Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army											Date: April 2022	
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 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
Total Program Element	-	202.256	164.804	64.115	-	64.115	81.095	78.963	70.347	69.293	0.000	730.873
AM6: *Modular RF Communications Technology*	-	3.810	-	-	-	-	5.960	8.271	-	-	0.000	18.041
AM8: *Protected SATCOM Technology*	-	4.813	1.703	-	-	-	6.570	11.930	3.628	2.218	0.000	30.862
AN3: *Non Traditional Waveforms Technology*	-	-	0.492	3.415	-	3.415	11.321	2.018	5.816	8.247	0.000	31.309
AN7: *COE - Every Receiver is a Sensor Technology*	-	2.976	2.492	2.543	-	2.543	1.039	-	-	2.104	0.000	11.154
AN9: *UNT - Every Receiver is a Sensor Technology*	-	1.925	1.963	2.074	-	2.074	2.106	2.103	2.104	-	0.000	12.275
AO2: *Stand-In Advanced RF Effects (STARE)*	-	4.223	1.972	-	-	-	-	-	-	-	0.000	6.195
AO4: *Energy Efficient Devices Technology*	-	5.454	5.710	5.480	-	5.480	5.564	5.613	5.615	5.614	0.000	39.050
AO5: *Tag Track and Locate Small Satellites Technology*	-	3.737	-	-	-	-	-	-	-	-	0.000	3.737
AP4: *CEMA Camouflage Technology*	-	9.559	-	-	-	-	-	-	-	-	0.000	9.559
AP5: *Electronic Warfare Technology*	-	2.878	2.928	5.246	-	5.246	5.331	5.359	2.854	2.853	0.000	27.449
AP7: *Comms/Horiz Int for Army Mod Priorities Tech*	-	2.914	-	-	-	-	-	-	-	-	0.000	2.914
AQ2: *EW Techniques Technology*	-	0.482	0.494	0.532	-	0.532	0.539	2.589	0.539	0.538	0.000	5.713
AQ7: *High Tempo Data Driven Decision Tools Technology*	-	2.701	-	1.289	-	1.289	1.300	2.338	2.339	4.126	0.000	14.093
AQ9: *Expeditionary Data to Decisions Technology*	-	2.760	-	-	-	-	-	-	-	-	0.000	2.760

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*							
AR1: *Robust, Resilient and Intelligent C3I Technology*	-	13.599	10.510	-	-	-	-	-	-	-	0.000	24.109
AR3: *Intelligent Environmental Battlefield Awareness*	-	2.897	3.059	-	-	-	-	-	3.424	2.217	0.000	11.597
AR5: *Understanding the Environment as a Threat Technolo*	-	2.246	1.956	1.314	-	1.314	1.006	0.402	-	-	0.000	6.924
AR7: *Sensing in Contested Environments Technology*	-	1.820	1.192	-	-	-	-	-	-	-	0.000	3.012
AR9: *Persistent Geophysical Sensing-Infrasound Tech*	-	3.035	3.414	-	-	-	-	-	-	-	0.000	6.449
AT2: *Subterranean Detection and Monitoring Technology*	-	2.791	-	-	-	-	-	-	-	-	0.000	2.791
AT7: *Network-Enabled GeoSpatial-GEOINT Services Tech*	-	3.855	4.635	3.137	-	3.137	2.544	3.517	2.077	1.419	0.000	21.184
AT9: *Tactical GeoSpatial Information Capabilities Techn*	-	4.085	1.776	0.518	-	0.518	2.705	2.053	1.144	-	0.000	12.281
AU3: *Geospatially Enabled Operational Design Technology*	-	1.413	-	-	-	-	-	-	-	-	0.000	1.413
AV3: *Foundational S&T for Network C3I Technology*	-	1.927	4.657	0.743	-	0.743	1.467	2.555	11.323	10.216	0.000	32.888
AV5: *Protective Technologies*	-	7.411	7.549	6.428	-	6.428	6.524	6.583	6.585	6.583	0.000	47.663
AV6: *Airborne Engineering Support Technology*	-	0.866	-	-	-	-	-	-	-	-	0.000	0.866
AV7: *Atmospheric Modeling and Meterological Technology*	-	5.918	5.931	-	-	-	-	-	-	-	0.000	11.849
AV9: *Advanced PNT for GPS Independent Environments Tech*	-	6.656	10.117	8.850	-	8.850	8.982	8.747	8.697	8.694	0.000	60.743
AW1: *Autonomous Navigation Technology*	-	1.732	2.066	2.052	-	2.052	-	-	-	-	0.000	5.850

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022		
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*							
AW3: *DoD PNT M&S Collaborative Initiative (CI) Technolo*	-	1.925	-	-	-	-	-	-	-	-	0.000	1.925
BP2: *Sensor and Electronic Network Initiatives (CA)*	-	90.500	80.300	-	-	-	-	-	-	-	0.000	170.800
BZ6: *Narrowband SATCOM Technology*	-	0.963	-	-	-	-	-	-	-	-	0.000	0.963
BZ8: *Aerial Teir Networking (High Altitude)*	-	0.385	-	-	-	-	-	-	-	-	0.000	0.385
CG3: *Assured PNT Communications Applied Research*	-	-	1.726	5.486	-	5.486	5.608	5.799	4.697	4.753	0.000	28.069
CI3: *Mobile and Survivable Command Post (MASCP) Tech*	-	-	6.236	5.728	-	5.728	3.254	0.607	0.607	0.607	0.000	17.039
CK1: *Assurred PNT Enabling Technologies*	-	-	1.926	-	-	-	-	-	-	-	0.000	1.926
CU6: *Adaptive Information Mediation and Analytics*	-	-	-	7.089	-	7.089	7.194	7.232	7.235	7.233	0.000	35.983
CV4: *Pathfinder 3D Applied Technology*	-	-	-	2.191	-	2.191	2.081	1.247	1.663	1.871	0.000	9.053

Note

In Fiscal Year 2023 (FY23), Projects CU6 (Adaptive Information Mediation and Analytics) and CV4 (Pathfinder 3D Applied Technology) are New Starts.

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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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*

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.

Research is 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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	202.257	84.606	0.000	-	0.000
Current President's Budget	202.256	164.804	64.115	-	64.115
Total Adjustments	-0.001	80.198	64.115	-	64.115
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	80.300			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.001	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	64.115	-	64.115
• FFRDC Transfer	-	-0.102	-	-	-

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: BP2: *Sensor and Electronic Network Initiatives (CA)*		
Congressional Add: *Program Increase - Inertial Navigation Systems*	10.000	-
Congressional Add: *Program Increase - APNT for Autonomous Vehicles*	5.000	-
Congressional Add: *Program Increase - CHARM*	5.000	-
Congressional Add: *Program Increase - Energy Efficient Devices*	5.000	5.000
Congressional Add: *Program Increase - Integrating Energy and Computing Networks*	10.000	-
Congressional Add: *Program Increase - Artificial Intelligence and Machine Learning Electronic Warfare Sensor Technology*	10.000	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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 2021	FY 2022
Congressional Add: *Program Increase - APNT Distributed Antennae*	20.000	-
Congressional Add: *Program Increase: Urban Subterranean Mapping Technology*	4.000	4.000
Congressional Add: *Program Increase: Unmanned Sensors for Biological and Chemical Hazards*	2.000	-
Congressional Add: *Program Increase: Mobile Environmental Contaminant Sensors*	8.000	5.000
Congressional Add: *Program Increase: Multi?UAS Integrated ISR Technology*	3.000	-
Congressional Add: *Program Increase: Autonomous Platform Threat Detection Sensors*	6.000	-
Congressional Add: *Program Increase: Intelligent Electronic Protection Technology*	2.500	-
Congressional Add: *ALTNAV*	-	13.800
Congressional Add: *Anti-Tamper Technology*	-	5.000
Congressional Add: *Backpackable COMINT System*	-	5.000
Congressional Add: *Distributed Radio Frequency and Sensor Technology Development*	-	8.000
Congressional Add: *EW and Advanced Sensing*	-	6.500
Congressional Add: *Integrated Photonics for Contested RF Environments*	-	15.000
Congressional Add: *Mass-Distributed Acoustic Surveillance Network*	-	8.000
Congressional Add: *Social Network Analysis*	-	5.000
Congressional Add Subtotals for Project: BP2	90.500	80.300
Congressional Add Totals for all Projects	90.500	80.300

Change Summary Explanation

FY23 funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AM6: *Modular RF Communications Technology*	-	3.810	-	-	-	-	5.960	8.271	-	-	0.000	18.041

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.

Research 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.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Modular Radio Frequency Communications Technology	3.810	-	-
Description: This effort investigates and develops techniques, methods, and standards for automation and intelligence to optimally route data among available radio frequency and networking technologies. This effort adds resiliency to the network through diversity and automation techniques to make automated network decisions, (e.g., automated PACE) for the tactical Army to maintain operation in continually changing environments.			
Accomplishments/Planned Programs Subtotals	3.810	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
AM8: *Protected SATCOM Technology*	-	4.813	1.703	-	-	-	6.570	11.930	3.628	2.218	0.000	30.862

Note

In Fiscal Year 2023 (FY23) this Project transitions to Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM9 (Protected SATCOM Advanced Technology).

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.

