Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I 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	-	221.293	81.618	84.576	-	84.576	82.597	81.884	85.162	98.578	0.000	735.708
AM6: *Modular RF Communications Technology*	-	-	5.986	8.335	-	8.335	-	-	3.507	12.835	0.000	30.663
AM8: *Protected SATCOM Technology*	-	-	6.599	6.510	-	6.510	3.659	2.238	6.513	12.023	0.000	37.542
AN3: *Non Traditional Waveforms Technology*	-	3.290	14.000	10.069	-	10.069	7.545	2.614	-	-	0.000	37.518
AN7: *COE - Every Receiver is a Sensor Technology*	-	2.450	1.044	-	-	-	-	2.124	2.147	2.168	0.000	9.933
AN9: *UNT - Every Receiver is a Sensor Technology*	-	1.998	2.115	4.624	-	4.624	11.045	8.129	6.713	6.141	0.000	40.765
AO4: *Energy Efficient Devices Technology*	-	5.280	5.589	7.159	-	7.159	9.377	11.385	11.948	11.013	0.000	61.751
AP5: *Electronic Warfare Technology*	-	5.230	5.355	5.400	-	5.400	2.879	2.880	2.912	2.941	0.000	27.597
AQ2: *EW Techniques Technology*	-	0.513	0.541	3.701	-	3.701	3.706	-	-	-	0.000	8.461
AQ7: *High Tempo Data Driven Decision Tools Technology*	-	1.242	1.306	-	-	-	2.359	4.165	3.839	3.879	0.000	16.790
AR5: *Understanding the Environment as a Threat Technolo*	-	1.297	-	-	-	-	-	-	-	-	0.000	1.297
AT7: *Network-Enabled GeoSpatial-GEOINT Services Tech*	-	3.137	2.555	4.045	-	4.045	3.103	3.014	8.924	8.480	0.000	33.258
AT9: *Tactical GeoSpatial Information Capabilities Techn*	-	0.499	2.717	2.069	-	2.069	2.962	2.225	4.155	2.955	0.000	17.582
AV3: *Foundational S&T for Network C3I Technology*	-	0.001	-	-	-	-	-	-	-	-	0.000	0.001

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*							
AV5: *Protective Technologies*	-	6.236	6.553	5.307	-	5.307	5.312	5.315	5.373	5.428	0.000	39.524
AV9: *Advanced PNT for GPS Independent Environments Tech*	-	8.829	9.022	8.062	-	8.062	8.020	8.776	8.871	8.960	0.000	60.540
AW1: *Autonomous Navigation Technology*	-	1.977	-	1.002	-	1.002	2.848	5.921	3.006	1.904	0.000	16.658
AW5: *Modular GPS Independent Sensors Technology*	-	-	-	4.546	-	4.546	6.896	7.297	3.782	6.532	0.000	29.053
BP2: *Sensor and Electronic Network Initiatives (CA)*	-	155.000	-	-	-	-	-	-	-	-	0.000	155.000
CG3: *Assured PNT Communications Applied Research*	-	9.833	5.652	4.158	-	4.158	2.867	4.231	4.283	4.332	0.000	35.356
CI3: *Mobile and Survivable Command Post (MASCP) Tech*	-	5.540	3.268	2.375	-	2.375	2.378	2.380	-	-	0.000	15.941
CU6: *Adaptive Information Mediation and Analytics*	-	6.830	7.226	5.957	-	5.957	5.964	7.301	7.380	7.454	0.000	48.112
CV4: *Pathfinder 3D Applied Technology*	-	2.111	2.090	1.257	-	1.257	1.677	1.889	1.809	1.533	0.000	12.366

Note

In Fiscal Year (FY) 2025, a portion of funding from PE 0602146A / Network C3I Technology, Project AV5 /Protective Technologies realigned to 0603042A/C3I Advanced Technology, Project DI6/Anti-Tamper Advanced Tech Development) to support maturation to Technology Readiness Level 6 (TRL6) and transition of anti-tamper technologies into DoD and Army weapons systems.

In FY2025, funding realigned from PE0603463A /Network C3I Advanced Technology, Project AW6/ Modular GPS Independent Sensors Advanced Tech and Project AV8/ Navigation Warfare (NAVWAR) Advanced Technology to PE 0602146A / Network C3I Technology, Project AW5/Modular GPS Independent Sensors Technology.

In FY2025, Project AQ7/High Tempo Data Driven Decision Tools Technology is a skip year.

A. Mission Description and Budget Item Justification

This Program Element (PE) is aligned to the Network and Assured Positioning, Navigation, & Timing (APNT) Army Modernization Priorities. This PE investigates technologies, techniques, components and tools to provide an Army tactical network and enabling infrastructure that support Multi-Domain operations in contested, congested, degraded, and/or denied environments. This is accomplished through the design and development of technologies and components (e.g., electronic

components, software and protocols) that provide unified transport and are supportable; mobile, and survivable, and robust mission command on the move; assured and secure positioning, navigation, and timing in all environments; converged and coordinated cyber and electronic warfare activities; resilient communication and intelligence, surveillance, and reconnaissance payloads for tactical space and high-altitude platforms, and the collection, processing, and dissemination of intel/ops information into a common operating environment. Commercial technologies are continuously investigated and leveraged where possible.

Work in this PE complements PE 0602143A (Soldier Lethality Technology), PE 0602145A (Next Generation Combat Vehicle Technology), PE 0602147A (Long Range Precision Fires Technology), PE 0602148A (Future Vertical Lift Technology), PE 0602150A (Air and Missile Defense Technology), PE 0603118A (Soldier Lethality Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0603464A (Long Range Precision Fires Advanced Technology), PE 0603465A (Future Vertical Lift Advanced Technology), PE 0603466A (Air and Missile Defense Advanced Technology), PE 0603463A (Network C3I Advanced Technology).

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 performed by the United States Army Futures Command, the United States Army Space and Missile Defense Command and the Army Engineer Research and Development Center.

B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	212.115	81.618	83.477	-	83.477
Current President's Budget	221.293	81.618	84.576	-	84.576
Total Adjustments	9.178	0.000	1.099	-	1.099
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	10.783	-			
• SBIR/STTR Transfer	-1.605	-			
• Adjustments to Budget Years	-	-	1.099	-	1.099

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: BP2: *Sensor and Electronic Network Initiatives (CA)*		
Congressional Add: *Program Increase - Energy Efficient Devices*	10.000	-
Congressional Add: *Program Increase - Anti-Tamper Technology*	25.000	-
Congressional Add: *Program Increase - EW and Advanced Sensing*	6.500	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Army	Date: March 2024
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602146A *I Network C3I Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Congressional Add: *Program Increase - Integrated Photonics for Contested RF Environments*	14.000	-
Congressional Add: *Program Increase - Social Network Analysis*	5.000	-
Congressional Add: *Program Increase - BEYOND-LINE-OF-SIGHT NETWORKING ENHANCEMENT*	5.000	-
Congressional Add: *Program Increase - INERTIAL NAVIGATION SYSTEMS*	11.500	-
Congressional Add: *Program Increase - KU-BAND PHASED-ARRAY RADAR EMPLOYING 5G TECHNOLOGY*	1.000	-
Congressional Add: *Program Increase - MAN PORTABLE DOPPLER RADAR*	10.000	-
Congressional Add: *Program Increase - SECURE ELECTRONIC PACKAGING*	10.000	-
Congressional Add: *Program Increase - SPECTRUM SHARING AND MANAGEMENT WITH ADAPTIVE AND RECONFIRURABLE TECHNOLOGY*	5.000	-
Congressional Add: *Program Increase - WAVEFORM DIVERSITY EXPERIMENTAL RESEARCH FOR SENSORS*	5.000	-
Congressional Add: *Program Increase - BIOLOGICAL SENSORS FOR REMOTE ENVIRONMENTS*	9.000	-
Congressional Add: *Program Increase - ALTERNATIVE POSITION, NAVIGATION, AND TIMING*	19.000	-
Congressional Add: *Program Increase - MASS-DISTRIBUTED ACOUSTIC SURVEILLANCE NETWORK*	8.000	-
Congressional Add: *Program Increase - URBAN SUBTERRANEAN MAPPING TECHNOLOGIES*	4.000	-
Congressional Add: *Program Increase - AI/ML Materials for Sensors and Electronics*	7.000	-
Congressional Add Subtotals for Project: BP2	155.000	-
Congressional Add Totals for all Projects	155.000	-

Change Summary Explanation

Increase funding reflects planned research to examine newly emerging quantum sensor architecture; investigate Free Space Optics (FSO) capabilities; design and develop classified RF training data sets; investigate non-GNSS RF sources, analog neural blocks and novel time transfer techniques/concepts.

