Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603008A *I Electronic Warfare Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
Total Program Element	-	40.345	44.851	-	-	-	-	-	-	-	-	-
TR1: *TAC C4 Technology Int*	-	29.287	29.788	-	-	-	-	-	-	-	-	-
TR2: *Secure Tactical Information Integration*	-	11.058	15.063	-	-	-	-	-	-	-	-	-

Note

In the FY15 PB a $5M Congressional add appropriated to PE 0603006A in FY14 appeared in this PE due to a database error. That has been corrected.

Efforts in this PE were transferred to PE 0603794A beginning in FY16 for the purposes of correctly identifying the efforts as Command, Control and Communications Advanced Technology.

A. Mission Description and Budget Item Justification

This program element (PE) matures and demonstrates technologies to address the seamless integrated tactical communications challenge with distributed, secure, mobile, wireless, and self-organizing communications networks and networked transceivers that will operate reliably in diverse and complex terrains, in all environments. Efforts demonstrate seamlessly integrated communications and information security technologies across all network tiers, ranging from unattended networks and sensors through maneuver elements using airborne and space assets. Project TR1 investigates and leverages antennas; wireless networking devices, protocols, and software; network operations tools and techniques; and combines these and other technology options in a series of command, control, communications, and computers, intelligence, surveillance, and reconnaissance (C4ISR) on-the-move (OTM) network modernization demonstrations to measure their potential battlefield effectiveness. Project TR2 researches information security devices, techniques, services, software and algorithms to protect tactical wired and wireless networks against modern network attacks; generate and distribute tactical cyber situational awareness; and focuses on configuration, operation, monitoring, defense and network reconstitution in bandwidth constrained tactical environments while reducing the operator workload required to conduct these functions.

Work in this PE is complimentary of PE 0602782A (Command, Control, Communications Technology), and fully coordinated with PE 0602120A (Sensors and Electronic Survivability), PE 0602270A (Electronic Warfare Technology), PE 0602783A (Computer and Software Technology), PE 0603001A (Warfighter Advanced Technology), PE0603270A (Electronic Warfare Technology) and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology).

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

Work is performed by the Army Research, Development, and Engineering Command (RDECOM), Communications-Electronics Research, Development, and Engineering Center (CERDEC), Aberdeen Proving Ground, MD.

Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army					Date: February 2015
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603008A / *Electronic Warfare Advanced Technology*		
B. Program Change Summary ($ in Millions)	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**
Previous President's Budget	45.394	44.871	46.431	-	46.431
Current President's Budget	40.345	44.851	-	-	-
Total Adjustments	-5.049	-0.020	-46.431	-	-46.431
• Congressional General Reductions	-	-0.020			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.049	-			
• Adjustments to Budget Years	-	-	-46.431	-	-46.431
• Other Adjustments 2	-5.000	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603008A / *Electronic Warfare Advanced Technology*	Project (Number/Name) TR1 / *TAC C4 Technology Int*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
TR1: *TAC C4 Technology Int*	-	29.287	29.788	-	-	-	-	-	-	-	-	-

Note

Efforts in this project were transferred to PE 0603794A Project EL4 beginning in FY16.

A. Mission Description and Budget Item Justification

This project matures and demonstrates key communications and mobile networking technologies, such as antennas, transceivers, transceiver components, networking software and novel techniques to provide secure, reliable, mobile network solutions that function in complex and diverse terrains. This project concentrates on four major goals: to provide a series of technology demonstrations of new and emerging command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) technology enabled capabilities to significantly reduce risk associated with the network-of-networks concept; to lower the size, weight power and cost of wireless networking systems deployed on Army platforms through hardware and software convergence; to provide critical improvements in the ability to communicate and move large amounts of information in radio frequency (RF) contested environments, in a seamless, integrated manner across the Army's highly mobile manned and unmanned force structure; and to assess the technology readiness level (TRL) of emerging network technologies in an operationally relevant environment.

This project supports Army science and technology efforts in the Command, Control, Communications and Intelligence, Ground Maneuver, Air and Soldier/Squad portfolios.