Research in this Project complements PE 0603463A (Network C3I Advanced Technology) / 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.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Protected Satellite Communication Technology ***Description:*** This effort designs and develops technologies and components to increase resiliency of Wideband SATCOM in contested and congested electromagnetic environments. This effort develops resiliency through science and technology investigation. ***FY 2022 Plans:*** Will investigate and design adaptive digital interference cancellation technology that adapts to changing contested environments for advanced fast moving waveforms, to improve satellite communications throughput. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort ends in FY22 and the work transitions to PE 0603463A (Network C3I Advanced Technology) / Project AM9 (Protected SATCOM Advanced Technology).	4.813	1.639	-
Title: SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638	-	0.064	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	4.813	1.703	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AN3: *Non Traditional Waveforms Technology*	-	-	0.492	3.415	-	3.415	11.321	2.018	5.816	8.247	0.000	31.309

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, or anti-jam capabilities to tactical networks. This Project develops network resiliency for the dismounted and vehicular units through science & technology investigation.

Research 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.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: 5G Technologies	-	0.474	3.415
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. ***FY 2022 Plans:*** Will investigate the use of software-defined networking and virtualization techniques for the development of a modular networks architecture using techniques, such as distributed 5G; develop methods for device-to-device communications to minimize required infrastructure; and examine methods to improve low probability of intercept (LPI), low probability of detection (LPD), counter-geolocation, and anti-jam (AJ) performance of technologies, such as 5G cellular. ***FY 2023 Plans:*** Will design and begin implementation of tactically relevant 5G capabilities in support of expeditionary and highly mobile communications by leveraging the results of the Fiscal Year 2022 (FY22) investigations. Will incorporate anti-jam and LPI / LPD and increase network robustness through spectrum diversity and efficiency across dispersed nodes and different terrain types. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase enables the study for tactical implementation of 5G technologies to deliver increased data rates and network capacities and increased anti-jam capability and reduced detectability and infrastructure demands in contested environment.			
Title: SBIR/STTR Transfer	-	0.018	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	0.492	3.415

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AN7: *COE - Every Receiver is a Sensor Technology*	-	2.976	2.492	2.543	-	2.543	1.039	-	-	2.104	0.000	11.154

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.

Research 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.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Data Analytics for Situational Awareness	2.976	-	-
Description: This effort investigates and designs spectrum sensing, electronic sensing and intelligence collection technologies and analytics to enhance overall situational understanding within a contested battlespace. Efforts focus on developing the analytics necessary to taking advantage of the expanding number of data sources available by leveraging existing tactical receivers and other tactical data feeds.			
Title: Intelligence Surveillance and Recognizance (ISR) Optimization for MDO Support Technology	-	2.401	2.543
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 2022 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will investigate threat forecasting technologies needed to drive prioritization of ISR collections based on unit intelligence requirements and threat tactics, techniques, and procedures (TTPs); research sensor performance models necessary to predict sensor performance in real-world environments. ***FY 2023 Plans:*** Will investigate sensor scheduling optimization to include sensor selection and routing; will conduct experiment to support an initial capability to task full spectrum ISR sensor availability to units across the army; will investigate how to integrate national and Joint ISR capabilities via advanced sensor frameworks. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this task.			
Title: SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.091	-
Accomplishments/Planned Programs Subtotals	2.976	2.492	2.543

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AN9: *UNT - Every Receiver is a Sensor Technology*	-	1.925	1.963	2.074	-	2.074	2.106	2.103	2.104	-	0.000	12.275

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.

Research 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 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Multi Intelligence Modernization Components and Architecture	1.925	1.891	-
Description: This effort investigates underlying architectures for dynamic resource management and technology underpinnings for advanced signal processing, exploitation, and novel sensor hardening to better understand our ability to detect, intercept, identify, and geo-locate radiated radio frequency (RF) energy to command our use of the electromagnetic spectrum while denying its use to our adversaries. ***FY 2022 Plans:*** Will investigate high altitude, long, stand-off range Electronic Warfare capabilities to bring situational awareness and understanding to the tactical edge; and conduct laboratory experiments on advanced signal processing and antenna designs for use from high altitude, long-endurance platforms. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned conclusion lifecycle of this task.			
Title: Multi-Int Modernization Combined Architecture (MIMCA)	-	-	2.074
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. ***FY 2023 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Will investigate and assess existing commercial investments in Simultaneous transmit and receive (STAR) technology for integration into EW/Cyber/SIGINT Army systems. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding for this effort begins in FY23			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.072	-
Accomplishments/Planned Programs Subtotals	1.925	1.963	2.074

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AO2 / *Stand-In Advanced RF Effects (STARE)*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AO2: *Stand-In Advanced RF Effects (STARE)*	-	4.223	1.972	-	-	-	-	-	-	-	0.000	6.195

Note

In Fiscal Year 2023 (FY23) funding is realigned to Program Element (PE) 0602146A (Network C3I Technology) / Project AP5 (Electronic Warfare Technology).

A. Mission Description and Budget Item Justification

This Project investigates distributed and synchronized electronic warfare (EW) techniques and applications for future distributed Army operations in complex environments, designs algorithms for synchronization, and investigates stable radio frequency transceivers and techniques for information distribution across dynamic channels.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO3 (Stand-In Advanced RF Effects (STARE) Adv Tech).

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: STAND-IN Advanced RF Effects	1.925	1.899	-
Description: This effort investigates emerging technologies to enable EW applications in a grey environment. The goal is to develop software and reconfigurable radio frequency (RF) hardware in a low size, weight, and power form factor for distributed EW and communications.			
FY 2022 Plans: Will investigate hardware limitations at extremely high frequencies; design and develop a stable transceiver architecture with optimal component technologies; research scalable synchronization techniques for phase/clock/channel alignment between RF transceivers agnostic of use case; conduct RF transceiver synchronization experiments to explore the bounds of coherent multi-aperture beam forming; and investigate reconfigurable transceiver hardware to enable a widely-applicable architecture.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AO2 / *Stand-In Advanced RF Effects (STARE)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding realigned to PE 0602146A (Network C3I Technology) / Project AP5 (Electronic Warfare Technology) to continue research into Combined and Distributed Electromagnetic Warfare.			
Title: Grey C3 Exploitation Technology ***Description:*** This effort investigates distributed EW techniques for grey-zone operations and designs algorithms for sparse detection and EW.	2.298	-	-
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.073	-
Accomplishments/Planned Programs Subtotals	4.223	1.972	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
AO4: *Energy Efficient Devices Technology*	-	5.454	5.710	5.480	-	5.480	5.564	5.613	5.615	5.614	0.000	39.050

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 improve 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.

Research 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 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Energy Efficient Electronic and Photonic Components	5.454	5.501	5.480
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 2022 Plans: Will determine and resolve scale-up issues with fast charge anode materials; investigate tradeoffs in energy and rate capability for ultrafast charge graphite cells with high energy cathodes; explore additives and electrode coating techniques and improve power capability; design and develop batteries for fast charge systems to investigate concepts for Fast Efficient Energy Distribution; investigate coupled isotope/energy converter geometry and increased density packaging techniques to validate proof-of-principle isotope power source; explore the coupling of piezoelectric transformers with silicon integrated circuit envelope detectors and baseband electronics for wake-up receivers; design and develop two dimensional (2D) fabrication processes to reduce energy loss; investigate concepts to achieve responsivity for viable communications wavelength in the near-to-mid infrared (IR) regime			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
in topological materials based devices; develop energy efficient electronic components based on silicon, gallium nitride, and diamond semiconductor materials. ***FY 2023 Plans:*** Will investigate aluminum gallium nitride semiconductors as Ultraviolet (UV) sources for communications; Will investigate piezoelectric transformer performance with integrated circuit envelope detectors at 100-500 MHz frequencies; Will determine coupled magnetic acoustic matching for efficient wireless power transfer; Will investigate novel energy efficient transceiver architectures for radar applications; Will investigate novel silicon based field programmable neural array circuits for efficient computation close to the network edge. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding reduction due to decrease in 2D fabrication processes research.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.209	-
Accomplishments/Planned Programs Subtotals	5.454	5.710	5.480

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AO5 / *Tag Track and Locate Small Satellites Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AO5: *Tag Track and Locate Small Satellites Technology*	-	3.737	-	-	-	-	-	-	-	-	0.000	3.737

A. Mission Description and Budget Item Justification

Tag, Track, and Locate Small Satellites Technology develops and adapts technologies for Space-Based and High Altitude applications for Army tactical ground forces. Efforts include the design and development of sensors and electronic components for communications, signal and information processing, target acquisition, position/navigation, and threat warning within space and high altitude environments. Evaluations conducted leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development. Funds research in quantum sciences based communications, sensing, and data teleportation to mature current technologies for small spacecraft applications.

The research cited 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 Space and Missile Defense Command (USASMDC) in Huntsville, AL.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Tag Track and Locate Small Satellites ***Description:*** This effort will design, develop, and adapt space-based technologies, components, and tools that lead to smaller, lighter, more responsive payloads and applications. These technologies allow for the rapid integration and development of tactical payloads in support of responsive space environments.	2.403	-	-
Title: Space Components and Systems Assessment Technology ***Description:*** This effort supports experimentation and validation of hardware and software components and models to further anchor laboratory capabilities enabling small spacecraft and payload design and development.	1.154	-	-
Title: Starlink	0.180	-	-
Accomplishments/Planned Programs Subtotals	3.737	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AO5 / *Tag Track and Locate Small Satellites Technology*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AP4 / *CEMA Camouflage Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
AP4: *CEMA Camouflage Technology*	-	9.559	-	-	-	-	-	-	-	-	0.000	9.559

A. Mission Description and Budget Item Justification

This Project develops and characterizes hardware and software to enable electronic spoofing and cyber deception along with inconspicuous Cyber Electromagnetic Activity (CEMA) and network operations of Army platforms and dismounts, while maintaining freedom to maneuver, communicate, and sense. This research is critical to counter near-peer ability to geo-locate our troops and put indirect fires onto our positions. This effort develops a holistic cross-domain analysis and assessment methodology for network and communication technologies faced with advanced CEMA. These investigations are critical to identifying vulnerabilities of United States systems and technologies so that network and network-enabled systems can be hardened as early in development as possible.