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AM6 / *Modular RF Communications 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
AM6: *Modular RF Communications Technology*	-	-	5.986	8.335	-	8.335	-	-	3.507	12.835	0.000	30.663

A. Mission Description and Budget Item Justification

This Project investigates and develops techniques, methods, and standards for automation and intelligence to optimally broadcast data among available radio frequency (RF) and networking technologies. This Project adds resiliency to the network through diversity and automation techniques to make automated network decisions (e.g., automated Primary, Alternate, Contingency, and Emergency (PACE)) for the tactical Army to maintain operation in continually changing environments.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM7 (Modular RF Communications Advanced Technology).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Predictive Intelligent Network (PIN)	-	5.986	8.335
Description: The effort investigates the Automated PACE plan capability by developing predictive algorithms and using various sources of information to create a resilient and adaptive network configuration that allows continued and secure communications in Anti-Access/Area Denial (A2AD) environments. The PIN predictive algorithms plans the optimal network topology and configuration by leveraging information on network loads, cyber activities, terrain, weather, movement, and RF situational awareness. In addition, this effort leverages and disseminates RF sensing electronic support information for use by operational forces, to coordinate and enable continued communications through electronic and navigation warfare effects. ***FY 2024 Plans:*** Will investigate the use of Artificial Intelligence/ Machine Learning (AI/ML) techniques to proactively respond to negative network anomalies before they occur by monitoring and processing information such as traffic patterns, congestion conditions, routing patterns and routing stability, movement patterns, and RF information from various sensors and detected cyber events; perform a simulation study to inform decisions on applying detected cyber activities to influence the selection of transports or selection of radio modalities to further protect communications in challenging environments; investigate the use of the prediction and automated PACE decision engines to provide resilient communications for aspects of electronic and navigation warfare missions, to include electronic protection, electronic support and electronic attack; investigate the use of the automated PACE capability to facilitate the transmission of electronic support data to planning and management tools; investigate use cases in which			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AM6 / *Modular RF Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
the predictive and automated PACE decision engines can enable continued communications through electronic attack and disseminate electronic support information for use by operational forces. ***FY 2025 Plans:*** Will investigate fielded sensors, sensor data collection systems, and the platforms on which they reside to determine the types of RF situational awareness information available for use in predictive algorithms; determine the current state-of-the-art for network prediction from the Army, Joint Service, and industry partners; will further refine understanding of algorithm performance, limitations, and computational requirements. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned milestones for investigation of fielded sensors, sensor data collection systems, and the platforms they reside in, as well as a state-of-the-art Network Prediction study. In Fiscal Year (FY) 2025 this project is realigned from Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM7 (Modular RF Communications Advanced Technology).			
Accomplishments/Planned Programs Subtotals	-	5.986	8.335

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AM8 / *Protected SATCOM 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**
AM8: *Protected SATCOM Technology*	-	-	6.599	6.510	-	6.510	3.659	2.238	6.513	12.023	0.000	37.542

A. Mission Description and Budget Item Justification

This Project investigates resiliency of Wideband Satellite Communications (SATCOM) in contested and congested electromagnetic environments. Wideband SATCOM is the primary high-bandwidth Beyond Line of Sight (BLOS) communications used by the tactical Army. This Project designs and develops technologies and components, such as interference cancellation, to increase availability and reliability of Wideband SATCOM in spectrum-challenged environments.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM9 (Protected SATCOM Advanced Technology).

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 Command, Control, Computer, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Multi-Orbit Modem (MOM)	-	6.599	6.510
Description: This effort designs and develops Satellite Communications (SATCOM) ground terminal modem and management technology components to enable operation over multiple satellite constellations to increase performance and resiliency of wideband SATCOM in contested and congested electromagnetic environments. Modem components will include a software based terminal controller for modem management, repository of modem waveforms, and supporting network management. This effort develops resiliency through a flexible modem technology investigation and is complementary with Protected SATCOM efforts focused on antenna development. ***FY 2024 Plans:*** Will investigate a SATCOM Multi-Orbit-Modem system of systems architecture through modeling and simulations that improves size, weight, and power requirements to access current SATCOM orbit constellations and integrate with SATCOM aperture technologies; validate modem architecture in relevant test events coordinated with stakeholders for initial single beam operations capabilities; investigate Multi-Orbit-Modem system, to determine initial requirements for simultaneous multi-beam capabilities both current and emerging SATCOM constellation; validate an integrated modem system to include an integrated virtual software environment with hardware based integrated circuit. ***FY 2025 Plans:*** Will investigate virtualization/containerization of waveforms and use of a 3U Virtual Path Cross-Connect (VPX) carrier card for Application Specific Integrated circuit (ASIC)-based waveforms;			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AM8 / *Protected SATCOM Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
investigate path to Digital-IF (DIFI) for analog-based waveforms; mature management and control system technology as applicable to satellite communications waveforms. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Minor funding decrease reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	6.599	6.510

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AN3 / *Non Traditional Waveforms 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
AN3: *Non Traditional Waveforms Technology*	-	3.290	14.000	10.069	-	10.069	7.545	2.614	-	-	0.000	37.518

A. Mission Description and Budget Item Justification

This Project investigates non-traditional protocols and technologies to provide spectrum efficiency, high bandwidth, low latency, lower spectrum footprint, and/or anti-jam capabilities to tactical networks. This Project develops network resiliency for the dismounted and vehicular units through science & technology investigation.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AN4 (Non-Traditional Waveforms Advanced Technology).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: 5G Technologies ***Description:*** This effort investigates the use of 5G communication services and associated technologies to support high bandwidth, low latency communications for tactical environments with mobile infrastructures.	3.290	-	-
Title: Tactical Application of Advanced Comms ***Description:*** This effort investigates the use of commercial communication services and associated technologies to support high bandwidth, low latency communications for tactical environments with mobile infrastructures. This effort will leverage the latest semi-conductor material research to enable compact antenna aperture designs that provide output power and/or broader frequency coverage required to support aerial platforms performing relay mission in support of non-line-of sight applications without increasing the overall SWAP. ***FY 2024 Plans:*** Will investigate tactically relevant advanced communications capabilities for air-to-ground and mature communications components such as antennas and waveforms. Will continue incorporation of anti-jam and LPI / LPD and increase network robustness through spectrum diversity and efficiency across dispersed nodes and different terrain types. ***FY 2024 to FY 2025 Increase/Decrease Statement:***	-	2.946	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AN3 / *Non Traditional Waveforms Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned conclusion of this effort.			
Title: Spectrum Superstorm ***Description:*** This effort investigates the use of obfuscation and technical effects in the radio frequency spectrum using distributed and dispersed techniques to coordinate signal effects against adversaries from distant transmitters. This effort enables Army emitters to operate free from adversary geolocation attempts through technical effect applications. ***FY 2024 Plans:*** Will investigate the use of distributed techniques, such as coherent and adaptive beamforming for technical effects. Will develop methods of obfuscating the spectrum while providing awareness and coordination with spectrum activities of blue forces. Will research multiple-input multiple-output (MIMO) algorithms aiming to have single obfuscation nodes appears as many systems on the battlefield. ***FY 2025 Plans:*** Will develop orchestration software to dynamically manage RF emissions with emphasis on proof of concept of command and control and incorporating feedback from vendor commercial off the shelf hardware; demonstrate minimum viable product over the air. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.	-	1.857	2.033
Title: Relay for Aerial to Non-line-of-sight Ground Environments (RANGE) ***Description:*** This effort investigates the use of aerial platforms as communications relays ensuring communications coverage is maintained in non-line-of-sight (NLOS) environments, while considering communications resiliency such as anti-jam and low probability of detection. This effort will mature covert, multiband, and embedded antenna elements using new antenna materials for compact antenna aperture designs. ***FY 2024 Plans:*** Will investigate small form factor aerial relay communications payloads capable of enabling both low-band (e.g. L-band (1-2 GHz)/ S-band (2-4 GHz)/C-band (4-8 GHz)) and high-band (e.g. millimeter-wave (30-300 GHz)) operations. Will mature directional communications components and determine applicability of novel waveforms and antennas for aerial relay. Will develop novel software and hardware for tracking and steering directional links. Will design and develop new antenna apertures. Will validate spatial low probability of detection is effective versus the threat using modeling and simulation. Will investigate impact of directional communications on spectrum re-use in congested and contested frequency bands. ***FY 2024 to FY 2025 Increase/Decrease Statement:***	-	6.580	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AN3 / *Non Traditional Waveforms Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects planned conclusion of this effort.			
Title: Quantum Sensing ***Description:*** This effort investigates the use of novel quantum-enhanced spectral receivers capable of wideband sensing of extremely low power signals at very large standoff distances. This effort matures quantum component technologies for use in very high receiver sensitivity. This effort designs and develops tactically relevant quantum sensors, considering form-factor, size, weight, power, and receiver performance. ***FY 2024 Plans:*** Will investigate Josephson Junction (JJ) and Rydberg receiver quantum sensor technologies via modeling and simulation. Will begin development of classical auxiliary components to support and enable quantum sensors for tactical Army applications. Will validate range of frequencies in which Rydberg sensors can reliably detect signals. Will investigate optimal frequency bands for both Rydberg and JJ quantum receivers. Will investigate methods to continue to improve the sensitivity to detect even weaker signals and expand detection protocols for more complicated waveforms. ***FY 2025 Plans:*** Will develop improved modeling and simulation of Josephson Junction and Rydberg receiver quantum sensor technologies with increased fidelity, additional capabilities, and/or increased model scope. Will investigate non-traditional system configurations such as hybrid sensors and external accessories to enhance capability for targeted applications. Will conduct experiments to characterize performance limitations of quantum sensors and their auxiliary components including response to environmental conditions. Will mature classical auxiliary components as necessary to achieve the receiver sensitivity and spectrum agility of quantum sensors. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned milestone investigations to examine newly emerging quantum sensor architecture concepts, which will enable performance optimization and risk mitigation for the future architecture design of the hardware.	-	2.617	4.930
Title: Extremely High Bandwidth Communications (ExHiBComm) ***Description:*** This effort develops communication systems capable of 100X today's data rates while providing spatial low probability of intercept and low probability of detection to the links due to extremely high frequencies of operation. This effort will generate two products: Free Space Optics (FSO) and access points supporting multiple users with extremely high bandwidth. ExHibComm will target on-the-move ground links, but it can support ground to air, ground to space, air to air and air to space applications, enabling multi domain operations. ExHiBComm solves the challenge of spectrum scarcity and enables links anywhere in the world without the need of frequency clearances. ***FY 2025 Plans:***	-	-	3.106

