Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army												Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	-	32.458	54.956	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	87.414
779: *Command, Control And Platform Electronics Tech*	-	12.638	11.144	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	23.782
CY2: *Applied Defensive Cyber*	-	0.000	8.257	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.257
H92: *Communications Technology*	-	19.820	35.555	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	55.375

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is being 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 (Electronic Warfare Technology) , PE 0602705A (Electronics and Electronic Devices), PE 0603270A (EW Technology), PE 0603772A (Adv Tactical Computer Science & Sensor Technology), 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 2020 Army					Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*		
B. Program Change Summary ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**
Previous President's Budget	33.123	55.003	49.895	-	49.895
Current President's Budget	32.458	54.956	0.000	-	0.000
Total Adjustments	-0.665	-0.047	-49.895	-	-49.895
• Congressional General Reductions	-0.013	-0.047			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.652	-			
• Adjustments to Budget Years	-	-	-49.895	-	-49.895

Change Summary Explanation

FY20 decrease related to science and technology financial restructuring.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*				Project (Number/Name) 779 / *Command, Control And Platform Electronics Tech*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
779: *Command, Control And Platform Electronics Tech*	-	12.638	11.144	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	23.782

Note

In Fiscal Year (FY) 2020 this Project is being 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 2020 Army		Date: March 2019
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 2018	FY 2019	FY 2020
Title: Assured Positioning, Navigation, and Timing (A-PNT)	7.114	6.356	-
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. ***FY 2019 Plans:*** Research and investigate new and novel GPS-independent sensors; investigate innovative ways to use exiting PNT sensors; design and develop sensor fusion algorithms; develop portable sensor fusion core, allowing for a platform-agnostic solution for navigation in GPS denied or degraded environments that can be tailored based on mission or size, weight and power (SWAP) requirements; develop interfaces for GPS independent sensors, allowing connectivity with the portable sensor fusion core; continue investigation of miniature inertial sensors to augment PNT in GPS denied environments; continue research involving LIDAR odometry, visual navigation, and map building as potential sensor packages for use with the sensor fusion core; investigate new signals of opportunity for augmenting positioning and timing solutions on the battlefield; continue to improve localization and movement of an autonomous vehicle using PNT sensors through a complex environment; and continue to develop models of PNT sensors and conduct simulations of operational scenarios, especially under GPS challenged conditions. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AW1 (Autonomous Navigation Technology), Project AW3 (DoD PNT M&S Collaboration Initiative (CI) Technology), and Project AW5 (Modular GPS Independent Sensors Technology) in FY20 as part of the financial restructuring.			
Title: Next Generation Mission Command Technologies	5.524	4.639	-
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. ***FY 2019 Plans:*** Investigate and leverage relevant research and technology in pattern matching and cognitive science; develop data-driven decision tools with pre-populated decision models, user directed machine learning, and machine directed human learning to enhance the speed of decision making in high operational tempo environments; design a software framework to allow the dynamic connection of information sources and sensors to decision tools; and develop and validate visualization techniques that supply			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** 779 / *Command, Control And Platform Electronics Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
increased situational awareness, understanding, and recommendations based on the primary, secondary, and third order effects of decisions through the identification of patterns detected in available battle-space data, resulting in improved decision cycles for commanders and staff. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to 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), and Project AV6 (Airborne Engineering Support Technolog) in FY20 as part of the financial restructuring.			
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.149	-
Accomplishments/Planned Programs Subtotals	12.638	11.144	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*	Project (Number/Name) CY2 / *Applied Defensive Cyber*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
CY2: *Applied Defensive Cyber*	-	0.000	8.257	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.257