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Radio Frequency/Cyber Sensing and Deception ***Description:*** This effort develops technologies to avoid geolocation of blue force radio frequency (RF) emissions by peer/near-peer adversaries. Research will focus on developing low probability of detection (LPD) communications and decoys to increase freedom of maneuver while maintaining effective communications.	2.998	-	-
Title: Dynamic Intelligent Networks and Cyber Camouflage and Decoy for CEMA ***Description:*** This effort investigates techniques and develops methods for combining the physical RF and network (cyber) layers for enhanced effects when coupled with electromagnetic camouflage and decoy methods.	2.398	-	-
Title: Understanding, Protecting, and Enabling CEMA Effects ***Description:*** This effort develops and continually improves methodology and approaches for estimating and predicting CEMA effects on networks and network-enabled systems during complex multi-domain operations when significant cross-domain effects can be expected. Methods include drawing upon past research concerning the interaction of cyber and electromagnetic threats on operational networks; anechoic chamber, laboratory, and field measurements; and first principles Modeling and Simulation (M&S) and engineering analysis. Abstracting, generalizing, and automating multi-domain CEMA operations will enable the development of analysis and assessment capabilities to anticipate the impact of future threats. Live, virtual, and simulated environments will be developed to estimate the potential operational impact of threat CEMA technologies on friendly systems.	2.145	-	-
Title: Vulnerability Analysis Methodology for CEMA Threats	2.018	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AP4 / *CEMA Camouflage Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Description: This effort investigates threat/target interactions to develop experimental and analytical methodology for separate and cross-domain cyber and electromagnetic threat attack so that assessed vulnerabilities in a multi-domain complex environment can be reduced or eliminated before fielding new networks and network-enabled systems. Experimental and analysis methodology will be developed to investigate vulnerabilities of specific configurations of complex future networks with multiple communications modalities, advanced decoy techniques in the cyber and electromagnetic areas, and advanced Positioning, Navigation, and Timing (PNT) systems.			
Accomplishments/Planned Programs Subtotals	9.559	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
AP5: *Electronic Warfare Technology*	-	2.878	2.928	5.246	-	5.246	5.331	5.359	2.854	2.853	0.000	27.449

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).

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Electronic Warfare Technology Research	2.231	2.206	2.432
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. ***FY 2022 Plans:*** Will implement hardware-in-the-loop capability for multi-channel experiments with low-cost, distributed hardware; investigate spectrum analysis algorithms for Size, Weight, and Power (SwaP) constrained platforms; investigate techniques to characterize radio frequency (RF) emitter behavior; investigate implementation of cognitive radar threats in the hardware-in-the-loop laboratory environment; and develop tools to automate scenario generation in hardware-in-the-loop laboratory environment. ***FY 2023 Plans:*** Will validate concepts with multi-channel hardware-in-the-loop (HIL) experiments using low-cost distributed hardware; will implement algorithms for spectrum analysis for low SWaP platforms; will validate techniques for dynamic RF emitter characterization; will design experiments and validate complex and cognitive radar threats with research HIL environment; implement distributed and complex scenario generation tools with research HIL environment. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase supports additional experiments to validate radar threats.			
Title: Electronic Warfare Assessment Technologies	0.647	0.615	0.675
Description: This research 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			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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 2022 Plans:*** Will converge EW and Cyber techniques into a comprehensive CEMA capability for assessment and analysis of advanced electromagnetic technologies. Apply advanced CEMA analytical capabilities to applicable network and horizontal integrated technologies and systems to assess defensive and cognitive EW in controlled environments, including hardware in the loop and linkage to operational mission simulations. ***FY 2023 Plans:*** Will initiate development of distributed EA within hardware-in-the-loop capability to analyze distributed EA operation and measures of effectiveness; will investigate and develop EW capabilities for assessment and analysis of advanced electromagnetic attack; will initiate measures of effectiveness for advanced EW analytical capabilities in network and horizontal integrated technologies and systems that assess defensive and cognitive EW in controlled environments; will use AFC sponsored events such NetModX and PC to execute developed EA techniques and identify candidates for distributed EA operation. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: Combined and Distributed Electromagnetic Warfare (CDEW) ***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. ***FY 2023 Plans:*** Will investigate, develop and assess stable transceiver architecture designs suitable for high carrier frequency and large signal bandwidth with optimal component technologies; Will validate techniques for scalable synchronization and multi-aperture beamforming from RF transceivers agnostic of use case; Will research methods for rapid technique generation and design reconfigurable transceiver hardware to enable a widely-applicable architecture; Will validate modeling and simulation framework with hardware experiments for scalability and synchronization for large-scale effects. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort commences in Fiscal Year 2023 (FY23).	-	-	2.139
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:***	-	0.107	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	2.878	2.928	5.246

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AP7 / *Comms/Horiz Int for Army Mod Priorities Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AP7: *Comms/Horiz Int for Army Mod Priorities Tech*	-	2.914	-	-	-	-	-	-	-	-	0.000	2.914

A. Mission Description and Budget Item Justification

This Project investigates the communication architectures of each of the Army's modernization priorities and determines technologies and components to enable assured and resilient communications and horizontal integration.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech).

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Communications Support to Army Modernization Priorities / Horizontal Integration Fields Technology	2.914	-	-
Description: This effort investigates the communication architectures of each of the Army?s modernization priorities and determines technologies and components to enable assured and resilient communications.			
Accomplishments/Planned Programs Subtotals	2.914	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AQ2: *EW Techniques Technology*	-	0.482	0.494	0.532	-	0.532	0.539	2.589	0.539	0.538	0.000	5.713

A. Mission Description and Budget Item Justification

This Project develops countermeasures against adversarial counter-fire systems that obscure and create distractive blue force locations.

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

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 Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
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 2022 Plans:*** Will further investigate and experiment against modeled or representative threats to validate technical approach feasibility for EW effects against adversary counter-fire sensors and Intelligence, Surveillance, and Reconnaissance (ISR). ***FY 2023 Plans:*** Will validate electronic decoy techniques using advanced signal apertures via modeling and simulation. Will research techniques and waveforms for counter radar applications. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of project.	0.482	0.476	0.532
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:***	-	0.018	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	0.482	0.494	0.532

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AQ7: *High Tempo Data Driven Decision Tools Technology*	-	2.701	-	1.289	-	1.289	1.300	2.338	2.339	4.126	0.000	14.093

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.

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 supports the Network Command, Control, Communications and intelligence (C3I) Army Modernization Priority.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: High Tempo Data Driven Decision Tools ***Description:*** Develops data driven decision tools that help develop cyber Situational Understanding (SU) for commanders and staff that will enable them to more quickly and accurately assess and integrate cyber impacts with all of the domains in Multi-Domain Operations (MDO) and to thereby enhance mission effectiveness by improving decision cycles.	2.701	-	-
Title: RoadRunner ***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. ***FY 2023 Plans:*** Will conduct basic software development help Commanders and staff manage time constraints and cognitive limitations in the synchronization of Warfighting functions to maintain dominance in evolving and compressed / complex decision spaces. Will research and develop digital battle damage assessments and after action reports to automatically update proposed force structures and operations. Will investigate the use of battlespace data and intelligence information to adjust running estimates, in order to continually analyze the changing battlespace and drive friendly Observe, Orient, Decide, and Act (OODA) loops that outpace the enemy. ***FY 2022 to FY 2023 Increase/Decrease Statement:***	-	-	1.289

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
In FY23 this effort will build upon the High Tempo Data Driven Decision Tools effort to include the fusion of intelligence and operations information that enable faster decision making process.			
Accomplishments/Planned Programs Subtotals	2.701	-	1.289

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AQ9 / *Expeditionary Data to Decisions Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AQ9: *Expeditionary Data to Decisions Technology*	-	2.760	-	-	-	-	-	-	-	-	0.000	2.760

A. Mission Description and Budget Item Justification

This Project investigates, codes and designs software, and algorithms that improve Mission Command by increasing situational understanding, via the intelligent sharing of data in degraded networks during high op-tempo missions or while under cyber-attack. This Project includes researching artificial intelligence techniques to improve decision making capacity across the battlefield by using software knowledge representation to model the mission, automate staff tasks, correlate and analyze information, and provide recommendations. These capabilities allow forces to maximize op-tempo and maintain strategic advantage.

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Mission Command Technologies ***Description:*** This effort investigates and designs components and technologies for agile, survivable, modular, non-traditional Command Post platforms to enable decentralized and distributed mission command operations in the future operating environment.	0.890	-	-
Title: Camouflage, Concealment and Decoys ***Description:*** This effort investigates 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. Designs 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.	1.870	-	-
Accomplishments/Planned Programs Subtotals	2.760	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AQ9 / *Expeditionary Data to Decisions Technology*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AR1 / *Robust, Resilient and Intelligent C3I Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR1: *Robust, Resilient and Intelligent C3I Technology*	-	13.599	10.510	-	-	-	-	-	-	-	0.000	24.109

Note

This project is Terminated starting in Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project develops and characterizes machine learning and artificial intelligence methods for processing, analysis and provisioning control of smart, distributed, networked sensors and devices. It provides situational understanding and decision support to enable fast, adaptive and interoperable Command, Control, Communications and intelligence (C3I) network-integrated applications, resilient to adversarial activity in contested and complex environments. Effective use of distributed networked sensors, autonomous agents and automated decision support tools is critical to address threats posed by peer competitors and more capable asymmetric forces, particularly in complex environments where traditional sensors provide an incomplete understanding of the tactical situation due to adversarial activity, occluded sightlines and small fields of regard.