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AN3 / *Non Traditional Waveforms Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will conduct an analysis of alternatives to investigate Free Space Optics (FSO) capabilities when mounted on a mobile platform. Will determine the capabilities and limitations for FSO systems to perform 360-degree sector scanning to track well and maintain connectivity while a vehicular platform is on-the-move. Will conduct experiments to assess the capabilities of the FSO system on frequency transport legacy communication radios, enable multipoint operations and fail over with a primary, alternate, contingency and emergency (PACE) communication plan. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** In FY2025, expansion of communication efforts throughout the program element and funding will be utilized to conduct an analysis of alternatives to investigate FSO capabilities and experimentation to assess the capabilities of the FSO system.			
Accomplishments/Planned Programs Subtotals	3.290	14.000	10.069

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AN7 / *COE - Every Receiver is a Sensor 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**
AN7: *COE - Every Receiver is a Sensor Technology*	-	2.450	1.044	-	-	-	-	2.124	2.147	2.168	0.000	9.933

A. Mission Description and Budget Item Justification

This Project investigates, designs, and codes advanced automated exploitation and fusion analysis tools, applications, and software services that harvest, correlate and fuse tactical receiver sources with new and emerging data sources to improve understanding of the threat picture and more efficiently support near-real time Situational Understanding of the battlefield.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AN8 (COE - Every Receiver is a Sensor Advanced Tech) and PE 0602146A (Network C3I Technology) / Project AN9 (UNT - Every Receiver is a Sensor Technology).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Intelligence Surveillance and Recognizance (ISR) Optimization for MDO Support Technology	2.450	1.044	-
Description: This effort investigates and designs Intelligence Surveillance and Reconnaissance (ISR) collection management technologies and analytics to enhance performance and optimize use of Army ISR resources during multi-domain operations (MDO). Efforts focus on developing the analytics necessary to increase situational awareness of non-organic collections across all domains (Air, Land, Maritime, Space, Cyber and Electromagnetic spectrum), determine highest payoff use of tactical ISR assets, and optimize sensor selection and placement to answer unit intelligence requirements. ***FY 2024 Plans:*** Will develop threat forecasting technologies to validate derivation of prioritized collection requirements to optimize application of Army ISR resources during MDO in contested environments. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding change reflects planned lifecycle conclusion of this Science and Technology effort.			
Accomplishments/Planned Programs Subtotals	2.450	1.044	-

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AN7 / *COE - Every Receiver is a Sensor Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AN9 / *UNT - Every Receiver is a Sensor 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
AN9: *UNT - Every Receiver is a Sensor Technology*	-	1.998	2.115	4.624	-	4.624	11.045	8.129	6.713	6.141	0.000	40.765

A. Mission Description and Budget Item Justification

This Project develops algorithms that enable every communication receiver in the tactical environment to operate as a sensor while maintaining the systems' original networking capability. This Project matures standards and protocols to expand the Cyber-Electromagnetic Activity (CEMA) situational understanding. This Project extends Army's deep sensing capability by improving simultaneous functionality, leveraging all potential sensing assets within the area of operations and supporting real time feedback of mission effectiveness.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO1 (UNT - Every Receiver is a Sensor Advanced Tech) and PE 0602146A (Network C3I Technology) / Project AN7 (COE - Every Receiver is a Sensor Technology).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Multi-Int Modernization Combined Architecture (MIMCA)	1.998	2.115	2.119
Description: This effort investigates optimization of radio frequency transmit and receive resources to conduct simultaneous electronic warfare (EW), signals intelligence (SIGINT) and offensive cyber missions. Efforts will leverage low power interference techniques adapted to high power applications to reduce interference from co-located capabilities on multifunction systems and novel resource scheduling characteristics to execute Cyber and ElectroMagnetic Activities (CEMA) and support real-time feedback such as Battle Damage Assessment (BDA) and adaptive Electronic Attack (EA).			
FY 2024 Plans: Will leverage interference mitigation techniques primarily designed for low power systems and investigate their feasibility to support multifunction operations; investigate applications for sensor assets that operate in the same portion of the spectrum.			
FY 2025 Plans: Will mature commercial interference mitigation concepts that operate with high power multifunction systems to increase the efficiency of Radio Frequency (RF) spectrum resources; design of multifunction scheduling interfaces to ensure compatibility with the commercial interference mitigation technology.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AN9 / *UNT - Every Receiver is a Sensor Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding increase is an economic adjustment.			
Title: Army SIGINT Modernization	-	-	2.505
Description: This effort will investigate and develop Radio Frequency (RF) signal analysis and processing techniques to improve detection, identification, and exploitation of high priority peer/near-peer adversary military signals. Effort will significantly increase detection and parameterization of unknown signals, improving battlespace operations in contested Radio Frequency (RF) environments. ***FY 2025 Plans:*** Will design detection, classification, direction finding, and multi-channel adaptive beamforming techniques for peer/near-peer adversary military RF signals; conduct experiments to validate technique performance metrics to quantify algorithm robustness against various RF environments and scenarios. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort. Funds realigned from PE 0603457 (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology) and PE 0603463 (Network C3I Advanced Technology) / Project AO1 (UNT - Every Receiver is a Sensor Advanced Tech).			
Accomplishments/Planned Programs Subtotals	1.998	2.115	4.624

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AO4 / *Energy Efficient Devices 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**
AO4: *Energy Efficient Devices Technology*	-	5.280	5.589	7.159	-	7.159	9.377	11.385	11.948	11.013	0.000	61.751

A. Mission Description and Budget Item Justification

This Project addresses sustainment operations by unburdening the Soldier and reducing logistics requirements (e.g., fewer batteries) for communications, computing, and sensing. The objective is to investigate the underlying energy efficiency of supply and demand for Soldier-portable and distributed sensor electronics to enable the dismounted Soldier to maintain communications, freedom of movement, and increase mission duration. The majority of the electronics power used by the dismounted Soldier and by distributed electronics is attributable to radio frequency (RF) communications. In addition, freedom of movement and action during sustained and high tempo operations requires seamless battery recharging. To address these challenges, energy efficient electronics research includes RF and optoelectronic circuits, devices, materials and wireless power (and data) transfer.

Work in this Project complements Program Element (PE) 0602146A (Network C3I Technology) / Project AN3 (Non-Traditional Waveforms Technology), PE 0602143A (Soldier Lethality Technology) / Project BD8 (Soldier & Sm Unit Tactical Energy Tech), and PE 0601102A (Defense Research Sciences) / Project AA9 (Information and Networking).

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 Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Energy Efficient Electronic and Photonic Components	5.280	5.589	5.656
Description: This effort investigates energy efficiency improvements in support of four key areas: RF component devices, optoelectronic devices for alternative communications modes, long-lived and high efficiency power sources, and efficient wireless power and data transfer technologies. These components enable energy-efficient communications and networked energy, specifically leading to increased Soldier mission duration and long-lived networked electronics.			
FY 2024 Plans: Will investigate approaches to increase efficiency in Ultraviolet (UV) sources for communications; conduct research of 'time folding' radio frequency (RF) circuits for efficient operation of small size, weight and power (SWaP) systems, encompassing techniques for increasing the RF power in short pulses, while utilizing charging from a small battery; investigate power density limitations of textured silicon carbide betavoltaic devices coupled with nickel-63 radioisotope beta emission; design piezoelectric transformer for temperature robustness as well as model and experimentally assess wake-up receiver sensitivity as a function of			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AO4 / *Energy Efficient Devices Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
operation frequency and power draw; continue to investigate novel silicon based field programmable neural array circuit with in-memory computing for efficient computation close to the network edge. ***FY 2025 Plans:*** Will mature novel silicon-based reprogrammable neural array circuitry components to include refinement of arithmetic logic units, memory, routing, and timing for efficient inferencing close to the network edge; investigate and develop novel materials and heterostructures to natively embed mathematical integration of spiking signals for efficient neural networks; investigate semiconductor and scintillator materials that can efficiently convert ions into electrical output in compact power sources; assess self-detachable receiver with improved power transfer and magnetic attachment for acoustic through metal power transfer; investigate novel architectures such as super-luminescent designs to increase Ultraviolet (UV) source output power and efficiency for communications; investigate novel high efficiency high performance transceivers using high-voltage wide bandgap and ultra-wide bandgap semiconductor materials. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Tactical Edge Cognitive Computing (TECC) ***Description:*** This effort investigates innovative microelectronic designs that incorporate spiking neural network devices with state-of-the-art digital electronics. Novel physical material processing methods will enable the incorporation of emerging materials for spiking neural networks into complementary metal-oxide semiconductor (CMOS) foundries and circuit structures to enable hardware configuration to different neural networks. Models of spiking devices and circuits guide the translation of mathematical spiking neural networks into state-of-the-art neuron hardware. These designs are combined with state-of-the-art digital electronics to enable highly efficient artificial intelligence on sensors, radios and/or other Army systems. ***FY 2025 Plans:*** Will investigate incorporating analog neural blocks alongside digital neural blocks using state-of-the-art microelectronics approaches; incorporate specific inferencing neural networks into the microchips for assessment and proof of concept; mature processes for ferroelectric oxides to enable non-volatile spike integration in legacy CMOS; develop automated design techniques. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding realigned from Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) / Project BF8 (Artificial Intelligence & Machine Learning Tech) and PE 0602181A (All Domain Convergence Applied Research) / Project CM7 (Collaborative Convergence Applied Research) to this effort.	-	-	1.503
Accomplishments/Planned Programs Subtotals	5.280	5.589	7.159

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AO4 / *Energy Efficient Devices Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AP5 / *Electronic Warfare 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
AP5: *Electronic Warfare Technology*	-	5.230	5.355	5.400	-	5.400	2.879	2.880	2.912	2.941	0.000	27.597

A. Mission Description and Budget Item Justification

This Project investigates emerging technologies related to Electronic Warfare (EW) applications, non-kinetic survivability/lethality, and emerging concepts of employment in the increasingly contested and congested electromagnetic environment, with the goal of enhancing the survivability/lethality of Army platforms through Electronic Attack (EA), electronic warfare support (ES), and Electronic Protection (EP) with high operational realism for current and future threats being implemented at multiple scales.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO7 (EW for Maneuver Operations (EMO) Adv Tech).

