Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602782A *I Command, Control, Communications Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	-	51.685	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	51.685
779: *Command, Control And Platform Electronics Tech*	-	9.195	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.195
CY2: *Applied Defensive Cyber*	-	7.955	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.955
H92: *Communications Technology*	-	34.535	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	34.535

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is realigned, with continuity of effort realigned to the following PEs:
* PE 0602146A Network C3I Technology
* PE 0602213A C3I Applied Cyber

A. Mission Description and Budget Item Justification

This PE researches and investigates communications, mission command (MC), and electronics components, sub-components, software and protocols that provide the Army with enhanced capabilities for secure, mobile, networked communications, assured information delivery, and presentation of information that enables decision-making. Commercial technologies are continuously investigated and leveraged where possible. Project 779 researches and develops MC software, algorithms, protocols, architectures, and devices that enable management of information across the tactical and strategic battle space; provides automated cognitive reasoning and decision making aids; allows timely distribution, presentation/display and use of MC data on Army platforms; and researches alternatives to Global Positioning System (GPS) for positioning, navigation and timing. Project CY2 investigates cyber electromagnetic activities (CEMA), cyber security devices, software and techniques to harden wireless communications networks against cyber-attacks and new mobile networking protocols that afford resilience within our networks to autonomically 'fight through' and/or evade hostile cyber effects. Project H92 supports research in communications components, software, algorithms and protocols, which allow field commanders to communicate on-the-move to/from virtually any location, through a seamless, secure, self-organizing, self-healing network.

Work in this PE complements PE 0601104A (University and Industry Research Centers), PE 0602270A (EW Technology) , PE 0602705A (Electronics and Electronic Devices), PE 0603270A (EW Technology), PE 0603772A (Advanced Tactical Computer Science & Sensor Tech), and PE 0603794A (C3 Advanced Technology).

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

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

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	54.956	0.000	0.000	-	0.000
Current President's Budget	51.685	0.000	0.000	-	0.000
Total Adjustments	-3.271	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.800	-			
• SBIR/STTR Transfer	-1.471	-			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army											Date: February 2020	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*				Project (Number/Name) 779 / *Command, Control And Platform Electronics Tech*			
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
779: *Command, Control And Platform Electronics Tech*	-	9.195	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.195

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
Program Element (PE) 0602146A Network C3I Technology
* Project AQ6 Command Applications of Machine Learning Technolog
* Project AQ7 High Tempo Data Driven Decision Tools Technology
* Project AQ9 Expeditionary Data to Decisions Technology
* Project AV6 Airborne Engineering Support Technology
* Project AW1 Autonomous Navigation Technology
* Project AW3 DoD PNT M&S Collaborative Initiative (CI) Technology
* Project AW5 Modular GPS Independent Sensors Technology

A. Mission Description and Budget Item Justification

This Project researches moveable and mobile command post hardware and other components, software and algorithms that enable commanders at all echelons to have more accurate, useful, and timely information and allows them to execute mission command (MC) from anywhere on the battlefield. Emphasis is on advancements to MC computing platforms, with a specific emphasis on positioning, navigation, and timing (PNT); user/computing platform interaction and cognitive burden reduction; informed operations; and commander-centric capabilities, including using automation to augment or supply staff capabilities. This Project researches technologies that support multi-modal man-machine interaction, battle space visualization, positioning and navigation in degraded environments (poor Global Positioning System (GPS) performance), automated cognitive decision aids, real-time collaborative tactical planning tools, open system architectures, and integration concepts which contribute to more efficient expeditionary and uninterrupted operations.

Work in this Project is related to, and fully coordinated with PE 0603772A (Adv Tactical Computer Science & Sensor Technology) / Project 101 (Tactical Command and Control).

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

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

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

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** 779 / *Command, Control And Platform Electronics Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Assured Positioning, Navigation, and Timing (A-PNT) ***Description:*** This effort investigates positioning, navigation and timing sensor and sensor integration technologies to provide position, velocity, and time information to support operational and training requirements, especially in GPS denied/degraded environments. This effort also designs PNT modeling and simulation (M&S) architectures, frameworks and models.	6.344	-	-
Title: Next Generation Mission Command Technologies ***Description:*** This effort investigates, designs and codes software to enable a uniform MC capability and experience for the commander in the command post, on the move in vehicles, or dismounted, increases the situational awareness through software data architectures and algorithms that intelligently share data across low bandwidth networks and across dismounted, mounted and command post platforms, and improves decision making capacity across the battlefield by using software knowledge representation to model mission, enabling artificial intelligence techniques to use the model to automate staff tasks, correlate and analyze information and provide recommendations.	2.851	-	-
Accomplishments/Planned Programs Subtotals	9.195	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*	Project (Number/Name) CY2 / *Applied Defensive Cyber*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CY2: *Applied Defensive Cyber*	-	7.955	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.955

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602213A Network C3I Technology
* Project 2CY Information Trust Technology
* Project CY6 Autonomous Cyber Technology
* Project CY8 Cyber Sec Applied Research and Exper Partner Tech
* Project CY9 Decoy and Deterrence Technology