Research in this Project complements Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) / Project BF8 (Artificial Intelligence & Machine Learning Tech), PE 0603463A (Network C3I Advanced Technology) / Project AQ5 (Sensor CE - Integrated Sensor Architecture Adv Tech) and Project AN8 (COE - Every Receiver is a Sensor), and PE 0602146A (Network C3I Technology) / Project AN7 (COE- Every Receiver is a Sensor Technology).

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Intelligent Signal and Image Analytics for C3I	6.282	3.132	-
Description: This effort designs and characterizes technologies for multi-modal (Electro-Optical/Infra-Red (EO/IR) imaging, acoustic, seismic, infrasound, electric and magnetic (E/H) field, and passive radio frequency (RF), low-cost networked sensors to enhance persistent sensing capabilities for increased probability of target localization, tracking, classification, and reduced false alarms. These combined sensors have unique capabilities that enable passive discrimination from deception and decoys, detection of electrical equipment operation, underground facilities, vehicles, weapons launch, gunfire, and explosions. The work includes development of learning algorithms to improve situational understanding.			
FY 2022 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AR1 / *Robust, Resilient and Intelligent C3I Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will develop artificial intelligence and machine learning (AI & ML) based analytics to process multi-modal data, both imaging based (electro-optical, infrared) and non-imaging based (acoustic, seismic, electric, and magnetic field sensing), for automated detection, classification, and tracking of targets from both ground and airborne platforms; develop synthetic data generation techniques for algorithm training to augment limited availability of real world data for robust signal and image analytics in operationally-relevant settings; understand three-dimensional (3-D) electric and magnetic-field sensors and sensing arrays for extremely low frequency imaging and electric power grid analysis for pattern of life analysis; continue research of infrasound through audible frequency sensors, algorithmic, and hardware solutions to automate target detection, tracking, and localization; and validate advanced seismic sensing for enhanced detection and localization of ground targets. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 the effort is Terminated			
Title: Smart Networks and Distributed Sensing for C3I ***Description:*** This effort will develop and assess a concept to link physical sensors and information sources to Soldiers and small units. Specifically, the research focuses on (1) multi-modal sensor fusion for detection and classification of human activities and infrastructures such as personnel, vehicles, machinery, RF emissions, chemicals, and computers in hidden and confined spaces, (2) interoperability and networking of disparate sensors and information sources, (3) distributed information for decision-making, and (4) approaches for fusing results of processed outputs of multi-modal sensors, such as visible, infrared (IR), and hyperspectral imagers, and acoustic, magnetic, and electric field sensors. ***FY 2022 Plans:*** Will implement real-time scene perception based algorithms for optimal relocation of sensor assets for robust target detection, classification, and tracking; design approaches for optimally determining sensor modality, parameters, and energy requirements for carrying out scene perception tasks in resource-constrained distributed network environments; implement light-weight machine learning architectures for real-time inference at the edge on low size, weight, and power (SWaP) computing devices utilizing both centralized and distributed processing frameworks; research and validate novel adaptive real-time multimodal sensing and processing methods using low-SWaP edge processing and mobile user interfaces and controls; validate deep sensing concepts by characterizing remote employment of sensors in a strategic and tactical scenario to enable autonomous threat detection, localization, and high confidence classification. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 the effort is Terminated	5.336	5.067	-
Title: Information Processing and Analysis	1.981	1.928	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AR1 / *Robust, Resilient and Intelligent C3I Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Description: This effort investigates techniques that integrate local and external information sources and applies machine learning and artificial reasoning approaches to support automated intelligence analysis, command/control, and decision-making. The goal is to enable tactical users to cooperatively interact with relevant and timely tactical information supported by methods that are network-aware/adaptive and deliver transparent and uniform transport. ***FY 2022 Plans:*** Will investigate and conduct experiments that explore methods for intelligent information mediation and adaptive information representation; identify methods for accelerating decision support and information synthesis in SWaP and time constrained systems and adversarial environments; determine feasibility, viability, and limitations of data-driven, physics-guided information interaction and its impact on situational awareness in multi-modal, multi-perspective information representations in two-dimensional (2-D) and immersive adaptive interfaces; continue to examine quantitative information recommendation and filtering approaches such as VoI/QoI for policy-based and continuously-learned multi- sensor and multi-domain battlefield information-interaction. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 the effort is Terminated			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.383	-
Accomplishments/Planned Programs Subtotals	13.599	10.510	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AR3 / *Intelligent Environmental Battlefield Awareness*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR3: *Intelligent Environmental Battlefield Awareness*	-	2.897	3.059	-	-	-	-	-	3.424	2.217	0.000	11.597

Note

In Fiscal Year 2023 (FY23), this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX3 (Intelligent Env Battlefield Awareness Apl Tech).

A. Mission Description and Budget Item Justification

This Project investigates, develops, and designs technologies to allow Soldiers to maneuver faster in dynamic environments as informed by physical, geological, and biological constraints. This Project enhances visualization tools for mission planning through delivery of web modules/software tools which contain crucial geo-chemical resources and advanced knowledge of geo-environmental infrastructure for mission planners.

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 Engineer Research and Development Center and coordinated with the United States Army Futures Command.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AR4 (Intelligent Env Battlefield Awareness Adv Tech).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Arctic Threat	1.442	0.856	-
Description: This effort delivers a geospatial decision aid to United States Army units conducting expeditionary operations to anticipate threats, hazards and dependencies posed by terrain and weather extremes in cold regions. ***FY 2022 Plans:*** Generate new input parameters for geospatial overlays that represent soil mechanics representing thaw effects based on terrain conditions and temperature extremes. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort ends in Fiscal Year 2022 with transition of applied technologies to Advanced Technology Development for demonstrating terrain state changes such as freeze/thaw, snowmelt, and ice vulnerability.			
Title: Geo-Forensics	0.675	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AR3 / *Intelligent Environmental Battlefield Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Description: This effort generates data to develop the data mining framework and software tools to generate geo-referenced predictive map layers to inform mission planning and operational assessments for area denied sites.			
Title: Predictive Geographic Information System (GIS) Mapping (physical) ***Description:*** This effort develops a comprehensive GIS tool that integrates predictive models of soil, vegetation, hydrology, and permafrost conditions outside the continental U.S. (OCONUS) dark sites from the statistical analysis of known datasets and the application of geophysical principles. ***FY 2022 Plans:*** Consolidate geophysical data and begin parameterization for data input into unified geospatial framework. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) / Project CX3 (Intelligent Env Battlefield Awareness Apl Tech).	0.780	0.760	-
Title: Hydrology Mapping ***Description:*** This effort provides data tools and models to support high-fidelity battlefield overlay maps that accurately show hydrologic/soil moisture threats (soil, hydrology, and snow/ice) not captured by current terrain mapping capabilities. ***FY 2022 Plans:*** Develop predictions of soil moisture state, infiltration, and runoff that better reflect the high degree of spatial and temporal variability in ground and surface water. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) Project CX3 (Intelligent Env Battlefield Awareness Apl Tech).	-	1.331	-
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:***	-	0.112	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AR3 / *Intelligent Environmental Battlefield Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	2.897	3.059	-

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 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR5: *Understanding the Environment as a Threat Technolo*	-	2.246	1.956	1.314	-	1.314	1.006	0.402	-	-	0.000	6.924

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

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 Engineer Research and Development Center and coordinated with the United State Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Predictions of Lethal Environments/ Computational Prediction of Threats in the Operational Environment ***Description:*** This effort develops tools and models for the Soldier providing critical information of the operational environment allowing the Soldier to operate in, avoid, or prepare for contaminated battlefields.	1.156	-	-
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. ***FY 2022 Plans:*** Consolidate candidate sensor technologies based on effectiveness and form/fit design constraints that detect and characterize hazards including water quality, explosive constituents, and non-weaponized radiological hazards. ***FY 2023 Plans:***	1.090	1.884	1.314

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will develop techniques to achieve ultra-low detection levels of explosive constituents and non-weaponized radiological hazards for reverse-point sourcing threats. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding decrease reflects the planned lifecycle of this effort to realign resources to PE 0603463A (Network C3I Advanced Technology) / Project AR6 (Understanding the Environment as a Threat Adv Tech) as applied technologies are transitioned for maturation and demonstration in the final years of the effort.			
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.072	-
Accomplishments/Planned Programs Subtotals	2.246	1.956	1.314

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 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AR7 / *Sensing in Contested Environments Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR7: *Sensing in Contested Environments Technology*	-	1.820	1.192	-	-	-	-	-	-	-	0.000	3.012

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX5 (Sensing in Contested Environments Technologies).

A. Mission Description and Budget Item Justification

This Project characterizes through direct or inferential methods the identification of non-weaponized biological hazards posed to Soldiers in operational environments by advancing sensor technologies and software modules that will detect and characterize hazards including water quality, heavy metals in soils, breath-ability, and non-weaponized radiological hazards within confined environments. This Project supports the Common Operating Environment program.