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 Army Research Laboratory (ARL) and Data and Analysis Center (DAC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Electronic Warfare Technology Research	2.416	2.499	2.524
Description: This research investigates emerging Electromagnetic Warfare technologies and novel approaches to apply distributed and combined effects to a broader class of threats, with a goal of adequately degrading threat performance. This effort examines approaches for interdisciplinary laboratory and field experiments with analysis and assessment tools to address survivability and effective countermeasures in a realistic Electromagnetic environment. ***FY 2024 Plans:*** Will investigate cognitive countermeasures to emerging complex and cognitive radar threats whereby reducing reliance on human operators and a priori information; validate effects in multi-channel Hardware-in-the-Loop (HIL) environment thus increasing scenario complexity to enable distributed electronic warfare applications while incorporating a high-level of operational realism; validate indoor HIL simulated results in a relevant outdoor test environment. ***FY 2025 Plans:*** Will validate cognitive countermeasures by improving network-enabled Hardware-in-the-loop (HIL) assessment environment; adapt cognitive algorithms to emerging high performance processing innovations; leverage advancements in generative artificial			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AP5 / *Electronic Warfare Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
intelligence and reinforcement learning to improve effectiveness of countermeasures against emerging complex emitters and cognitive radar threats. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Electronic Warfare Assessment Technologies ***Description:*** This effort investigates emerging technologies related to EW applications (e.g., digital RF memory, software defined radios, cognitive radars) and electromagnetic-enabled cyberspace operations in the increasingly contested and congested environment. Research is focused on near-peer and future threats to enhance survivability/lethality, and discover critical vulnerabilities, of Army technologies and systems through cyber and electromagnetic activities (CEMA). ***FY 2024 Plans:*** Will develop EW techniques and processes for use as cognitive countermeasures for emerging complex and cognitive radar threats; conduct laboratory, HIL, and field experimentation for assessment of developing technology; mature techniques for low-cost emitting targets and countermeasure assets. ***FY 2025 Plans:*** Will investigate emerging complex threats related to cognitive radars and near peer adversary use of artificial intelligence/machine learning (AI/ML) techniques in radars for identification and classification of targets; develop EW threat emulation capabilities to investigate the effects of emerging radar threats (e.g., cognitive, AI-enabled functions) by conducting laboratory, hardware-in-the loop, and field experiments of technology; develop metrics to quantify and understand EW effects. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.	0.675	0.686	0.690
Title: Combined and Distributed Electromagnetic Warfare (CDEW) ***Description:*** This research investigates emerging Electromagnetic Warfare technologies and novel approaches to apply distributed nodal and combined/coordinated electromagnetic spectrum warfare effects to counter a broader class of threats, with a goal of adequately degrading threat performance, increasing standoff distance to target, and increasing the survivability of US systems contested and complex environments. ***FY 2024 Plans:*** Will investigate, develop, and assess EW techniques requiring the use of distributed apertures; investigate combined and distributed techniques against emerging multi-static emitters; refine and assess a 2-node synchronization technique that includes	2.139	2.170	2.186

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AP5 / *Electronic Warfare Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
feedback electronics to correct node phase in real-time; assess multi-aperture beam-forming performance for improved pointing-angle for electronic support and electronic attack. ***FY 2025 Plans:*** Will design and build a 5-node, distributed transceiver aperture for electronic attack and benchmark its performance; implement an algorithm to measure the relative position of the distributed nodes without Global Positioning System (GPS); mature the synchronization algorithm for the 5-node architecture; and assess increased power density on a target. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Accomplishments/Planned Programs Subtotals	5.230	5.355	5.400

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AQ2 / *EW Techniques 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**
AQ2: *EW Techniques Technology*	-	0.513	0.541	3.701	-	3.701	3.706	-	-	-	0.000	8.461

A. Mission Description and Budget Item Justification

This Project develops countermeasures against adversarial counter-fire systems that obscure and create distractive blue force locations. This Project will develop and mature distributed, coordinated electronic warfare (EW) capabilities designed to extend effective range, reduce blue transmitter susceptibility to localization, and introduce errors in adversary intelligence, surveillance and reconnaissance (ISR) systems to facilitate maneuver within multi-domain operations (MDO).

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO7 (EW for Maneuver Operations (EMO) Adv Tech).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025**
Title: Simultaneous Counter Measures (CM) for Active Reconnaissance and Surveillance (SCARS) ***Description:*** This effort will provide investments in Electronic Warfare (EW), against advancing counter-fire sensors. This effort will investigate highly synchronized techniques to achieve advanced effects. ***FY 2024 Plans:*** Will validate reduced efficacy of adversary counterfire systems to target friendly forces via modeling and simulation; overlay counter ISR and counterfire applications to assess the impact decoy techniques have on adversarial targeting capabilities. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned life cycle conclusion of this Science and Technology effort.	0.513	0.541	-
Title: Sparrow Technology ***Description:*** This effort will fund research in Electronic Warfare (EW) to impair and/or degrade adversary counter-fire sensor networks. This effort will investigate and mature highly synchronized techniques to simultaneously produce advanced effects against RF systems capable of degrading Army countermeasures (camouflage, concealment, tactics, and other EW capabilities) leaving friendly forces susceptible to detection, location, and kinetic engagement. The hardware and software capabilities developed will provide opportunistic, multiplatform delivery of electromagnetic warfare capabilities that are more challenging for adversaries to mitigate.	-	-	3.701

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AQ2 / *EW Techniques Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
FY 2025 Plans: Will perform hardware and software validation supporting the design and development of distributed EW payloads; mature and develop software capabilities on distributed EW payload for specific threat(s). ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of project. In Fiscal Year (FY) 2025, funding is realigned from Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO7 (EW for Maneuver Operations (EMO) Adv Tech) to this effort.			
Accomplishments/Planned Programs Subtotals	0.513	0.541	3.701

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AQ7 / *High Tempo Data Driven Decision Tools 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**
AQ7: *High Tempo Data Driven Decision Tools Technology*	-	1.242	1.306	-	-	-	2.359	4.165	3.839	3.879	0.000	16.790

Note

In Fiscal Year (FY) 2025, this Project has a skip year.

A. Mission Description and Budget Item Justification

This Project investigates and develops data driven decision tools that increase operational tempo and allow commanders to dominate decision spaces over adversaries. The tools will provide the commander with contextually relevant data and adaptive decision models. Information and recommendations will be made and disseminated to commander and staff in a cognitively appropriate manner.

Work in this Project complements Program Element (PE) 0603463A Network C3I Advanced Technology / Project AQ8 (High Tempo Data Driven Decision Tools Adv Tech).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: RoadRunner	1.242	1.306	-
Description: This effort investigates and develops stakeholder prioritized capabilities that fuse intel and ops perspectives that drive decisions to enable dominance in complex Multi-Domain Operations. Effort will design applications which provide enhanced operations, and intelligence functions through efficient analysis and utilization of battlespace data, and increased speed of action.			
FY 2024 Plans: Will develop fused intel and ops software assisting Commanders and staff by managing time constraints and cognitive limitations to synchronize warfighter functions; validate battle damage assessments and after action reports automatically with proposed force structures and operations; conduct experiments with live and simulated battlespace data and intelligence information, adjusting running estimates by analyzing the changing battlespace OODA loops.			
FY 2024 to FY 2025 Increase/Decrease Statement: This effort completes in FY 2024, in FY 2025 this project is a skip year.			
Accomplishments/Planned Programs Subtotals	1.242	1.306	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AQ7 / *High Tempo Data Driven Decision Tools Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AR5 / *Understanding the Environment as a Threat Technolo*	

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
AR5: *Understanding the Environment as a Threat Technolo*	-	1.297	-	-	-	-	-	-	-	-	0.000	1.297

A. Mission Description and Budget Item Justification

This Project designs and advances mission planning software enabling the Soldier to identify, track, and plan for industrial or commercial chemical/environmental threats. Software modules will increase capability of mission based planning technologies providing new operational routing options for mission execution with environmental threat overlays.

Work in this Project complements Program element (PE) 0603463A (Network C3I Advanced Technology) / Project AR6 (Understanding the Environment as a Threat Adv Tech).

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 Engineer Research and Development Center Environmental Laboratory, Geospatial Research Laboratory, and Information Technology Laboratory..

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Subsurface Forensics ***Description:*** This effort will prepare Soldiers for the risks of deliberate or accidental release of toxic industrial chemicals and materials by investigating and developing methods to collect data to characterize and predict the fate and transport of hazards of concern.	1.297	-	-
Accomplishments/Planned Programs Subtotals	1.297	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AT7 / *Network-Enabled GeoSpatial-GEOINT Services Tech*			
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**
AT7: *Network-Enabled GeoSpatial-GEOINT Services Tech*	-	3.137	2.555	4.045	-	4.045	3.103	3.014	8.924	8.480	0.000	33.258

A. Mission Description and Budget Item Justification

This Project investigates and develops an integrated capability to rapidly share mission critical 3-dimensional (3D) information that supports planning and execution at the Soldier level. This will be achieved through the maturation of next-generation geospatial analytical models for 3D complex urban environment data, delivering enriched understanding of dynamic Operational Environments and distributed to a tactical Common Operating Environment. This Project will result in improved situational awareness and autonomy at low echelons, contributing to increased maneuver and mobility during manned and unmanned teaming operations.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AT8 (Network-Enabled GeoSpatial and GEOINT Services AdvTech).

