Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602270A / *Electronic Warfare Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	-	33.683	25.558	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	59.241
475: *ELECTRONIC WARFARE COMPONENT TECHNOLOGIES (CA)*	-	7.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.000
906: *Tactical Electronic Warfare Applied Research*	-	26.683	20.197	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	46.880
CYB: *Applied Offensive Cyber*	-	0.000	5.361	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.361

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is realigned with continuity of effort to the following PEs:
* 0602146A Network C3I Technology
* 0602148A Future Vertical Lift Technology
* 0602150A Air and Missile Defense Technology
* 0602213A C3I Applied Cyber

A. Mission Description and Budget Item Justification

This PE designs and validates electronic warfare (EW) components, both hardware and software, that deny, disrupt, or degrade the enemy's use of the electromagnetic spectrum for offensive or defensive operations. This is accomplished through the investigation of electronic support measures (ESM); countermeasures against communications systems and networks; the design and fabrication of sensors used to identify and locate threat forces in an asymmetric environment; and threat warning and electronic countermeasures (ECM) against munitions sensors, missile guidance systems, targeting systems, and explosive hazards. Project 906 supports protection of high-value ground platforms, aircraft and the Soldier from threat surveillance and tracking systems, imaging systems, and advanced radio frequency (RF)/electro-optical (EO)/infrared (IR) guided missiles, artillery, and smart munitions. Information fusion research addresses sensor correlation and fusion, relationship discovery, and management services through use of automated processing, as well as software that applies higher level reasoning techniques to support automated combat assessment. Project 906 also supports research and application of key EW sensors, direction finders and jammers to intercept, locate, and disrupt current and emerging communications and non-communications threat emitters to provide vital quality combat information directly to users in a timely and actionable manner. It focuses on detection of threat sensors and emitters associated with weapon systems, targeting systems and command, control, communications, computers, and intelligence systems and networks. Project CYB designs, creates, evaluates, and applies emerging cyber techniques and cyber situational awareness technologies to enhance Army capabilities and to mitigate risks and investigates cyber collection and mapping technologies to offer real time cyber situational awareness to enable interpretation of current threats and predict future enemy activities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army	Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602270A *I Electronic Warfare Technology*

Work in this PE complements PE 0602120A (Sensors and Electronic Survivability), PE 0602782A (Command, Control, Communications Technology), PE 0603270A (Electronic Warfare Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology); and is coordinated with PE 0603710A (Night Vision Advanced Technology) and PE 0603794A (Command, Control and Communications Advanced Technology).

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Futures Command (AFC).

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	27.144	25.571	26.008	-	26.008
Current President's Budget	33.683	25.558	0.000	-	0.000
Total Adjustments	6.539	-0.013	-26.008	-	-26.008
• Congressional General Reductions	-0.009	-0.013			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	7.000	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.452	-			
• Adjustments to Budget Years	-	-	-26.008	-	-26.008

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: 475: *ELECTRONIC WARFARE COMPONENT TECHNOLOGIES (CA)*		
Congressional Add: *Congressional Program Increase*	7.000	-
Congressional Add Subtotals for Project: 475	7.000	-
Congressional Add Totals for all Projects	7.000	-

Change Summary Explanation

FY18 Congressional add of $7 Million.

FY20 PE realigned due to Science and Technology financial restructuring.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602270A / *Electronic Warfare Technology*	Project (Number/Name) 475 / *ELECTRONIC WARFARE COMPONENT TECHNOLOGIES (CA)*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
475: *ELECTRONIC WARFARE COMPONENT TECHNOLOGIES (CA)*	-	7.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.000

Note

Fiscal Year (FY) 2018 Congressional Increase.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Electronic Warfare technology applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Congressional Add: Congressional Program Increase	7.000	-
FY 2018 Accomplishments: Congressional Program Increase		
Congressional Adds Subtotals	7.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602270A / *Electronic Warfare Technology*				Project (Number/Name) 906 / *Tactical Electronic Warfare Applied Research*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
906: *Tactical Electronic Warfare Applied Research*	-	26.683	20.197	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	46.880

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
Program Element (PE) 0602146A Network C3I Technology
* Project AN7 COE - Every Receiver is a Sensor Technology
* Project AO2 Stand-In Advanced RF Effects (STARE)
* Project AQ2 EW Techniques Technology
* Project AQ3 Network Access and Effects
* Project AV3 Foundational S&T for Network C3I Technology
PE 0602148A Future Vertical Lift Technology
* Project AK2 Aviation Survivability Technology