Research in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AR8 (Sensing in Contested Environments Adv Tech).

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 Engineer Research and Development Center and coordinated with the United States Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Non-Traditional Threat Detection in Contested Environment	1.820	1.149	-
Description: This effort identifies, examines and prioritizes commercial of the shelf (COTS) capabilities from multiple sources that can accurately detect biological hazards relevant to operations in subterranean environments from point of ingress/egress to evaluate exposure potential and affects. ***FY 2022 Plans:*** Consolidate candidate sensor technologies based on effectiveness and form/fit design constraints that detect and characterize hazards including water quality, explosive constituents, and non-weaponized radiological hazards. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) / Project CX5 (Sensing in Contested Environments Technologies).			
Title: FY 2022 SBIR/STTR Transfer	-	0.043	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AR7 / *Sensing in Contested Environments Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	1.820	1.192	-

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 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AR9 / *Persistent Geophysical Sensing-Infrasound Tech*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR9: *Persistent Geophysical Sensing-Infrasound Tech*	-	3.035	3.414	-	-	-	-	-	-	-	0.000	6.449

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX4 (Persistent Geophysical Sensing-Infrasound Apl Tech).

A. Mission Description and Budget Item Justification

This Project designs and develops algorithms, software, and hardware components to enable near-real-time battlespace awareness to persistently monitor (through non-line-of-sight sensing including infrasound) critical infrastructure conditions and threat activities in dynamic battlefields. These technologies provide near real time data collection, processing, and alerts of infrastructure go/no-go condition required for maneuver planning. This Project also designs and develops methodologies to assign maneuver relevant engineering attributes to geospatial feature data such as bridge load classification, road condition, and bathymetry.

Research in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AS9 (Persistent Geophysical Sensing-Infrasound Adv Tech).

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 conducted at United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Battlefield Intelligence by Geophysical Sensing (BIGS)	3.035	3.290	-
Description: This effort develops a suite of geophysical and geo-sensing technologies to persistently assess battlefield elements to include infrastructure and additional sources of interest such as explosive and fires events and various air platforms; refines terrain, topography, and meteorological models related to acoustic propagation detected by the employed sensor suite as well as detection and classification signal processing algorithms for a broader range of sources and/or threats.			
FY 2022 Plans: Focus on algorithm research and development based on down-selected sources of interest as prioritized by stakeholders/ transition partners and complete a sensor placement optimization tool to evaluate alternate array geometries/sensor configurations.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AR9 / *Persistent Geophysical Sensing-Infrasound Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) / Project CX4 (Persistent Geophysical Sensing-Infrasound Apl Tech).			
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.124	-
Accomplishments/Planned Programs Subtotals	3.035	3.414	-

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 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AT2 / *Subterranean Detection and Monitoring Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AT2: *Subterranean Detection and Monitoring Technology*	-	2.791	-	-	-	-	-	-	-	-	0.000	2.791

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX6 (Subterranean Detection and Monitoring Apl Tech).

A. Mission Description and Budget Item Justification

This Project designs and develops an integrated suite of tunnel detection, subterranean monitoring solutions, and vulnerability assessment technologies to detect, identify, and monitor subterranean threat activities in urban environments through advanced sensing and rapid analysis capabilities. This Project also develops and investigates enhanced technologies to detect tunnels and tunneling activity in complex and varied environments.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AT3 (Subterranean Detection and Monitoring Adv Tech).

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

Research in this Project is conducted at the United States Army Engineer Research and Development Center and coordinated with the United States Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Subterranean Threat Assessment by Real-time Sensing	2.791	-	-
Description: This effort designs and develops an integrated suite of tunnel detection and persistent surveillance technologies to detect, track, and identify subsurface activities; expedient underground municipal infrastructure detection system; urban source characterization and modeling algorithms; expedient void detection systems in urban areas, and vulnerability assessment tools for the urban subterranean domain.			
Accomplishments/Planned Programs Subtotals	2.791	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AT2 / *Subterranean Detection and Monitoring Technology*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AT7: *Network-Enabled GeoSpatial-GEOINT Services Tech*	-	3.855	4.635	3.137	-	3.137	2.544	3.517	2.077	1.419	0.000	21.184

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.

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

The research cited 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 Engineer Research and Development Center (ERDC) and coordinated with the United States Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Geo-registration, Analytical Tool Development and Visualization	2.897	2.326	-
Description: This effort investigates the design and formulation of new urban terrain data models, frameworks and processes to automate the geo-registration of 3D and 2-dimensional (2D) source data (e.g. light detection and ranging (LiDAR), imagery, Open Street Maps, and full motion video derived data) to new model constructs for rapid alerting to changes in the Operational Environment of interest. ***FY 2022 Plans:*** Advance the investigation of automated 3D data geo-registration techniques, and advance the development co-registration software algorithms applied to multi-temporal 3D terrain data sets. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort ends in FY22 with the transfer of applied technologies to PE 0603463A (Network C3I Advanced Technology) / Project AT8 (Network-Enabled GeoSpatial-GEOINT Services AdvTech).			
Title: Geospatial Data for Tactical Visualization	0.958	2.140	1.057

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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. ***FY 2022 Plans:*** Develop lightweight tools consistent with the Common Operating Environment computing environments for analytics, tiling, and streaming of 3D data. Investigate the integration of new geospatial data models that support 3D visualization, analysis and localization from a single source on tactical computing devices. ***FY 2023 Plans:*** Will develop the geospatial extraction and protocols to allow position-navigation self-localization capability on end-user systems. Will advance development of computer visual navigation, fusion, error modeling and dissemination tools for rigorous position, orientation and navigation that would support targeting and maneuver. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding decrease reflects planned lifecycle progression of transitioning work to advanced technology development PE 0603463A (Network C3I Advanced Technology) / Project AT8 (Network-Enabled GeoSpatial-GEOINT Services AdvTech).			
Title: Geospatial - Intelligence Community Merge Research ***Description:*** This effort researches different approaches to automatically search Intelligence Community 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 developed. ***FY 2023 Plans:*** Will investigate automated approaches for designation of geospatial search terms followed by discovery and extraction from intelligence community (IC) data bases; will design a revised schema for geospatial data stored within the 3D data repository Program of Record (POR)-- GRiD-- to enable IC attributes to be adaptively appended as new metadata with view options from individual 3D terrain features scalable to regional and larger geographic areas. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** New task will support focused development of integration of intelligence community databases.	-	-	1.062
Title: Geospatially Relevant Intuitive Propagation Services Technology	-	-	1.018

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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) and will reduce analyst cognitive load. ***FY 2023 Plans:*** Will investigate workflows within common operating environment to enable automated extraction of physical and operational parameters used in sensor performance analyses. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** New task will support optimized collection assets for enhanced situational awareness and targeting.			
Title: SBIR/STTR Transfer ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.169	-
Accomplishments/Planned Programs Subtotals	3.855	4.635	3.137

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AT9: *Tactical GeoSpatial Information Capabilities Techn*	-	4.085	1.776	0.518	-	0.518	2.705	2.053	1.144	-	0.000	12.281

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 at the tactical edge in the complex environment 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.

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

The research cited 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 Engineer Research and Development Center (ERDC) and coordinated with the United State Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: 3D Terrain Analysis	2.654	1.711	-
Description: This effort investigates and develops software models and workflows provisioned on the geospatial and GEOINT workstations for improved capabilities to generate, process and exploit terrain products enabling situational awareness and rapid decision making at the tactical edge. ***FY 2022 Plans:*** Develop improved collection and processing of complex 3D urban terrain increasing processing time and accuracy, leveraging evolutionary improvements to airborne, ground-level, and interior, subterranean mapping collection capabilities. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** This effort ends in Fiscal Year 2022 with the transfer of applied technologies to PE 0603463A (Network C3I Advanced Technology) / Project AU1 (Tactical GeoSpatial Information Capabilities ATech).			
Title: Airborne Light Detection and Ranging (LiDAR)	1.431	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Description: This effort investigates and develops enhanced Geiger-mode LiDAR hardware/software, for advanced testing of protocols, equipment, and products for improved high-altitude/wide area terrain data collection, to support tactical operations.			
Title: Geospatial Analytics and Prediction Technology ***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 2023 Plans:*** Will investigate optimized workflows for 3-Dimensional data from collection through product generation for building interiors and subterranean spaces. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** New task will support development of enhanced automated/semi-automated analysis tools.	-	-	0.518
Title: FY 2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.065	-
Accomplishments/Planned Programs Subtotals	4.085	1.776	0.518

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 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AU3 / *Geospatially Enabled Operational Design Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AU3: *Geospatially Enabled Operational Design Technology*	-	1.413	-	-	-	-	-	-	-	-	0.000	1.413

A. Mission Description and Budget Item Justification

This Project investigates, advances and develops a geospatially enabled collaborative planning environment, accessible across echelons, with capabilities that support Army Design Methodology (ADM) by providing the ability to perform conceptual planning and problem framing, supporting a greater understanding and visualization of the dynamic operational environment, a shared understanding of the operations purpose across echelons, and enhanced products to drive detailed planning (Military Decision Making Process - (MDMP) and the operational assessment process, enhancing the collaborative interaction between commanders, staffs, and unified action partners.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AU4 (Geospatially Enabled Operational Design Adv Tech).

