warfare & Cyber (EW&C) efforts to find synergistic relationships between cyber and Electronic warfare (EW), including EW-enabled cyber effects non-kinetic approaches. • EW Collaboration and Coordination (EW C&C): Continue OUSD(R&E) Electronic warfare & Cyber (EW&C) work to guide, shepherd and oversee all EW and EW/Cyber technology development across DOD. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** The FY 2025 increase of $0.557 million will be used to fund additional studies needed to complete Silent Swarm 24 (SS-24) and assess new capabilities related to Photonically distributed antenna System (PDAS), Platform Self-Protection (PS-P), Joint Aircraft Survivability-Electro-optical/Infrared (JAS-EO/IR) Study, and Electronic warfare Cyber Interface (EWCI) capabilities.			
Accomplishments/Planned Programs Subtotals	18.289	19.793	20.188

	FY 2023	FY 2024
Congressional Add: Photonically Distributed Antenna System	5.000	-
FY 2023 Accomplishments: The $5M congressional plus-up will fund research within Distributed Antenna Systems and focus on: Aperture Building – A minimum of 3 RF photonic aperture will be built for both RX and TX based on technology available at start of effort. Develop Distributed Aperture Synthesis Models– Develop numerical models to predict performance of aperture synthesis for a range of configurations and potential applications.		

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	FY 2023	FY 2024
Evaluate Distributed Aperture Synthesis Techniques– Using laboratory hardware, experimentally validate fundamental aspects of the different aperture techniques. These results will be compared against modelled results to validate model performance. Aperture Synthesis Laboratory Measurements– Perform laboratory experiments to demonstrate and quantify the utility of synthesized apertures. Field Demonstration– Develop a field demonstration plan to prove the utility of the distributed aperture approach for the applications identified over the course of the effort. Program Documentation and Final Report– The results will be documented in a final presentation and report, detailing findings of the investigation and providing recommendations for further paths to transition technology.		
Congressional Adds Subtotals	5.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A