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 2018	FY 2019	FY 2020
Title: Defensive Cyber Operations	-	6.641	-
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 2020 Army		Date: March 2019
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 2018	FY 2019	FY 2020
FY 2019 Plans: Research and validate cyber security technologies to improve the depiction, perception, and understanding of cyber space as it pertains to a commander?s operational environment to speed actionable decisions; research cyber hardening methodologies for software, hardware, identities, and information to create trusted architectures and measures of provable identity, pedigree, and provenance; investigate robust built-in techniques that enable systems and networks to absorb, fight through, and adapt to adversary attacks; research and design autonomic techniques, models and algorithms to support convergence of defensive cyber, offensive cyber, Electronic Warfare (EW), and network/spectrum management information to improve decision response; research and validate block-chaining methodologies to trace and validate pedigree of tactical information as it traverses the network; research and validate robust non-intrusive identity authentication techniques that supports tactical access control; and will research models and algorithms that can provably determine a confidence factor associated with software vulnerability prioritization. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602213A (Network C3I Technology) / Projects CY9 (Decoy and Deterrence Technology), Project CY6 (Autonomous Cyber Technology) and Project 2CY (Information Trust Technology) in FY20 as part of the financial restructuring.			
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. ***FY 2019 Plans:*** Investigate and validate artificial intelligence and machine learning models and methods for reasoning on real time vulnerability prediction/analysis at a system-of-system perspective; investigate use of modeling methodologies and techniques to capture and specify system properties (e.g., structural and behavioral), and characterize cybersecurity attributes (e.g., confidentiality, integrity and availability); investigate biological-inspired self-securing models and methods that can support capabilities to autonomously perform analytic monitoring, maintain dynamic representation, realign their resources as necessary, and be able to substantiate integrity; and will investigate models and methods that can estimate what likely impact a vulnerability will cause to a system or network based on incomplete and inaccurate data. ***FY 2019 to FY 2020 Increase/Decrease Statement:***	-	1.616	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** CY2 / *Applied Defensive Cyber*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned to PE 0602213A (Network C3I Technology) / Project CY8 (Cyber Sec Applied Research and Exper Partner Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	8.257	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602782A / *Command, Control, Communications Technology*				Project (Number/Name) H92 / *Communications Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
H92: *Communications Technology*	-	19.820	35.555	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	55.375

Note

In Fiscal Year (FY) 2020 this Project is being 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 2020 Army		Date: March 2019
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 2018	FY 2019	FY 2020
Title: Communications, Adaptive Networks to Improve Maneuver Operations, formerly Networking to Improve Maneuver and Expeditionary Operations	4.508	14.705	-

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.

FY 2019 Plans:
Design and develop exquisite local communication techniques with inherent low probability of interception/low probability of detection (LPI/LPD) characteristics and high frequency reuse for spectrum supportability; investigate use of non-traditional networking methods for high bandwidth needs; design and develop techniques to extend the range of waveforms with propagation limitations and challenges operating through obstruction blockages (e.g. foliage, building, etc.) for line of sight networking; investigate technology with large channel bandwidths that support high data-rate transfer; design and develop mature non-traditional transceiver components for increased capacity, and reduced interference; conduct experiments for high bandwidth, resilient communications for high data rate applications, with improved communications protection between nearby vehicles with LPI/LPD; investigate improved methods to adapt LPI/LPD techniques to mesh networks to counter contested threats in the spectrum environment; mature distributed dismounted beam forming algorithms that enable two distributed beam forming nets to communicate; design and develop an architecture, and related protocols, for secure connection onto existing or third party transport infrastructure; investigate methods to utilize existing networks that will increase available network bandwidth and provide access to resources through a local network topology in which infrastructure nodes cooperatively connect directly, dynamically, and non-hierarchically; begin the design and development of a system that integrates sensor data which is harvested from existing fielded receivers, and propagated across the network to enable improved situational understanding; design and develop components that will help incorporate future radio systems into the sensing architecture; develop data analytics algorithms to identify, evaluate, and correlate specific events from available tactical and intelligence data, leveraging standard protocols and interfaces to current and future tactical receivers with associated visualization and data analytics tools; investigate components for low cost, unattended sensors that can be readily distributed ,then discarded, within an area of interest; develop interfaces and methods to use existing tactical radios and receivers; develop small, easily dispersible sensors to deliver large scale sensing over designated areas; develop data consolidation and sampling methods to minimize bandwidth use of large scale sensing devices available through tasking existing receivers.

FY 2019 to FY 2020 Increase/Decrease Statement:
This research effort was realigned to 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