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 Engineer Research and Development Center (ERDC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Virtual Collaborative Operational Design (GEOD) Research	1.413	-	-
Description: This effort investigates automation technologies to digitally visualize, create and assess critical elements of the Operational Environment required to inform the Operational Design functions, including collaborative conceptual framing of the problem by examining the differences between the current state of an operational environment and the desired end state.			
Accomplishments/Planned Programs Subtotals	1.413	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AV3: *Foundational S&T for Network C3I Technology*	-	1.927	4.657	0.743	-	0.743	1.467	2.555	11.323	10.216	0.000	32.888

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 2021	FY 2022	FY 2023
Title: Development of Foundational technologies for holistic network integration ***Description:*** This effort develops underlying technologies applicable to next generation networks and integration of the same.	1.927	-	-
Title: Development of Disruptive, Innovative Research for Emerging (DIRE) Applied Network Capabilities ***Description:*** This effort develops innovative network capabilities using a rapid and agile methodology to examine feasibility of incorporation into Army network problem sets. ***FY 2022 Plans:*** Will investigate and research innovative emerging technologies focusing on network resiliency, artificial intelligence, and autonomy enabled machine learning technologies that will be integrated into a holistic network in support a Multi-Domain Operations (MDO) enabled environment. ***FY 2023 Plans:*** Completing innovative technology pilot for discovering and developing innovative and disruptive network capabilities in the space of network resiliency, artificial intelligence, and autonomy. ***FY 2022 to FY 2023 Increase/Decrease Statement:***	-	4.487	0.743

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Decrease in funding due to fewer requirements needed to complete identified efforts during the Fiscal Year 2022 (FY22) search process.			
Title: SBIR/STTR Transfer ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.170	-
Accomplishments/Planned Programs Subtotals	1.927	4.657	0.743

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
AV5: *Protective Technologies*	-	7.411	7.549	6.428	-	6.428	6.524	6.583	6.585	6.583	0.000	47.663

A. Mission Description and Budget Item Justification

This Project develops tools, devices, and techniques to protect acquisition program systems and Critical Program Information (CPI) from adversarial threats.

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Protective Technologies	7.411	7.273	6.428
Description: This effort develops tools, devices, and techniques to protect acquisition program systems and (CPI) from adversarial threats. ***FY 2022 Plans:*** Will develop additional technologies focused on the latest adversarial threats being faced by Army programs. Evaluate the technology protection requirements of Army and Department of Defense (DoD) programs; and develop technologies to assist those programs in maintaining their technological overmatch capabilities. ***FY 2023 Plans:*** Will develop advanced packaging microelectronics security solutions for anti-tamper application through continued rigor development and analysis. Will investigate and evaluate new protective technologies for integration in Army and DoD systems to protect critical technology with improved resilience to exploitation. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort programmed in coordination with the DoD Executive Agent for Anti-Tamper.			
Title: FY2022 SBIR/STTR Transfer	-	0.276	-
Description: Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	7.411	7.549	6.428

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AV6 / *Airborne Engineering Support Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AV6: *Airborne Engineering Support Technology*	-	0.866	-	-	-	-	-	-	-	-	0.000	0.866

A. Mission Description and Budget Item Justification

This Project supports advanced Command, Control, Communications, Intelligence, Surveillance and Reconnaissance (C3ISR) research and development technologies for airborne, and air-to-ground based testing of emerging Radio Frequency (RF) technologies.

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Airborne Engineering Support Technology	0.866	-	-
Description: This effort supports the experimentation of new and emerging C3ISR technologies. This venue performs technology assessments by evaluating candidate technologies in support of the Army Modernization Priorities. Events are determined by the maturity of the tech base programs across the Army?s Science and Technology (S&T) C3ISR portfolio.			
Accomplishments/Planned Programs Subtotals	0.866	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) AV7 / *Atmospheric Modeling and Meterological Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AV7: *Atmospheric Modeling and Meterological Technology*	-	5.918	5.931	-	-	-	-	-	-	-	0.000	11.849

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CW2 (Exploitation of Atmospheric Impacts across Domains)

A. Mission Description and Budget Item Justification

This Project develops tactical atmospheric sensing, modeling, and decision support technologies. New atmospheric sensing technologies are developed that enable near-real-time, high-resolution measurements of atmospheric parameters via light-weight systems that can be employed in tactical domains. Efforts include high-resolution local assessments and forecasts of meteorological conditions that can accommodate the effects of dense urban and complex, mountainous terrain. Both physics-based and rule-based decision support systems are developed for assessing the impacts of weather/atmosphere across a spectrum of friendly and threat weapons systems, sensors, platforms, and operations. It provides detailed model applications for various effects of the atmosphere on electro-optical and acoustic target detection, location, and identification. Information can be applied to mission planning and execution, battlefield visualization, reconnaissance, surveillance, and target acquisition, route planning to maximize stealth and efficiency, web-enabled tactical decision aids, long-range precision fires, and modeling of environmental impacts for combat simulations and war games.

This research provides technologies for evaluation by and/or transitions to the Department of Defense weather and operations community including: Program Executive Office (PEO) Ammunition-PM Combat Ammunition Systems (CAS) and Marine Corps Systems Command (MCSC) for meteorological message input to field artillery targeting systems, Project Manager, Distributed Common Ground System-Army (DCGS-A), the United States Air Force 557th Weather Wing, and the Air Force Life Cycle Management Center (AFLCMC) to improve their operational weather support to the Army.

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Atmospheric Characterization, Modeling, and Impacts	5.918	5.714	-
Description: This effort develops environmental situational understanding enabled though coupled sensing, modeling, and decision support technologies for data-sparse, computationally-limited, and network-constrained domains.			
FY 2022 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AV7 / *Atmospheric Modeling and Meterological Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Will conduct validation study of Atmospheric Boundary Layer Environment Lattice-Boltzmann Method (ABLE-LBM) in urban domains and mature Light Detection and Ranging (LiDAR) and radar assimilation methods building from initial Perdigo, Portugal field experiment data; develop and implement improved atmospheric acoustic propagation model with range dependence; investigate applicability of machine learning modeling based on heterogeneous sensor input to inform situational awareness; investigate machine algorithms to characterize and assess aerosols; experiment with the use of surrogate models to quantify uncertainty of impactful environmental conditions for autonomous flight of unmanned aerial systems (UASs); and investigate assimilation of multi-UAS sensing as constraints in simplified-physics or other surrogate models designed for low-resource platforms. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding administratively realigned to PE 0602182A (C3I Applied Research) / Project CW2 (Exploitation of Atmospheric Impacts across Domains).			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.217	-
Accomplishments/Planned Programs Subtotals	5.918	5.931	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AV9: *Advanced PNT for GPS Independent Environments Tech*	-	6.656	10.117	8.850	-	8.850	8.982	8.747	8.697	8.694	0.000	60.743

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 research 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.

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).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Precision Measurement Technology for Contested Environments	3.054	2.968	3.260
Description: This effort will develop technologies that will enable precise and assured PNT in GPS-denied environments for up to 1 hour. This research will improve the accuracy while also focusing on size, weight, power, cost (SWAP-C) of current IMUs through 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 2022 Plans: Will iterate designs, fabricate, and validate performance of novel MEMS IMUs using advanced MEMS materials and micro-structures to develop path to low cost navigation grade MEMS IMUs accuracy and improved drift correction techniques in representative operational environments (temperature and vibration); study performance of chip-scale, low-noise stabilized frequency sources and integrated electro-optic frequency combs for low SWAP-C atomic clock designs to assess improved clock stability over relevant operating environments; develop algorithms to implement RF sources of opportunity and multi-sensor/multi-			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
waveband vision-based geo-localization and validate their performance on the PNT testbed; perform laboratory and relevant environment performance validation of low SWAP multi-node, anti-jam reception/operations of both GPS and 5G operations. ***FY 2023 Plans:*** Will develop chip embodiment of the self-stabilization circuitry for frequency stabilization of linked micro-resonator optical frequency combs; Will mature and optimize novel MEMS inertial sensors using advanced MEMS materials and micro- structures to develop path to low-cost, navigation-grade MEMS IMU accuracy and improved drift correction techniques tested over temperature; Will continue to validate performance of chip-scale, low-noise stabilized frequency sources and integrated frequency combs for low SWAP-C clocks; Will validate and optimize algorithms to process RF signals of opportunity and multi-sensor/multi-waveband vision-based geo-localization. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase reflects planned lifecycle of this effort.			
Title: Quantum Effects for Assured PNT in Zero-GPS Environments ***Description:*** This effort will conduct research on SWAP-C quantum based timing sub-systems, incorporating 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 2022 Plans:*** Will assess high performance and reasonable SWAP atomic clock for platform and increased performance network applications and iterate design to increase hardening and manufacturability; will validate initial designs of low cost (<$300 per unit) SWAP Chip-Scale Atomic Clock 2.0 (CSAC 2.0) for Soldier and small platform and munition applications; will iterate design, fabricate, and validate performance of first low cost SWAP CSAC 2.0; will investigate transition of government gyro designs (sub-component of high performance IMUs) to commercial partners to accelerate maturity of advanced government gyro capability; will validate a minimum of three heterogeneous sensor modalities into an embedded hybrid multi-sensor fusion engine with continuous Inertial Navigation System (INS) calibration capable of interfacing with the Department of Defense PNT Open Architecture standards; will validate multi-sensor fusion engine and perform continuous INS calibration in a relevant environment using the additional capability of the high performance and reasonable SWAP atomic clock to assess potential performance improvements of PNT calculations during GPS contested events. ***FY 2023 Plans:*** Will assess rackmount atomic clock under relevant environments and optimize design for ruggedization and clock manufacturing considerations; Will assess and optimize gyro and accelerometer performance with novel self-calibration techniques; Will validate	3.602	6.779	5.590