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 Engineer Research and Development Center Geospatial Research Laboratory, Cold Regions Research and Engineering Laboratory, and Information Technology Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025**
Title: Geospatial Data for Tactical Visualization ***Description:*** This effort develops new open source software, data models and processes to generate a vision-based geospatial foundation layer to enable end-users systems to visualize real-time mission critical geospatial content at the required level-of-detail (LOD) and enable position-navigation self-localization capability applicable to end-user devices at required accuracies optimized for the device, application, and mission.	1.057	-	-
Title: Geospatial - Intelligence Community Merge Research ***Description:*** This effort researches different approaches to automatically search Intelligence Community (IC) databases to discover and then extract relevant attributes to be added as new metadata to adaptively scaled 3D terrain features and/or geographic areas. Geospatial and relevant intelligence data will be merged together, discoverable, and capable of user-selected query from a single computing environment. An enhanced 3D common operating picture will be demonstrated providing a more comprehensive understanding of the Operational Environment for greater situational awareness and decision making. ***FY 2024 Plans:***	1.062	1.675	1.139

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AT7 / *Network-Enabled GeoSpatial-GEOINT Services Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will develop an automated approach for connectivity and integration of enriched specific geospatial products and selected Intelligence community (IC) databases/schemas for the purpose of developing and refining situational understanding of a triggered or selected situation.?Will investigate automated approaches for designation of intelligence search terms that will spawn discovery, or automated processing, of geospatial/GeoINT products that improve situational understanding. ***FY 2025 Plans:*** Will investigate GIS mapping software deployment for mesh and intelligence attributes and explore other types of information with geographics (or derivable location) that can be fused on mesh data. Will develop software for automated crawling, discovery, and extraction of IC database attributes and appending of these attributes as new 3D model metadata. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned completion of workflows required to complete software development in Fiscal Year 2025.			
Title: Geospatially Relevant Intuitive Propagation Services Technology ***Description:*** This effort researches a novel expert propagation model to integrate battlefield sensor data with environmental predictive modeling (weather and terrain influences). The resulting technology will optimize collection asset employment against adversaries as well as providing situational awareness of friendly units' multi-modal signature footprint (e.g. radio frequency, thermal, acoustic). This effort will significantly reduce the analyst cognitive load, and fill an important need for fused, validated, environment and terrain-aware analyses for multi-modal sensors in support of C2, Intelligence and Protection Warfighting Functions. ***FY 2024 Plans:*** Will design realistic use cases within the Common Operating Environment to evaluate and gather relevant data and submit sensor performance analysis requests to optimize collection assets. ***FY 2025 Plans:*** Will develop multi-modality software to take real-time cues from the sensor network and publish sensor performance results back to the Sensor Compute Environment producing geospatial data discoverable within Army devices. Will integrate fractional line of sight algorithms into the Geospatial Relevant Intuitive Propagation Services (GRIPS) sensor performance modeling environment. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects the planned milestones for the development of capabilities integrated with sensor networks to enable full automation from discovery to output.	1.018	0.880	2.404
Title: Terrain & Battlefield Computing, Optimized Network Computing Resources ***Description:*** This effort investigates the Army's network ability to provide appropriate resources for geospatial data to include tools that require a wide range of data volumes (from low to very heavy), and as a consequence, may incur significant	-	-	0.502

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AT7 / *Network-Enabled GeoSpatial-GEOINT Services Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
computational costs. The goal is to develop a simulation testbed for geospatial tools under different network configurations and application scenarios. The simulation testbed will measure and inform network requirements that can accommodate geospatial products downstream and as far out as necessary. ***FY 2025 Plans:*** Will research and assess geospatial tools that perform machine learning, require medium-to-high data volumes, and enable visualization. Will investigate computing environments based on hardware capabilities (server, desktops, small devices). Will determine access and permissions to existing networks that will be targeted for deployment and design initial testbed specifications for simulation based on targeted tools. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects planned initiation of this effort.			
Accomplishments/Planned Programs Subtotals	3.137	2.555	4.045

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AT9 / *Tactical GeoSpatial Information Capabilities Techn*	

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
AT9: *Tactical GeoSpatial Information Capabilities Techn*	-	0.499	2.717	2.069	-	2.069	2.962	2.225	4.155	2.955	0.000	17.582

A. Mission Description and Budget Item Justification

This Project investigates and develops next generation geospatial analytical tools for 3-dimensional complex environments for low echelon and tactical edge exploitation. Research focuses on improving geospatial and Geospatial Intelligence (GEOINT) aspects of situational awareness in the complex environments by exploiting new data sources, automating analytical tasks, and testing new collection technologies, including interiors of infrastructure. Research develops capabilities to enhance/ update provisioned (baseline) standard, sharable, geospatial foundation (SSGF) data through automated analytics on multi-sourced spatial data resulting in streamlined, enhanced high fidelity terrain analysis products. Reducing data gaps and processing timelines will greatly increase Soldier situational awareness and support faster decision making in complex terrain.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AU1 (Tactical GeoSpatial Information Capabilities ATech).

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 Engineer Research and Development Center Geospatial Research Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Geospatial Analytics and Prediction Technology	0.499	2.717	2.069
Description: This effort designs and develops automated/semi-automated geospatial tools implementing spatial/temporal data analysis, creation of predictive scenarios, anomaly detection and cross-scale and local scale analysis of terrain.			
FY 2024 Plans: Will develop a high resolution 3-Dimensional workflow from building interiors and subterranean spaces. Will investigate temporal nature of landscape and anomaly detection and cross-scale analysis of terrain.			
FY 2025 Plans: Will conduct investigations of terrain and scenario forecasting for integrated effects of changing terrain, in support of anticipatory decision making. Will advance spatial-temporal and cross-scale analysis of terrain to identify regions requiring additional surveillance and generate seasonally adjusted layers.			
FY 2024 to FY 2025 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AT9 / *Tactical GeoSpatial Information Capabilities Techn*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Funding decrease reflects the planned reduction of workflows as technologies transition to Program Element 0603463A (Network C3I Advanced Tech) / Project AU1 (Tactical GeoSpatial Information Capabilities ATech).			
Accomplishments/Planned Programs Subtotals	0.499	2.717	2.069

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AV3 / *Foundational S&T for Network C3I 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
AV3: *Foundational S&T for Network C3I Technology*	-	0.001	-	-	-	-	-	-	-	-	0.000	0.001

A. Mission Description and Budget Item Justification

This Project develops underlying technologies applicable to artificial intelligent agents and holistic network integration as applied to, but not limited to autonomous manned-unmanned teaming for ground and air platforms. This Project also matures emerging research leading to potential technology development in areas of strategic importance to the Army in network technologies, by bringing competitively selected Universities with research teams into Technical Alliances.

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

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

Research in this project is done in coordination with PE 0603463A (Network C3I Advanced Technology) / Project AV4 (Foundational S&T for Network C3I Advanced Tech).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Development of Disruptive, Innovative Research for Emerging (DIRE) Applied Network Capabilities	0.001	-	-
Description: This effort develops innovative network capabilities using a rapid and agile methodology to examine feasibility of incorporation into Army network problem sets.			
Accomplishments/Planned Programs Subtotals	0.001	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AV5 / *Protective Technologies*			
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**
AV5: *Protective Technologies*	-	6.236	6.553	5.307	-	5.307	5.312	5.315	5.373	5.428	0.000	39.524

Note

AV5/Protective Technologies restructured -In Fiscal Year (FY) 2025, funding is restructured to Program Element (PE) 0603462 (C3I Advanced Technology) / Project DI6 (Anti-Tamper Adv Tech Dev).

A. Mission Description and Budget Item Justification

This Project develops Anti-Tamper tools, devices, and techniques to protect acquisition program systems' Critical Program Information (CPI) from continually evolving adversarial reverse engineering/exploitation threats due to battlefield loss and foreign sale. Loss of CPI will impact the ability of these systems to maintain US overmatch capabilities.

Research in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project DI6 (Anti-Tamper Advanced Tech Development)

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 Aviation & Missile Center (AvMC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Protective Technologies	6.236	6.553	-
Description: This effort develops tools, devices, and techniques to protect acquisition program systems' Critical Program Information (CPI) from adversarial reverse engineering/exploitation threats due to battlefield loss and foreign sale. Loss of CPI will impact the ability of these systems to maintain US overmatch capabilities. ***FY 2024 Plans:*** Will continue to explore the latest exploitation threats faced by DoD and Army weapons systems and focus design and development efforts toward new protective technologies to be made available to Army and DoD weapons system programs and their developers in meeting their Ant-Tamper requirements. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** In Fiscal Year (FY) 2025, funding is restructured to Program Element (PE) 0603462 (C3I Advanced Technology) / Project DI6 (Anti-Tamper Adv Tech Dev).			
Title: Anti-Tamper Technology Development	-	-	5.307
Description: This task continues the development of anti-tamper tools, devices, and techniques to protect acquisition program systems' (CPI) from adversarial reverse engineering/exploitation threats due to battlefield loss and foreign sale. Loss of CPI will			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AV5 / *Protective Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
impact the ability of these systems to maintain US overmatch capabilities. Such tools, devices and techniques are not readily available for use by US Army and DoD programs to use in their systems. ***FY 2025 Plans:*** Will develop advanced microelectronics-based security solutions for anti-tamper application to address emerging adversarial threats. Will evaluate new anti-tamper technologies for integration in Army and DoD systems to protect critical technology with improved resilience to exploitation. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects restructure from task Protective Technologies within this project.			
Accomplishments/Planned Programs Subtotals	6.236	6.553	5.307

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AV9 / *Advanced PNT for GPS Independent Environments Tech*			
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**
AV9: *Advanced PNT for GPS Independent Environments Tech*	-	8.829	9.022	8.062	-	8.062	8.020	8.776	8.871	8.960	0.000	60.540

A. Mission Description and Budget Item Justification

This Project develops technologies that will enable precise and assured Positioning, Navigation, and Timing (PNT) in Global Positioning System (GPS)-denied environments by addressing the PNT's toughest Scenario - Scenario 4 (no available GPS signal during the mission duration) with a goal of enabling Soldier missions of up to seven days in a GPS denied environment. This is achieved by researching advanced quantum timing circuits, advanced inertial measurement unit (IMU) components, multi-sensor modalities, perception techniques, geo-location data, vision aided navigation sensors, and available radio frequency (RF) signals.