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** H92 / *Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
AO2 (Stand-In Advanced RF Effects (STARE)), Project AP7(Comms/Horiz Int for Army Mod Priorities Tech), and PE 0602143A (Soldier Lethality Technology) / Project AN1 (Narrowband SATCOM Technology) in FY20 as part of the financial restructuring.			
Title: Defensive Cyber Operations, formerly Cyber/CEMA Operations ***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.	7.130	-	-
Title: 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.	2.916	-	-
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 Satellite Communications (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. ***FY 2019 Plans:*** Design and develop an agile network architecture that globally manages traffic from traditional and non-traditional networks; design and develop algorithms and software to enable resilient controls to support network traffic over Commercial and Government satellite communications (SATCOM) systems; conduct experiments to develop methods for robust narrowband SATCOM with resilience against adversary jamming; research to resilient Mission Command designs that are transport agnostic; investigate and design software-based algorithms for anti-jam, Low Probability of Interception and Deception (LPI/LPD) high frequency communications that incorporate state of the art protection against threat systems and enable operation in a contested environment of High Frequency systems; design and develop a standard interface specification to enable tactical Army units to interoperate with Navy and Air Force components; investigate components for a reliable, long range, and low data rate communications link to provide uninterrupted communications in a contested environment for the Army Tactical network; design a	5.266	15.030	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** H92 / *Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
proof of concept adaptive system that supports multiple simultaneous radio frequency connections, multiple types of interference cancellation, incorporating diverse paths and waveforms, beam forming, and power control; design and develop a control modem supporting required connectivity, throughput, and protection to support resiliency functions in a contested environment; design and develop a software based adaptive system that supports multiple types of Wideband SATCOM interference mitigation techniques; validate applicability of cognitive reasoning software to recognize interference signals and select the appropriate mitigation techniques and, through machine-learning, grow in responsiveness; conduct experiments to evaluate uninterrupted SATCOM configurations; conduct analysis to determine approach for developing and adding interference cancellation to the Army tactical modems; design and develop algorithms for improved interference rejection and improved jammer stand-off distance to address the tactical Army threats; investigate and design a decoy signal generator of multiple waveforms, capable of deceiving Intelligence, Surveillance, & Reconnaissance (ISR) systems; design and develop obfuscator hardware, supporting sensor and policy-based dynamic spectrum access (DSA) and transmitting obfuscation (flooding) waveforms, and frequency obfuscation to hide troop?s radio frequency signatures and spend enemy resources; conduct research to enable extended reach back, data link, and localized communications for long range precision fires; design and develop a single, autonomous and intelligent network across the tactical Army, providing a common user interface and drawing on the available resilient links to maintain data flow; develop solutions to provide reliable voice/data links for the next generation combat vehicles, and tele-operation and data links for Manned/Unmanned-Teaming (MUM-T); develop components to improve resilience of Air-to-Air and Air-to-Ground links for future vertical lift and next generation unmanned aerial system; design algorithms for intelligent networks to enable resilient links and data flow capability for Fire control, sensor data flow, and proximity/distance networking for air and missile defense; validate network-enabled mission command to the dismount soldier through intelligence and situational understanding-based routing of data over resilient communication links. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to 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), and PE 0602143A (Soldier Lethality Technology) / Project AN1 (Narrowband SATCOM Technology) in FY20 as part of the financial restructuring.			
Title: Modular Radio Frequency (RF) ***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. ***FY 2019 Plans:*** Design and develop product architectures based on a Modular Open System Architecture (MOSA) approach that incorporates components of network technologies into a unified solution; identify, validate, and develop standards for major internal interfaces	-	4.800	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** H92 / *Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
and all external interfaces to product components and network capabilities and services; identify, develop, and validate quality attribute requirements that reflect a focus on resilience for autonomous networking to addresses critical product qualities that span a design space of feasible solutions that will allow high value services to maintain persistent network connectivity in congested and contested environments; investigate alternative requirement allocations for different network technology components that will incorporate identified technologies currently in use, and new network technologies, within an agile and resilient autonomous network; develop alternative solutions and validate selection criteria for autonomous networking approaches that provide agile detection and switching among available network connections in order to sustain the network in dense and hostile spectrum environments; investigate situation-adaptive communications to inform networks of current spectrum environment changes (e.g. interference, congestion) for the tactical network links, in an effort to optimize their performance based on available resiliency features, to implement mitigation techniques to maintain operation and inform the automated network of their status and any degradations; investigate the methods for agile networking algorithms to detect network technologies available for inclusion in the automated network processing and determine techniques to minimize user input to establish the detections, authentications, and incorporation of the technologies into the automation. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 062146A (Network C3I Technology) / Project AM6 (Modular RF Communications Technology) in FY20 as part of financial restructuring.			
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	1.020	-
Accomplishments/Planned Programs Subtotals	19.820	35.555	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602782A / *Command, Control, Communications Technology*	**Project (Number/Name)** H92 / *Communications Technology*

E. Performance Metrics

N/A