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
hybrid, modular multi-sensor fusion engine with continuous Inertial Navigation System (INS) calibration capable of interfacing with the Department of Defense PNT Open Architecture standards; develop and optimize novel algorithms and architecture for sensor fusion state estimation. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding reduction reflects decrease in research of heterogeneous sensor modalities that are embedded into a hybrid multi-sensor fusion engine.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.370	-
Accomplishments/Planned Programs Subtotals	6.656	10.117	8.850

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AW1: *Autonomous Navigation Technology*	-	1.732	2.066	2.052	-	2.052	-	-	-	-	0.000	5.850

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

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

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Intelligent Electronic Protect (IEP)	1.732	1.990	2.052
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.			
FY 2022 Plans: Will continue to investigate assured access to PNT in contested electromagnetic environments; and validate unhindered access to military GPS level of accuracy. Will develop techniques to detect and identify radio frequency (RF) signals on a PNT system with minimal additional hardware. Will begin algorithm development to enhance integrity and graceful degradation in challenged environments.			
FY 2023 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Will continue to mature techniques to detect and identify RF signals. Will conduct lab based experiments to validate the maturity and feasibility of algorithmic approach in GPS challenged environments. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding change reflects planned life cycle of this effort.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.076	-
Accomplishments/Planned Programs Subtotals	1.732	2.066	2.052

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army											Date: April 2022	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*				Project (Number/Name) AW3 / *DoD PNT M&S Collaborative Initiative (CI) Technolo*			
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
AW3: *DoD PNT M&S Collaborative Initiative (CI) Technolo*	-	1.925	-	-	-	-	-	-	-	-	0.000	1.925

A. Mission Description and Budget Item Justification

This Project designs and develops Positioning, Navigation and Timing (PNT) modeling and simulation (M&S) frameworks and tools to provide Department of Defense (DoD) with the capability to conduct analysis and create quantifiable data on the impact of PNT technologies on warfighters and missions operating in a denied or degraded Global Positioning System (GPS) environment. Additionally, it provides senior leadership with the information required to understand the value of PNT investment versus the improvement in mission performance and operational effectiveness. This Project also assess the effectiveness and maturity of complementary PNT systems/sensors.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW4 (DoD PNT M&S Collaborative Initiative (CI) Adv Tech).

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: DoD PNT M&S Collaborative Initiative	1.925	-	-
Description: This effort designs and develops PNT M&S frameworks and tools to provide DoD with the capability to conduct analysis and create quantifiable data on the impact of PNT technologies on warfighters and missions operating in a denied or degraded GPS environment. Additionally, it provides Senior leadership with the information required to understand the value of PNT investment versus the improvement in mission performance and operational effectiveness. This effort also assess the effectiveness and maturity of complementary PNT systems/sensors.			
Accomplishments/Planned Programs Subtotals	1.925	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** AW3 / *DoD PNT M&S Collaborative Initiative (CI) Technolo*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BP2: *Sensor and Electronic Network Initiatives (CA)*	-	90.500	80.300	-	-	-	-	-	-	-	0.000	170.800

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 2021	FY 2022
Congressional Add: Program Increase - Inertial Navigation Systems ***FY 2021 Accomplishments:*** Conducted applied research in Inertial Navigation Systems. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase - APNT for Autonomous Vehicles ***FY 2021 Accomplishments:*** Conducted applied research in APNT for Autonomous Vehicles. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - CHARM ***FY 2021 Accomplishments:*** Conducted applied research in CHARM. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - Energy Efficient Devices ***FY 2021 Accomplishments:*** Conducted applied research in Energy Efficient Devices.	5.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022
Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Energy Efficient Devices		
Congressional Add: Program Increase - Integrating Energy and Computing Networks ***FY 2021 Accomplishments:*** Conduct applied research in Integrating Energy and Computing Networks. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase - Artificial Intelligence and Machine Learning Electronic Warfare Sensor Technology ***FY 2021 Accomplishments:*** Conducted applied research in Artificial Intelligence and Machine Learning Electronic Warfare Sensor Technology. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase - APNT Distributed Antennae ***FY 2021 Accomplishments:*** Conduct applied research in APNT Distributed Antennae. Work executed by Army Futures Command.	20.000	-
Congressional Add: Program Increase: Urban Subterranean Mapping Technology ***FY 2021 Accomplishments:*** Conduct applied research in Urban Subterranean Mapping Technology. Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Urban Subterranean Mapping Technologies	4.000	4.000
Congressional Add: Program Increase: Unmanned Sensors for Biological and Chemical Hazards ***FY 2021 Accomplishments:*** Conduct applied research in Unmanned Sensors for Biological and Chemical Hazards. Work executed by Army Futures Command.	2.000	-
Congressional Add: Program Increase: Mobile Environmental Contaminant Sensors ***FY 2021 Accomplishments:*** Conduct applied research in Mobile Environmental Contaminant Sensors.	8.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022
Work executed by Army Futures Command. ***FY 2022 Plans:*** Congressional Interest Item funding provided for Mobile Environmental Contaminant Sensors		
Congressional Add: Program Increase: Multi?UAS Integrated ISR Technology ***FY 2021 Accomplishments:*** Conduct applied research in Multi-UAS Integrated ISR Technology. Work executed by Army Futures Command.	3.000	-
Congressional Add: Program Increase: Autonomous Platform Threat Detection Sensors ***FY 2021 Accomplishments:*** Conducted applied research in Autonomous Platform Threat Detection Sensors. Work executed by Army Futures Command.	6.000	-
Congressional Add: Program Increase: Intelligent Electronic Protection Technology ***FY 2021 Accomplishments:*** Conducted applied research in Intelligent Electronic Protection Technology. Work executed by Army Futures Command.	2.500	-
Congressional Add: ALTNAV ***FY 2022 Plans:*** Congressional Interest Item funding provided for ALTNAV	-	13.800
Congressional Add: Anti-Tamper Technology ***FY 2022 Plans:*** Congressional Interest Item funding provided for Anti-Tamper Technology	-	5.000
Congressional Add: Backpackable COMINT System ***FY 2022 Plans:*** Congressional Interest Item funding provided for Backpackable COMINT System	-	5.000
Congressional Add: Distributed Radio Frequency and Sensor Technology Development ***FY 2022 Plans:*** Congressional Interest Item funding provided for Distributed Radio Frequency and Sensor Technology Development	-	8.000
Congressional Add: EW and Advanced Sensing ***FY 2022 Plans:*** Congressional Interest Item funding provided for EW and Advanced Sensing	-	6.500
Congressional Add: Integrated Photonics for Contested RF Environments	-	15.000

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022
FY 2022 Plans: Congressional Interest Item funding provided for Integrated Photonics for Contested RF Environments		
Congressional Add: Mass-Distributed Acoustic Surveillance Network ***FY 2022 Plans:*** Congressional Interest Item funding provided for Mass-Distributed Acoustic Surveillance Network	-	8.000
Congressional Add: Social Network Analysis ***FY 2022 Plans:*** Congressional Interest Item funding provided for Social Network Analysis	-	5.000
Congressional Adds Subtotals	90.500	80.300

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) BZ6 / *Narrowband SATCOM Technology*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BZ6: *Narrowband SATCOM Technology*	-	0.963	-	-	-	-	-	-	-	-	0.000	0.963

A. Mission Description and Budget Item Justification

This Project designs and develops technologies to enable Army Narrowband Satellite Communications (SATCOM) networks to control traditional military tactical SATCOM along with non-traditional networks, such as commercial networks, to enable adaptability of the narrowband SATCOM network in a contested environment.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AN2 (Narrowband SATCOM Advanced Technology).

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Narrowband Satellite Communication Technology	0.963	-	-
Description: This project designs and develops technologies to enable Army Narrowband SATCOM networks to control traditional military tactical SATCOM along with non-traditional networks, such as commercial networks, to enable adaptability of the narrowband SATCOM network in a contested environment.			
Accomplishments/Planned Programs Subtotals	0.963	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) BZ8 / *Aerial Teir Networking (High Altitude)*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BZ8: *Aerial Teir Networking (High Altitude)*	-	0.385	-	-	-	-	-	-	-	-	0.000	0.385

A. Mission Description and Budget Item Justification

This Project designs and develops technologies for aerial networking to establish line of sight and beyond line of sight communications.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Aerial Tier Networking (High Altitude)	0.385	-	-
Description: Develop a Wideband Global Satellite Communications (WGS) surrogate payload for usage on a High Altitude Platform (HAP) with seamless transition to existing ground terminals by modifying existing solutions to support Network Modernization Capability Sets (CS) beginning with CS23 - Capacity & Resiliency.			
Accomplishments/Planned Programs Subtotals	0.385	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CG3: *Assured PNT Communications Applied Research*	-	-	1.726	5.486	-	5.486	5.608	5.799	4.697	4.753	0.000	28.069

A. Mission Description and Budget Item Justification

Tactical Land Component Forces require access to Space and High Altitude capabilities to enable force projection and maneuver during Multi-Domain Operations (MDO). Space and High Altitude payloads provide persistent/deep sensing to increase the number of actionable targets, decrease target discovery time, extend the range of Army sensing capabilities, improve commander's situational understanding of the Electromagnetic Spectrum and enable lethal and non-lethal fires, and increase/accelerate improved MDO data to assist Commander's decision making process.