This work also addresses the PNT Scenario 1 (GPS operations that start well and have degraded GPS signals throughout the mission duration) through Scenario 3 (GPS operations that have bad or limited availability of GPS signals throughout the entire mission). This is achieved by investigating the ability to transmit jam- resistant, precision timing synchronized signals using optical fibers, free-space using lasers, and in the RF domain using innovative RF antenna concepts to extend the reach of Soldier compatible capabilities in heavily contested GPS environments.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Modular GPS Independent Sensors Advanced Tech) and Program Element (PE) 0602146A (Network C3I Technology) / Project AW5 (Modular GPS Independent Sensors Technology).

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 Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Precision Measurement Technology for Contested Environments	3.260	3.309	2.464
Description: This effort will develop technologies that will enable precise and assured PNT in GPS-denied environments for extended durations. This research will improve the accuracy while also focusing on size, weight, power, cost (SWAP-C) of current IMUs to advance capability at the tactical edge to include sUAS and dismounts. This effort will address the design, fabrication, and assessment of novel micro-electromechanical system (MEMS) sensor designs and materials and the integration of multiple sensor modalities with the IMUs using sensor fusion and perception techniques to reduce drift and increase positional accuracy. Research will also include the ability to transmit jam-resistant precision position, navigation, and timing signals via electro-optical and/or RF transmission methods.			
FY 2024 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AV9 / *Advanced PNT for GPS Independent Environments Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Will fabricate, characterize, and optimize micro-electromechanical systems (MEMS) gyroscopes and accelerometers with novel self-calibration techniques; apply inertial measurement unit (IMU) system-level modeling techniques to determine expected performance improvements due to novel materials and calibration techniques; validate inertial sensor performance improvements with integrated control electronics; design, fabricate, and characterize performance of resonators and inertial sensors leveraging novel piezoelectric materials. ***FY 2025 Plans:*** Will assess performance limits of micro-electromechanical systems (MEMS) inertial sensors with novel self-calibration and tuning methods based on integrated novel piezoelectric materials; investigate new high-quality-factor structural materials for next-generation inertial sensors; validate inertial measurement unit (IMU) system-level modeling techniques for multiple degrees of freedom. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects reduction of research in the area of inertial sensors and optical designs for MEMs.			
Title: Quantum Effects for Assured PNT in Zero-GPS Environments ***Description:*** This effort will research SWAP-C quantum based timing sub-systems, incorporate advanced sensors, RF signals (beyond GPS), navigation databases, and advanced algorithms. This effort incorporates advanced quantum timing circuits, advanced IMU components, multi-sensor modalities, perception techniques, geolocation data, vision aided navigation sensors, and available RF signals in order to increase precise and assured PNT operations in a GPS denied environments for up to seven days. ***FY 2024 Plans:*** Will validate and integrate novel PNT sensors with hybrid, modular multi-sensor fusion engine; develop and optimize novel algorithms and architecture for sensor fusion state estimation; continue to develop self-stabilization circuitry for frequency stabilization of micro-resonator optical frequency combs; design and develop integration techniques for micro-resonator optical frequency combs, injection-locked laser, and self-stabilization circuit that enable low-SWAP chip-scale optical clocks/oscillators; develop low SWAP-C optical transmit/receive unit for free-space optical positioning and time transfer. ***FY 2025 Plans:*** Will investigate optimized algorithms and architecture for modular positioning, navigation, and timing (PNT) sensor fusion state estimation; down-select self-stabilization circuitry architecture for frequency stabilization of micro-resonator optical frequency combs; assess integration techniques for micro-resonator optical frequency combs, injection-locked laser, and self-stabilization	5.569	5.713	5.598

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AV9 / *Advanced PNT for GPS Independent Environments Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
circuit that enable low-SWAP chip-scale optical clocks/oscillators; investigate performance of low SWAP-C optical transmit/receive unit for free-space optical positioning and time transfer. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	8.829	9.022	8.062

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AW1 / *Autonomous Navigation 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**
AW1: *Autonomous Navigation Technology*	-	1.977	-	1.002	-	1.002	2.848	5.921	3.006	1.904	0.000	16.658

A. Mission Description and Budget Item Justification

This Project investigates use of sensors on the platform and available navigation signals to the localization and decision making of Robotic/Autonomous Systems. Additionally, it examines the use of machine learning algorithms for cooperative navigation to aid in a Positioning, Navigation and Timing (PNT) solution. This will enable the user to achieve operational overmatch in a Global Positioning System (GPS) impeded environment as well as enhanced navigation (reducing dependence on GPS) through challenging terrains. This project investigates and develops techniques and algorithms to provide assured access to PNT in degraded electromagnetic (jamming), space, or cyber environments and notify Soldiers, Systems, and Platforms when PNT cannot be trusted for mission duration. This project seeks to study and develop an innovative, adaptive Navigation Warfare (NAVWAR) electronic attack (EA) capability, both jamming and spoofing, utilizing cooperative platforms to deny adversaries the ability to utilize GNSS receivers, reducing their overall mission effectiveness. The cooperative platforms can defeat advanced Global Navigation Satellite System (GNSS) capabilities, including controlled reception pattern antennas (CRPAs), by creating a diverse and adaptive jamming geometry. Cooperative platforms can leverage their distributed environmental situational awareness to establish and transmit spoofing solutions.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AV8 (Navigation Warfare (NAVWAR) Advanced Technology).

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 Space and Missile Defense Technical Center and Command, Control, Computer, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Intelligent Electronic Protect (IEP)	1.977	-	-
Description: This effort provides assured access to PNT in degraded electromagnetic (jamming), space, or cyber environments; notifies Soldiers, Systems, and Platforms when PNT cannot be trusted for mission duration; provides Soldiers, Systems, and Platforms a reduction in the likelihood of being spoofed for mission duration; provides unhindered access to military GPS level of accuracy when access to military GPS is unavailable; and facilitates graceful degradation of PNT systems when military GPS is denied or degraded.			
Title: Positioning, Navigation and Timing (PNT) Defeat Techniques	-	-	0.501

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AW1 / *Autonomous Navigation Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: This effort enables simultaneous execution of Electronic Warfare (EW) and PNT defeat missions with more efficient use of available EW/Cyber and Electromagnetic Activities/PNT (EW/CEMA/PNT) resources. It will provide a unique approach to defeat adversary systems utilizing NAVWAR Attack as an embedded mode in EW systems. ***FY 2025 Plans:*** Will investigate current-state and novel NAVWAR Attack techniques. Will determine the capabilities and limitations of utilizing existing EW systems for NAVWAR Attack. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding realigned from Program Element (PE) 0603041A (All Domain Convergence Advanced Technology) / Project DA4 (All Domain Convergence Engineering & Architectures).			
Title: Resilient NAVWAR Defeat ***Description:*** This effort provides dynamic and resilient Navigation Warfare (NAVWAR) electronic attack through employing cooperative platforms to deny the adversaries use of GNSS, decrease the adversary's operational effectiveness, and increase blue-force maneuver space. ***FY 2025 Plans:*** Will conduct a study to quantify this advanced resilient NAVWAR EA capability to include platform market research, optimized geometric diversity, platform formation control, EA techniques, targeting algorithms, and machine learning (ML) parameters. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding realigned from Program Element (PE) 0603041A (All Domain Convergence Advanced Technology) / Project DA4 (All Domain Convergence Engineering & Architectures).	-	-	0.501
Accomplishments/Planned Programs Subtotals	1.977	-	1.002

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AW5 / *Modular GPS Independent Sensors 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**
AW5: *Modular GPS Independent Sensors Technology*	-	-	-	4.546	-	4.546	6.896	7.297	3.782	6.532	0.000	29.053

Note

In Fiscal Year (FY) 2025, funding was realigned from Project Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Navigation Warfare (Modular GPS Independent Sensors Advanced Tech) and Project AV8 (Navigation Warfare (NAVWAR) Advanced Technology).

A. Mission Description and Budget Item Justification

This Project performs research and development of modular Global Positioning System (GPS)-independent sensors and an open architecture sensor fusion core enabling simple, plug-and-play sensor modules that can be tailored for any platform based on mission needs and requirements. This Project investigates the design of a single receiver that integrates multiple commercial and military signal sources to provide Position Navigation and Timing (PNT) solution effective in contested environments.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Modular GPS Independent Sensors Advanced Tech).