A. Mission Description and Budget Item Justification

This Project designs, fabricates, evaluates, and applies key electronic warfare (EW)/information operations technologies to enhance platform survivability (to include ground combat vehicles, aircraft, and the dismounted Soldier) and to intercept, track and locate current and emerging threat munitions, communications and non-communications threat emitters. This project applies recent advances in radio frequency (RF), infrared (IR), and electro-optical (EO) sensors and jamming sources to detect, locate, deceive, and jam threats (to include radar directed target acquisition systems, target-tracking sensors, surface-to-air missiles (SAMs), air-to-air missiles (AAMs), top attack weapons, and electronically fused munitions). This project also pursues the ability to neutralize improvised explosive devices. This project designs information systems to provide vital, quality combat information directly to users in a timely, actionable manner in accordance with concepts for future force intelligence operations. This Project investigates RF collection and mapping technologies to offer real time emitter detection, location, and identification. In addition, this project enables a remote capability to disrupt, deny, or destroy threat communication signals and enables fusion (automated assimilation and synthesis) of battlefield intelligence data to enable interpretation of current threats and future enemy activities. This allows commanders to develop operational courses of action in time to act decisively and in a pre-emptive manner.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Futures Command (AFC).

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602270A / *Electronic Warfare Technology*	**Project (Number/Name)** 906 / *Tactical Electronic Warfare Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Multi-Intelligence Data Fusion and Targeting ***Description:*** This effort investigates, designs and codes advanced automated exploitation and fusion analysis tools, applications, and software services for the creation of improved intelligence products, common information management and information dissemination systems to facilitate collaboration between intelligence and mission command functions. This will provide relevant and timely information in support of command decisions, such as high value identification and targeting in an asymmetric environment.	2.319	-	-
Title: Data Analytics for Situational Awareness ***Description:*** This effort researches and designs spectrum sensing, electronic sensing and intelligence collection technologies and analytics to enhance overall situational understanding within a contested battlespace. Efforts focus on developing the analytics necessary to taking advantage of the expanding number of data sources available by leveraging existing tactical receivers and other tactical data feeds. ***FY 2019 Plans:*** Identify relevant tactical receiver data and emerging Internet of Things (IoT) data sources, to include publicly available information, enriching the existing cyber terrain and electromagnetic operations environment; will investigate potential correlation points with non-traditional datasets to identify cyber events; and explore new data analytics, fusion algorithms and semi-automated analytical methods to process and exploit the extended datasets to support cyber situational understanding. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AN7 (COE - Every Receiver is a Sensor Technology) in FY20 as part of the financial restructuring.	-	2.946	-
Title: Offensive Information Operations Technologies ***Description:*** This effort designs, codes and evaluates techniques for RF network mapping, surgical disruption and unobtrusive operations in the presence of host nation networks. Electronic warfare capabilities include detection, location, classification, mapping and disruption of RF networks and providing data to a user. ***FY 2019 Plans:*** Investigate emerging networks to identify shortfalls in capability to detect, identify and map network nodes; identify future analytic, sensor, and data research needs; and investigate techniques for surgical disruption and unobtrusive operation within native network infrastructures. ***FY 2019 to FY 2020 Increase/Decrease Statement:***	7.984	2.470	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602270A / *Electronic Warfare Technology*	**Project (Number/Name)** 906 / *Tactical Electronic Warfare Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AO2 (Stand-In Advanced RF Effects (STARE)) in FY20 as part of the financial restructuring.			
Title: Multispectral Threat Warning and Countermeasures, formerly Multispectral Threat Warning ***Description:*** This effort investigates and evaluates software and warning sensor/countermeasure components to increase probability to detect and defeat current and evolving small arms and man-portable air defense system (MANPADS) type threats for aviation platforms using modeling and simulation (M&S) and hardware in the loop (HWIL) simulations. Work being accomplished under PE 0603270A/Project K16 complements this effort. ***FY 2019 Plans:*** Investigate technologies to indiscriminately detect and defeat broad classes of threats; conduct analysis of next-generation detect technologies with focus on machine learning algorithms to enable detection of unrecognized threat features; conduct analysis of advanced defeat technologies focusing on new lasers and laser materials and build a breadboard laser to indiscriminately degrade EO threat sensor performance; investigate RF digital hardware and software techniques that are adaptive to agile RF threats; use modeling and simulation (M&S) to iteratively train machine learning algorithms to perform threat classification and optimize laser countermeasure and RF technique development; and assess performance of technologies (e.g., machine learning, lasers, etc.) and techniques independently and incorporate them into a digital M&S platform. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602148A (Future Vertical Lift Technology) / Project AK2 (Aviation Survivability Technology) in FY20 realignments as part of the financial restructuring.	6.605	6.800	-
Title: Multi-Function Intelligence, Surveillance and Reconnaissance Technologies ***Description:*** This effort investigates and codes software algorithms and techniques to intelligently integrate tactical Intelligence, Surveillance, and Reconnaissance (ISR) sensors, improve their individual performance and increase the effectiveness of battlespace awareness/intelligence data in an area of operations. Efforts focus on networking of sensors and open, scalable common RF architectures for terrestrial and aerial sensors. ***FY 2019 Plans:*** Research enhanced next generation techniques for distributed sensing and single sensor geolocation to enable detection, and geolocation of advanced threats and inform requirements for future hardware designs; investigate state of the art electronic situational awareness technique susceptibility to adversarial use of next generation RF deception and jamming; investigate cyber hardening of sensor component technology for front-end sensors; investigate a best-of-breed low-cost HF software defined radio for use in an open multifunction ISR platform to be utilized in a hostile cyber environment; will explore trade space of shared multi-function next generation hardware for Radar, SIGINT and EW; perform tradeoff studies to understand the feasibility and impact	8.771	7.246	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602270A / *Electronic Warfare Technology*	**Project (Number/Name)** 906 / *Tactical Electronic Warfare Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
of executing multi-function capabilities from a common RF array with consideration for advancing threat electronic protection capability; and perform laboratory sensing data collections and analysis to address the applicability of a multi-function sensor. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AN7 COE (Every Receiver is a Sensor Technology) and Project AV3 (Foundational S&T for Network C3I Technology) in FY20 as a result of the financial restructuring.			
Title: Multi Function Electronic Warfare (MFEW) Technique Development ***Description:*** This effort investigates and develops EW techniques critical to countering communications, such as networked command and control nodes or improvised explosive device threats, and radars, such as ground surveillance and counter-fire radars. The techniques developed are system agnostic and applicable to a wide variety of EW and electronic countermeasure applications, and they can be used to improve the performance and expand the functionality of both current and future EW system capabilities. ***FY 2019 Plans:*** Investigate and perform vulnerability analysis on emerging threats (including, but not limited to, tactical communications, ground surveillance radar, and counter-fire radar systems) and mature EW techniques and methods (such as active, reactive, surgical, and protocol based software) with the goals of maximizing EW waveform jamming effectiveness, minimizing transmission time, and reducing jamming power to defeat Army relevant threats. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AQ2 (EW Techniques Technology) in FY20 as part of the financial restructuring.	1.004	0.500	-
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.235	-
Accomplishments/Planned Programs Subtotals	26.683	20.197	-