This Program Element (PE) designs and develops technologies for Space-Based and High Altitude applications to support Army tactical ground forces. Focus is on advanced technology development in support of Army objectives for Joint Operating Environment 2035. Investigations conducted leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development. Efforts include, but not limited to, research to mature current technologies in quantum sciences based communications, sensing, and data teleportation for small spacecraft and high altitude applications.

Research complements PE 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech).

The research cited 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 Space and Missile Defense Command (USASMDC) in Huntsville, AL.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Assured PNT Communications Applied Research	-	1.709	5.486
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. ***FY 2022 Plans:*** Validate payload technologies in the lab to provide tactical land component forces with Space and High Altitude capabilities for force projection and maneuver during Multi-Domain Operations.			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Maturation of quantum science-based crosslink communications, sensing, and data teleportation. Conduct a series of progressive tests assessing and verifying photonic information components for Space/HA sensor or Deep Sensing capabilities. ***FY 2023 Plans:*** Expand capability development across multiple channel domains starting with fiber connectivity, followed by open transmission in a configuration supporting nonmoving platforms, and then to a configuration to track, lock, and maintain connectivity in open transmission supporting moving platforms (ground, air, and space vehicles). Extend quantum science technologies to warfighter needs such as opportunities in ground launched systems. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding increase will support assessments of high altitude platforms and classified capabilities which support Tactical Land Component Forces with APNT capabilities; and component developments in the laboratory including the testing necessary for Army APNT payloads to be compatible with the high altitude platforms and classified capabilities.			
Title: SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC 638. ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC 638.	-	0.017	-
Accomplishments/Planned Programs Subtotals	-	1.726	5.486

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CI3: *Mobile and Survivable Command Post (MASCP) Tech*	-	-	6.236	5.728	-	5.728	3.254	0.607	0.607	0.607	0.000	17.039

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.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: CP Modularity and Dispersion Technology	-	3.994	2.641
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. Initiates analysis to develop 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 2022 Plans: Will conduct gap and threat analysis of peer competitors; initiate market survey?s across the technology sectors applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution).			
FY 2023 Plans: Will research concepts refined from gap and threat analysis of peer competitors; will investigate technology solutions applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution); will conduct analysis and begin development of component level technologies to increase resiliency of Command Post specific communications systems.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Decrease in FY23 due to reduction in the development of component level technologies.			
Title: Signature Management and Reduction Technology ***Description:*** Investigates and develops electromagnetic spectrum (EMS) management tools to model CP signatures and optimize the employment of CP nodes and communication assets. ***FY 2022 Plans:*** Will validate threat capability and develop electromagnetic spectrum models of threat and friendly emissions. Implement a software model that visualizes CP emissions and conduct user design workshops that inform EMS signature management options. ***FY 2023 Plans:*** Will continue validation of the software model for visualizing CP emissions to incorporate automatic recognition and learning of CP radio frequency signatures. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Increase in funding to support the development of software model for RF Signals due to new requirement from Cyber Center of Excellence (CCoE)	-	1.341	2.491
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 2022 Plans:*** Will investigate the use of natural fibers for use in camouflage materials; investigate the use of various materials for use in the physical assets to achieve more accurate signatures; conduct a feasibility study of active sensor identification systems; and investigate improvements to current CP infrastructure through the development of material solutions that will enable rapid set-up/ tear down times, allow for longer loiter times and provide greater protection of command post structures and enclosures. ***FY 2023 Plans:***	-	0.673	0.596

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Will validate natural fiber camouflage material performance based on analysis of alternatives; perform trade space analysis for concealment properties from ISR threats; conduct experiments to validate concealment properties for command post survivability; perform capability assessments of command post structure and enclosure mobility. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding in this effort reflects planned lifecycle of this effort.			
Title: FY2022 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with Title 15 USC ?638	-	0.228	-
Accomplishments/Planned Programs Subtotals	-	6.236	5.728

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / *Network C3I Technology*	Project (Number/Name) CK1 / *Assured PNT Enabling Technologies*	

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CK1: *Assured PNT Enabling Technologies*	-	-	1.926	-	-	-	-	-	-	-	0.000	1.926

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CZ6 (Assured PNT Enabling Applied Technology).

A. Mission Description and Budget Item Justification

Tactical Land Component Forces require access to Space and High Altitude capabilities to enable force projection and maneuver during Multi-Domain Operations. Space and High Altitude sensors provide resilient communications, Assured Positioning Navigation and Timing (APNT) and deep sensing capabilities required in the targeting process to enable rapid and responsive sensor-to-shooter applications to engage and defeat Anti-Access/Area Denial (A2/AD) forces.

This Project investigates and matures technologies for Space-Based and High Altitude (HA) applications for Army tactical ground forces. Efforts include the development of sensors and electronic components for communications, signal and information processing, target acquisition, position/ navigation, and threat warning within Space and High Altitude environments. Investigations leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development. Efforts include research to mature current technologies in quantum sciences based communications, sensing, and data teleportation for small spacecraft applications.

Research complements PE 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech)

The research cited 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 Space and Missile Defense Command (USASMDC) in Huntsville, AL.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Assured PNT Enabling Technologies	-	1.855	-
Description: This effort supports validation of hardware and software components and models to further anchor laboratory capabilities enabling Space/HA sensor or Deep Sensing capabilities, payload design and development.			
FY 2022 Plans: Will design and develop an advanced laboratory testbed with the Mult-Axis Simulator (MAS) system that will be utilized to mature payloads for APNT, and optical/quantum secure communications on multiple simulated platforms simultaneously with hardware and software in the loop. Flight hardware will be designed to support delivery in early 2024 and for launch in 2025 to conduct			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602146A / *Network C3I Technology*	**Project (Number/Name)** CK1 / *Assurred PNT Enabling Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
experiments of the first US Army quantum entanglement transmission of data across free space for satellite-to-satellite and/or satellite-to-ground communications. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 funding is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CZ6 (Assured PNT Enabling Applied Technology).			
Title: SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC 638. ***FY 2022 Plans:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** Funding transferred in accordance with title 15 USC 638.	-	0.071	-
Accomplishments/Planned Programs Subtotals	-	1.926	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CU6: *Adaptive Information Mediation and Analytics*	-	-	-	7.089	-	7.089	7.194	7.232	7.235	7.233	0.000	35.983

Note

This is a new start in FY 2023.

In Fiscal Year 2023 (FY23) this Project is a New Start.

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Adaptive Cross Reality Information Mediation	-	-	2.115
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 2023 Plans: Will examine methods for intelligent information mediation and adaptive information representation that explore information selection and filtering approaches such as policy-based Value-of-Information/Quality-of-Information (VoI/QoI); Will investigate the utilization of ubiquitous Internet of Things (IoT) (smart) sensors to augment situational awareness and understanding and hence, increase effectiveness of military operations; Will investigate methods for resilient information network and processing which integrate heterogeneous IoT sensors, autonomous systems, and Command and Control (C2) systems and platforms, perform analytics, and deliver critical information with value-based selection, prioritization, and dissemination of information reliably over			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
constrained tactical networks; Will explore methods for improving an immersive Common Operating Picture (COP) by designing cross reality technology to support synthetic data. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 this effort is a New Start			
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 2023 Plans:*** Will develop aided target recognition (AiTR) algorithms for real-time detection and recognition of military vehicles and dismount target sets on small unmanned aerial vehicles (UAVs); Will develop synthetic data generation approaches to generate inherently labeled synthetic electro-optical infrared (EO/IR) data of vehicles and dismounts to substantially augment the limited availability of real training data; Will validate the AiTR algorithms using collected field data; Will investigate algorithm-architecture co-optimization frameworks with Field Programmable Gate Arrays (FPGAs) to increase neural network inference speed through optimal algorithm mapping to hardware; Will explore how machine learning algorithms implemented on size, weight, power and cost (SWaP-C) constrained devices can overcome uncertainty and limited network connectivity for battlefield sensors and Assured Position Navigation and Time (A-PNT) uses; Will research and develop event-triggered consensus-based distributed learning methods that are robust to adversarial manipulation for machine learning models meeting constraints of low SWaP computing devices; Will research techniques to develop and characterize synthetic data sets that include novel synthetic objects and backgrounds; Will experiment with larger and more varied synthetic augmentations to traditional training data sets; Will identify and correlate effects of synthetic training data augmentation to trained object classifier performance; Will develop methodologies to enhance classification performance against uncommon targets with synthetic training data augmentation; Will develop methods for incorporating synthetic scenes, real scenes, and SA in AI-driven multi-echelon C2 simulations. ***FY 2022 to FY 2023 Increase/Decrease Statement:***	-	-	4.974

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
In FY23 this effort is a New Start			
Accomplishments/Planned Programs Subtotals	-	-	7.089

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CV4: *Pathfinder 3D Applied Technology*	-	-	-	2.191	-	2.191	2.081	1.247	1.663	1.871	0.000	9.053

Note

This is a new start in FY 2023.

In Fiscal Year 2023 (FY23) this Project is a New Start.

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.

The research cited 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 Engineer Research and Development Center (ERDC) and coordinated with the United State Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: PATHFINDER 3-D Navigation Technology	-	-	2.191
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 2023 Plans:*** Will advance development in testing integrated foundation geospatial intelligence (GEOINT), sensory sources (from both air and ground) to derive state estimation for a semi-autonomous robotic system; will investigate routing capabilities, sensors and a basic inertial accuracy for VTRAN Geospatial solutions. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** In FY23 this effort is a New Start			
Accomplishments/Planned Programs Subtotals	-	-	2.191

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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