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 Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance, and Reconnaissance (C5ISR) Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Frequency Independent Localization and Time for Enhanced Resiliency (FILTER)	-	-	2.040
Description: This effort increases the resilience of Position, Navigation and Timing (PNT) systems by enabling them to take advantage of additional, non-Global Navigation Satellite Systems (GNSS) Radio Frequency (RF) sources. This effort investigates the design of a single PNT receiver that integrates multiple commercial and military signal sources to provide a PNT solution that enables operation in contested environments.			
FY 2025 Plans: Will begin investigation of non-GNSS RF sources, such as signals of opportunity (SOOPS) and Low Earth Orbit (LEO) satellite system technologies developed by industry and academia, to determine feasibility for use as alternate PNT sources; evaluate			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AW5 / *Modular GPS Independent Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
selected RF sources performance to determine their position and timing accuracies; conduct experiments with sensor fusion algorithms to incorporate selected RF sources into a single solution. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** In Fiscal Year (FY) 2025, funding was realigned from Project Element (PE) 0603463A (Network C3I Advanced Technology) / Project AV8 (Navigation Warfare (NAVWAR) Advanced Technology).			
Title: Techniques and Algorithms for Cooperative Assured Position, Navigation and Timing (PNT) ***Description:*** This effort develops techniques for precision time transfer across Army platforms (Soldier, Ground Vehicles, Aviation) to ensure accurate timing down to the most disadvantaged user It will enable provision of cooperative PNT between Army platforms as a core enabler of many warfighter capabilities (Electronic Warfare (EW, Radar, etc.)). Effort increases resilience of PNT systems through usage of additional RF sources reducing the effectiveness of outside interference of congested and contested environments. ***FY 2025 Plans:*** Will investigate novel time transfer techniques/concepts at nanosecond and picosecond precision levels to develop proof of concept; determine priority application areas for proof of concept cooperative PNT between Army platforms. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** In Fiscal Year (FY) 2025, funding was realigned from Project Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Navigation Warfare (Modular GPS Independent Sensors Advanced Tech).	-	-	2.506
Accomplishments/Planned Programs Subtotals	-	-	4.546

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) BP2 / *Sensor and Electronic Network Initiatives (CA)*	

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
BP2: *Sensor and Electronic Network Initiatives (CA)*	-	155.000	-	-	-	-	-	-	-	-	0.000	155.000

Note

Congressional Interest Item funding provided for Sensor and Electronic Network Initiatives.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Sensor and Electronic Network Initiatives.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
Congressional Add: Program Increase - Energy Efficient Devices ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Energy Efficient Devices	10.000	-
Congressional Add: Program Increase - Anti-Tamper Technology ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Anti-Tamper Technology	25.000	-
Congressional Add: Program Increase - EW and Advanced Sensing ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for EW and Advanced Sensing	6.500	-
Congressional Add: Program Increase - Integrated Photonics for Contested RF Environments ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Integrated Photonics for Contested RF Environments	14.000	-
Congressional Add: Program Increase - Social Network Analysis ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Social Network Analysis	5.000	-
Congressional Add: Program Increase - BEYOND-LINE-OF-SIGHT NETWORKING ENHANCEMENT ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for BEYOND-LINE-OF-SIGHT NETWORKING ENHANCEMENT	5.000	-
Congressional Add: Program Increase - INERTIAL NAVIGATION SYSTEMS	11.500	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** BP2 / *Sensor and Electronic Network Initiatives (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
FY 2023 Accomplishments: Congressional Interest Item funding provided for Inertial Navigation System		
Congressional Add: Program Increase - KU-BAND PHASED-ARRAY RADAR EMPLOYING 5G TECHNOLOGY ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for KU-BAND PHASED-ARRAY RADAR EMPLOYING 5G TECHNOLOGY	1.000	-
Congressional Add: Program Increase - MAN PORTABLE DOPPLER RADAR ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for MAN PORTABLE DOPPLER RADAR	10.000	-
Congressional Add: Program Increase - SECURE ELECTRONIC PACKAGING ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for SECURE ELECTRONIC PACKAGING	10.000	-
Congressional Add: Program Increase - SPECTRUM SHARING AND MANAGEMENT WITH ADAPTIVE AND RECONFIRURABLE TECHNOLOGY ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for SPECTRUM SHARING AND MANAGEMENT WITH ADAPTIVE AND RECONFIRURABLE TECHNOLOGY	5.000	-
Congressional Add: Program Increase - WAVEFORM DIVERSITY EXPERIMENTAL RESEARCH FOR SENSORS ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for WAVEFORM DIVERSITY EXPERIMENTAL RESEARCH FOR SENSORS	5.000	-
Congressional Add: Program Increase - BIOLOGICAL SENSORS FOR REMOTE ENVIRONMENTS ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for BIOLOGICAL SENSORS FOR REMOTE ENVIRONMENTS	9.000	-
Congressional Add: Program Increase - ALTERNATIVE POSITION, NAVIGATION, AND TIMING ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Alternative Position, Navigation, and Timing	19.000	-
Congressional Add: Program Increase - MASS-DISTRIBUTED ACOUSTIC SURVEILLANCE NETWORK	8.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** BP2 / *Sensor and Electronic Network Initiatives (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024
FY 2023 Accomplishments: Congressional Interest Item funding provided for Mass-Distributed Acoustic Surveillance Network		
Congressional Add: Program Increase - URBAN SUBTERRANEAN MAPPING TECHNOLOGIES ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for Urban Subterranean Mapping Technologies	4.000	-
Congressional Add: Program Increase - AI/ML Materials for Sensors and Electronics ***FY 2023 Accomplishments:*** Congressional Interest Item funding provided for AI/ML Materials for Sensors and Electronics	7.000	-
Congressional Adds Subtotals	155.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) CG3 / *Assured PNT Communications Applied Research*	

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
CG3: *Assured PNT Communications Applied Research*	-	9.833	5.652	4.158	-	4.158	2.867	4.231	4.283	4.332	0.000	35.356

A. Mission Description and Budget Item Justification

This Project designs and develops technologies for Space-enabled, High Altitude (HA) and Counter-Surveillance and Reconnaissance (C-SR) applications to support Army tactical ground forces. The Project focuses on advancing technology discovery and development in key research areas that support Army's access to space-based capabilities, C-SR, quantum science communications and sensing, multi-function and multi-mission applications. This Project supports Tactical Land Component Forces access to Space-enabled and C-SR capabilities for force projection and maneuver through persistent and deep sensing.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech).

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 Space and Missile Defense Technical Center.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Assured PNT Communications Applied Research	9.833	5.652	-
Description: This effort will design, develop, and validate Space and High Altitude technologies, components, and tools that lead to smaller, lighter, more responsive payloads and applications. These technologies will allow for the rapid integration and development of tactical payloads in support of responsive Space or High Altitude environments. Will develop High Altitude (HA) testbed environment. Will continue classified capability development. Will validate Quantum Entanglement (QE) in the lab.			
FY 2024 Plans: Will develop High Altitude (HA) testbed environment. Will continue classified capability development. Will validate Quantum Entanglement (QE) in the lab.			
FY 2024 to FY 2025 Increase/Decrease Statement: Funding decrease reflects administrative realignment to HAYFINS, Quantum Sensing, and Multi-Function RF Applications Research tasks within this project.			
Title: HAYFINS	-	-	1.838

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CG3 / *Assured PNT Communications Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: This effort researches and develops a ground-based system supporting Space and Autonomy Modernization priorities by fusing protection technologies with legacy systems that provide multi-modal capabilities to the Army to enhance freedom of maneuver supporting Multi-Domain Operations (MDO). This provides a tailored selection and application of multi-layered active and passive measures. ***FY 2025 Plans:*** Will validate component levels in the lab through integration and simulated testing of components. Investigate concept of component analysis. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects administrative realignment from the Assured PNT Communications Applied Research task within this project			
Title: Quantum Sensing ***Description:*** This effort investigates quantum sensing technologies for application to Army missions and matures capabilities to experimentally validate applications to the Army sensing missions. This effort will validate Quantum based Radio Frequency (RF) and Electro Optical (EO) architectures for enhancing Army sensor performance standards with particular interests in radar, deep sensing missions, Low Probability of Intercept/Low probability of Detection (LPI/LPD) signals acquisition and transmission, environmental characterizations, and traditional sensor sensitivity enhancements. ***FY 2025 Plans:*** Will design and develop a quantum sensing technology applicable to Army sensing missions. Will mature sensing components to enhance traditional sensing capabilities. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects administrative realignment from the Assured PNT Communications Applied Research task within this project.	-	-	0.600
Title: Multi-Function RF Applications Research ***Description:*** This effort investigates multi-function Radio Frequency (RF) systems for Army missions. Design and develop a flexible configuration enabling multi-mission applications utilizing single or multi-antenna configurations. This effort will validate the complex combinations of multi-antenna configurations, and multi-mission waveforms for enhancements to traditional sensor modalities such as radar, communications and other missions. Components will be matured enabling optimal combinations of RF architectures to enhance traditional sensor and RF system performances (e.g., enhanced receiver sensitivities, enhanced sensing distances, enhanced simultaneous multi-mission performance metrics, and more).	-	-	1.720

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CG3 / *Assured PNT Communications Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
FY 2025 Plans: Will design and develop an architecture capable of supporting multiple Army missions, investigate waveforms and system configurations to optimize the independent missions from the multi-function system. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase reflects administrative realignment from the Assured PNT Communications Applied Research task within this project.			
Accomplishments/Planned Programs Subtotals	9.833	5.652	4.158

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army											Date: March 2024	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) CI3 / *Mobile and Survivable Command Post (MASCP) Tech*			
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**
CI3: *Mobile and Survivable Command Post (MASCP) Tech*	-	5.540	3.268	2.375	-	2.375	2.378	2.380	-	-	0.000	15.941

A. Mission Description and Budget Item Justification

This Project develops and investigates emerging communications, tactical cloud, distributed computing, power management and storage, and shielding materials necessary to improve Command Post (CP) survivability and effectiveness for near-peer Multi-Domain Operations (MDO) engagements.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).

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

Work in this Project is performed by the Command, Control, Communication, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) Center and Soldier Center (SC).