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602270A / *Electronic Warfare Technology*	**Project (Number/Name)** 906 / *Tactical Electronic Warfare Applied Research*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602270A / *Electronic Warfare Technology*	Project (Number/Name) CYB / *Applied Offensive Cyber*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
CYB: *Applied Offensive Cyber*	-	0.000	5.361	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.361

Note

In Fiscal Year (FY) FY 2020 this Project is realigned to::
Program Element (PE) 0602146A Network C3I Technology
* Project AQ3 Network Access and Effects
PE 0602213A C3I Applied Cyber
* Project 5CY Offensive Cyber Operations (OCO) Mirror Technology

A. Mission Description and Budget Item Justification

This Project designs, creates, evaluates, and applies emerging cyber techniques and cyber situational awareness technologies to enhance Army capabilities. This Project leverages behavioral Modeling and Simulation to mitigate risks and investigates cyber collection and mapping technologies to offer real time cyber situational awareness to enable interpretation of current threats and predict future enemy activities. This allows commanders to develop operational courses of action in time to act decisively and in a pre-emptive manner.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Offensive Information Operations Technologies	-	5.165	-
Description: This effort designs, codes and evaluates cyber architectures, software, tools and techniques that identify and capture data traversing targeted networks for the purpose of Cyber Electro Magnetic Activity (CEMA) or otherwise countering adversary communications. Cyber capabilities include detection, identification, exploitation, direction finding (DF), geolocation, and denial of service.			
FY 2019 Plans: Investigate utilizing Machine Learning for threat assessment, decision aid, and mission choreography; determine algorithm design needs for recognition and Battle Damage Assessment for the purposes of survey, network topology understanding, and effect			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602270A / *Electronic Warfare Technology*	**Project (Number/Name)** CYB / *Applied Offensive Cyber*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
assessment; refine CEMA interface definitions to include a mechanism for service/capability discovery to address solidifying mission management across Unified Land Operations platforms. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned in FY20 to PE 0602146A (Network C3I Technology) / Project AQ3 (Network Access and Effects) and PE 0602213A (C3I Applied Cyber) / Project 5CY (Offensive Cyber Operations (OCO) Mirror Technology) in FY20 as part of the financial restructuring.			
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.196	-
Accomplishments/Planned Programs Subtotals	-	5.361	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A