A. Mission Description and Budget Item Justification

This Project investigates cyber electromagnetic activities (CEMA), cyber security devices, software and techniques to harden wireless communications networks against cyber-attacks and new mobile networking protocols that afford resilience within our networks to autonomically 'fight through' and/or evade hostile cyber effects. This Project also investigates and applies robust cyber security techniques and applications to advanced communications and networking devices, software, algorithms and protocols utilized within wireless tactical networks to protect against nation state level cyber effects and maintain Warfighter confidence in network information, resources, identities and mission partners by hardening the blue force attack surface.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Defensive Cyber Operations	6.490	-	-
Description: This effort investigates and applies robust cyber security techniques and applications to advanced communications and networking devices, software, algorithms and protocols utilized within wireless tactical networks to protect against nation state level cyber effects and maintain Warfighter confidence in network information, resources, identities and mission partners by hardening the blue force attack surface. These capabilities will harden the attack surface by ensuring trustworthy software (SW), hardware (HW), information systems, communications and networks. This effort affords resilience within our networks to autonomically 'fight through' and/or evade hostile cyber effects and provide situational understanding (SU) to enable effective mission planning and execution.			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** CY2 / *Applied Defensive Cyber*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Cyber Security Applied Research & Experimentation Partner (AREP) Technology (formerly called the Cyber Collaborative Research Alliance (CRA)) ***Description:*** This effort will take innovative basic research theories from the Cyber CRA and experimentally validate the hypothesis and create proof-of-concept defensive cyber software implementations.	1.465	-	-
Accomplishments/Planned Programs Subtotals	7.955	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*				Project (Number/Name) H92 / *Communications Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
H92: *Communications Technology*	-	34.535	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	34.535

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
Program Element (PE) 0602146A Network C3I Technology
* Project AM6 Modular RF Communications Technology
* Project AM8 Protected SATCOM Technology
* Project AN3 Non Traditional Waveforms Technology
* Project AN5 Protected SATCOM-WB Global SATCOM Inter Canc Tech
* Project AN9 UNT - Every Receiver is a Sensor Technology
* Project AO2 Stand-In Advanced RF Effects (STARE)
* Project AP7 Comms/Horiz Int for Army Mod Priorities Tech
PE 0602143A Soldier Lethality Technology
* Project AN1 Narrowband SATCOM Technology

A. Mission Description and Budget Item Justification

This Project investigates and applies advanced communications and network devices, software, algorithms and services by leveraging and adapting commercial research and new communications and network sciences work by the Army Research Lab, Network Science Collaborative Technology Alliance or other Basic Research efforts. This Project leverages developments in wireless transport (e.g. mobile radio based communications systems) to design new techniques for improving communications in high radio frequency (RF) interference environments, such as in the presence of electronic warfare (EW), and to increase the communications capacity of terrestrial and satellite communications (SATCOM) systems. This Project also investigates antenna components, materials, designs and configurations to reduce the visual signature of antennas on Soldier, vehicular and airborne platforms and to reduce co-site interference on platforms with multiple transceivers, such as radios and jammers. Additionally, this Project investigates defensive cyber, cyber security devices, software and techniques to harden wireless communications networks against cyber attacks and new mobile networking protocols to make wireless, on-the-move (OTM) communications networks more responsive to user needs. Beginning in FY19 cyber efforts are being reported in Project CY2. This Project also investigates software and techniques that improve the ability of the Soldier to manage and maintain complex, dynamic networks; and it designs spectrum management software tools to make more efficient use of the congested RF spectrum. This Project also designs new technology and techniques to lower the size, weight, power and cost of networking systems deployed on Army platforms.

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

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

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** H92 / *Communications Technology*

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Communications, Adaptive Networks to Improve Maneuver Operations, formerly Networking to Improve Maneuver and Expeditionary Operations ***Description:*** This effort investigates new capabilities to provide a range of robust, reliable, scalable, agile, interoperable and resource efficient communications capabilities to forces on the move. These capabilities allow forces to conduct maneuver operations, develop situational understanding, and sustain operations while maintaining freedom of movement.	14.705	-	-
Title: Communications, Robust Tactical Systems, formerly Uninterrupted Communications ***Description:*** This effort designs and matures components, software and algorithms that enable Army tactical wireless networks to provide assured uninterrupted access to critical communications and information links so that they operate more robustly in congested, contested and competitive electromagnetic environments. These capabilities will result in robust, reliable and secure terrestrial and SATCOM networks with greater survivability in austere, congested and hostile electromagnetic environments while ensuring that the capabilities are interoperable and resource efficient and will allow forces to develop SU and conduct operations to support mission command networks even under adverse operational conditions.	15.030	-	-
Title: Modular Radio Frequency ***Description:*** This effort enables connectivity in contested & congested environments by applying automated networking techniques to modular RF technology & networking techniques to adapt and continue operation under interference signals.	4.800	-	-
Accomplishments/Planned Programs Subtotals	34.535	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A