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025**
Title: CP Modularity and Dispersion Technology	2.554	2.657	-
Description: Funds research to enable CP's to reconfigure and reconstitute at speeds consistent with a near-peer MDO engagement. Investigates emerging low probability of interception (LPI)/low probability of detection (LPD) radio technologies, distributed computing, tactical data and security architectures, and distributed collaboration methods. Develops mobile, and integrated power systems that enable CP's to disperse geographically and create extended at-the-halt and on-the-move command and control. ***FY 2024 Plans:*** Will mature technology solutions applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution); design and develop dispersed Command Post node communications with resilient (e.g. anti-jam, low probability of detection (LPD)) and redundant (e.g. spectrum agile, multiple transport path) capabilities; investigate directional antennas and components for each command post node for spatial LPD and improved frequency reuse. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects planned life cycle conclusion of this Science and Technology effort.			
Title: Signature Management and Reduction Technology	2.409	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CI3 / *Mobile and Survivable Command Post (MASCP) Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: Investigates and develops electromagnetic spectrum (EMS) management tools to model CP signatures and optimize the employment of CP nodes and communication assets.			
Title: Technology Supporting Camouflage, Concealment, and Deception ***Description:*** This effort matures innovative camouflage, concealment and deception technologies for expeditionary high-value assets to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats, and to reduce the probability of detection in multi-domain operations. Matures physics-based models for material and system performance that support probability of detection metrics in the multi-domain operational environment, assisting in closing the capability gap between current camouflage, concealment and deception technologies and defeating enemy sensorial capabilities in future operating environments. ***FY 2024 Plans:*** Will validate the performance of biomimetic camouflage materials or other solutions (Fibers, Coatings, and Pigments) based on analysis of alternatives; perform trade space analysis for concealment properties from ISR threats; conduct investigations to validate concealment properties for command post survivability. ***FY 2025 Plans:*** Will investigate and develop novel solutions to improve the electromagnetic signatures of Mobile Command Posts to avoid detection and improve Command Post survivability. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** In Fiscal Year (FY) 2025, funding was realigned from Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CI7 (Mobile & Survivable Command Post (MASCP) Adv Tech) to accomplish work related to improvements in signature management of Command Posts and Command Post survivability.	0.577	0.611	2.375
Accomplishments/Planned Programs Subtotals	5.540	3.268	2.375

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army			Date: March 2024
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) CU6 / *Adaptive Information Mediation and Analytics*	

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
CU6: *Adaptive Information Mediation and Analytics*	-	6.830	7.226	5.957	-	5.957	5.964	7.301	7.380	7.454	0.000	48.112

A. Mission Description and Budget Item Justification

This Project develops techniques to accelerate decision-making at lower echelons where data, information systems (IS), and Soldiers are distributed across complex and hostile environments. With robust multi-modal distributed information analytics and adaptive information mediation, decision makers can share understanding across echelons through a cross-reality information interaction. Research focuses on operational issues and gaps concerning decision uncertainty, at-the-edge situational awareness/understanding, and secure low-Size, Weight, and Power (SWAP) IS that support converged capabilities. These capabilities are critical in overcoming limitations in traditional uni-modal machine learning architectures that depend on extensive training data and stove-piped Command and Control systems that cannot provide a shared, adaptive common operating picture across echelons.

Work in this Project complements Program Element (PE) 0603462 (Next Generation Combat Vehicle Advanced Technology) / Project BF4 (Combat Vehicle Robotics Adv Tech) and Program Element (PE) 0603463 (Network C3I Advanced Technology) / Project AQ8 (High Tempo Data Driven Decision Tools Adv Tech).

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

Work in this Project is performed by the Army Research Laboratory (ARL).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: Adaptive Cross Reality Information Mediation	2.038	2.146	2.160
Description: This effort investigates and develops techniques that intelligently integrate local and external data sources across different interaction modalities to enable enhanced situational awareness, shared understanding between echelons, augmented information representations, and accelerated decision-making. It provides techniques that support at-the-edge situational awareness and accelerate decision-making among distributed humans and agents. Specifically, the research focuses on improving decentralized, yet collaborative decision-making agents through intelligent mediation and delivery of tactical information to dynamic immersive, augmented, and conventional displays that are adaptive to the user and context. ***FY 2024 Plans:*** Will explore a framework for prioritized data management, filtering, processing, and dissemination; investigate knowledge-based strategies and methods for quantifying the value of information to provide the right information to the right people at the right time; develop a framework for seamless integration with program of records and heterogeneous Internet of Things (IoT) smart sensors to enable a Common Operating Picture (COP) and Situational Awareness (SA) via information representation and visualization			

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CU6 / *Adaptive Information Mediation and Analytics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
in an immersive environment; explore cross-echelon and cross-reality information exchange in secure and controlled Joint Action Partner and Multi Domain Operation (MDO) environments. ***FY 2025 Plans:*** Will investigate how a cross-reality (XR) common operating picture (COP) can be used to enhance shared situational understanding within and across echelons and devices through adaptive visualization and interaction techniques; develop information mediation methods that enable intelligent interoperability with other immersive and non-immersive program of record information systems as part of a common 3-dimensional (3D) world model; study paradigms and develop tools that enable Soldiers equipped with XR devices to execute command and control of robotic autonomous systems and other intelligent sensors to improve battlefield awareness and enhance lethality across multiple domains. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding increase is an economic adjustment.			
Title: Multi-Domain Information Analytics (MDIA) ***Description:*** This effort develops Artificial Intelligence/Machine Learning (AI/ML) approaches for providing Situational Awareness (SA) across echelons that are robust to compromised, corrupted, or limited data and networks in contested and unpredictable battlespace environments. These approaches will provide increased probability of discernment of true vs. false targets, and incorporate uncertainty-aware neuro-symbolic AI/ML to calibrate confidence in algorithm predictions. Research will incorporate multimodal analysis with multi-view scene understanding from heterogeneous sensor systems for context-aware inference, utilize transfer learning techniques to bridge domain gap between real and synthetic data for improved machine learning, and employ Size, Weight and Power-Time (SWaP-T) constrained processing at the edge on emerging low power secure compute architectures through neural network pruning and compression. Simulations of Command and Control (C2) strategies will incorporate the MDIA approaches. ***FY 2024 Plans:*** Will develop enhanced aided target recognition (AiTR) and scene understanding algorithms for both ground based (manned and unmanned ground vehicles) and unmanned aerial vehicles (UAVs) applications; mature synthetic data generation techniques for simulation of militarily-relevant targets and environments, and optimize algorithm training through hybrid datasets of real and synthetic target data for both electro-optical/visible and infrared spectral bands; explore artificial intelligence (AI) for command and control approaches, integrating real-time in situ cursor on target information for course of action generation by an artificial commander; conduct holistic experiments of developed AiTR models and decision aid/command and control software at large scale Army field experimentation events to validate the efficacy of approaches and inform further technology development and maturation; develop uncertainty-aware evidential reasoning methods for processing over light weight SWaP computing devices	4.792	5.080	3.797

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CU6 / *Adaptive Information Mediation and Analytics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
and assess their robustness due to limited training data and adversarial manipulations; develop neuro-symbolic complex event processing algorithms for recognition of complex events. ***FY 2025 Plans:*** Will develop an NTC data pipeline that includes dataset preparation and data extraction software encoding; use Geospatial Data Integration Server (GDIS) to store geographically-synchronized data for planning and visualization tools; investigate optimization techniques, such as hyperparameter and neural-architecture search to determine uncertainty- aware evidential reasoning configuration to obtain optimal tradeoff across accuracy, uncertainty calibration, robustness to adversarial manipulation, and computational efficiency in light weight SWaP compute devices; investigate multiple user feedback approaches; develop approaches to fuse Aided Target Recognition (AiTR) and synthetically trained models with mission data. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects a reduction in research that supports battlefield modeling and learning models.			
Accomplishments/Planned Programs Subtotals	6.830	7.226	5.957

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army										Date: March 2024		
Appropriation/Budget Activity 2040 / 2				R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*					Project (Number/Name) CV4 / *Pathfinder 3D Applied 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**
CV4: *Pathfinder 3D Applied Technology*	-	2.111	2.090	1.257	-	1.257	1.677	1.889	1.809	1.533	0.000	12.366

A. Mission Description and Budget Item Justification

This Project investigates and develops a geospatial rapid position and navigation solution in Global Positioning System (GPS) degraded and denied environments. Research focuses on using onboard sensors and high-resolution digital terrain geospatial alternative solution based upon Visual Three-Dimensional (3-D) Terrain Referencing and Navigation (VTRAN). This Project will result in the linkage of air and ground assets integrating sensory and (One World Terrain and Reference) geospatial data within the modular GPS Independent Sensors architecture. This Project provides critical alternatives to maneuver forces for position and navigation in a multi-domain operational environment.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project DB6 (Pathfinder 3D Adv Technology).

The work cited 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 Engineer Research and Development Center Geospatial Research Laboratory.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2023**	**FY 2024**	**FY 2025**
Title: PATHFINDER 3-D Navigation Technology	2.111	2.090	1.257
Description: This effort will design and develop enhanced feature classification for improved position navigation performance and will improve 3-D data extraction techniques to reduce computation. ***FY 2024 Plans:*** Will develop algorithms and methods to generate position/orientation from geospatially-based Visual Terrain Reference and Navigation and onboard sensors in the absence of GPS as an assured position navigation technology. ***FY 2025 Plans:*** Will expand visual terrain referencing solutions to include inputs from thermal IR, intensified EO, and incorporate metrics for ancillary passive sensor devices to generate a two-dimensional feature set matched to a three-dimensional foundation terrain data set. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Funding decrease reflects the planned reduction of workflows as technologies transition to Program Element 0603463A (Network C3I Advanced Tech) / Project DB6 (Pathfinder 3D Advanced Technology).			
Accomplishments/Planned Programs Subtotals	2.111	2.090	1.257

Exhibit R-2A, RDT&E Project Justification: PB 2025 Army		Date: March 2024
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CV4 / *Pathfinder 3D Applied Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A