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

Work in this project is performed by the Army Research, Development, and Engineering Command (RDECOM), Communications-Electronics Research, Development, and Engineering Center (CERDEC), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Antenna and Hardware Technologies (Formerly named Antenna Technologies)	2.615	1.845	-
Description: This effort matures and demonstrates low cost, power efficient, communications and electronic warfare (EW) antenna technologies for terrestrial and tactical satellite ground terminals. The focus is to reduce the visual signature and cost of antennas and reduce the number of antennas required on platforms by proving the capability to transmit and receive on multiple frequency bands, such as X/K/KA/Q for satellite communication (SATCOM) and ultra-high frequency/very-high frequency (UHF/VHF) and L Band for terrestrial communications on the same antennas. This effort also develops small form factor interference mitigation hardware for compatibility between communications and electronic warfare (EW) systems. Work accomplished under PE 0602782A/project H92 compliments this effort. This effort transitioned to PE 0603794A Project EL4 in FY16.			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603008A / *Electronic Warfare Advanced Technology*	**Project (Number/Name)** TR1 / *TAC C4 Technology Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
FY 2014 Accomplishments: Demonstrated conformal antenna (including antenna feed system) integrated into Army ground platform; developed and fabricated EW antennas for non-tactical vehicles; developed radio frequency (RF) multiplexers to enable multiple communications systems to use a single antenna simultaneously within the same frequency bands. ***FY 2015 Plans:*** Design, fabricate and evaluate distributed On-the-Move (OTM) SATCOM antenna arrays to enable extension of high throughput satellite connectivity to tactical combat vehicles without interfering with weapons and targeting systems; develop a Government standard architecture for distributed SATCOM arrays to enable interoperability between various transceivers and antenna arrays.			
Title: RF Interoperability Through Convergence ***Description:*** This effort designs transceiver hardware and software standard and proof of concept that will reduce size, weight, power and cost of multiple communications and EW systems on tactical platforms. The standard and proof of concept demonstration takes advantage of common components within the communications and EW systems to define the internal and external interfaces to communications and EW devices. The effort includes implementing and publishing a reference architecture and associated specifications for a modular, open systems approach for integrating military communications and EW devices. Work being accomplished under PE 603270A/project K16 compliments this effort. This effort transitioned to PE 0603794A Project EL4 in FY16. ***FY 2015 Plans:*** Mature the radio reference architecture, specification and application program interfaces (API) to standardize radio modules and minimize life cycle cost of Army tactical communications devices on tactical vehicles; demonstrate, in a lab environment, a subset of communication systems components in an integrated package using the matured specification and API; investigate expansion of the reference architecture to include EW systems.	-	3.000	-
Title: C4ISR On-The-Move (OTM) ***Description:*** This effort provides a venue for the demonstration of new and emerging C4ISR technologies. This venue performs risk mitigation and technology assessments by evaluating the Technology Readiness Levels (TRLs) of candidate Army science and technology (S&T) and best of Industry efforts to support tactical network modernization. This effort transitioned to PE 0603794A Project EL4 in FY16. ***FY 2014 Accomplishments:*** Assessed the capability, functionality, and performance of network integrated architectures and emerging capabilities that support the Army Brigade Combat Team Modernization Plan and Network Modernization Strategy; finalized the evaluation of hybrid/ bridging architectures for Capability Sets 14/15 and conduct initial assessments of Capability Sets 16/17 architectures to support	8.956	8.939	-

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603008A / *Electronic Warfare Advanced Technology*	**Project (Number/Name)** TR1 / *TAC C4 Technology Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
the associated programmed increments of Warfighter Information Network-Tactical (WIN-T) and Nett Warrior; provided a system of systems environment/venue to evaluate technical progress, assess the next generation of Army technologies and facilitate transition of S&T efforts; performed risk mitigation and TRL assessment of Army S&T programs and best of Industry efforts maturing in the FY14 timeframe for selection/inclusion as systems under evaluation for future Army Network Integration Events; and continued to support research and development of enabling Future Force capabilities and accelerate capabilities to enhance the current force. ***FY 2015 Plans:*** Assess the capability, functionality, and performance of network integrated architectures and emerging capabilities that support the Army Brigade Combat Team Modernization Plan and Network Modernization Strategy; conduct red team assessment of network technologies and architectures, assess the next generation of Army technologies and facilitate transition of S&T efforts with particular emphasis on enhancing field robustness and simplifying network set up and maintenance processes; perform risk mitigation and TRL assessment of Army S&T programs and best of industry efforts maturing in the FY15 timeframe; support the associated programmed increments of WIN-T and Nett Warrior Programs of Record.			
Title: Communication Networking Technologies (Formerly named Wireless Mobile Networking)	8.942	8.254	-
Description: This effort matures and demonstrates components, software, algorithms and services that enable Army tactical wireless networks to operate more efficiently in both the use of RF spectrum and network resources for terrestrial and Satellite Communication (SATCOM) systems. This effort matures and demonstrates software to improve performance of wireless tactical networks in austere and hostile RF spectrum environments by composing and coding algorithms and protocols that sense network and spectrum conditions, to automatically adapt network node behaviors to make more efficient use of available resources. Efforts target improving RF communications performance in complex terrain, enabling communications while simultaneously operating electronic protection devices. Efforts also include adapting commercial wireless technology for use in the tactical environment. Work accomplished under PE 0602782A/project H92 and 0603008A TR2 compliments this effort. This effort transitioned to PE 0603794A Project EL4 in FY16. ***FY 2014 Accomplishments:*** Matured all-digital strategic SATCOM terminal components to increase SATCOM channel capacity and reduce vulnerability to interference; for Army tactical ground communications, adapted and matured directional radio networking protocols and routing algorithms to improve spectral efficiency, network robustness and resistance to RF interference; adapted and integrated spatial diversity signal processing to improve wireless communications performance in complex (e.g. urban, forested) terrain; designed modular waveform components and matured algorithms that support simultaneous communications and blue force jamming; designed radio reference architecture, specification and application program interface (API) to standardize radio modules and			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603008A / *Electronic Warfare Advanced Technology*	**Project (Number/Name)** TR1 / *TAC C4 Technology Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
minimize life cycle cost of Army tactical communications devices; investigated, adapted and developed techniques to allow use of commercial cellular and smart devices in Army communications bands and environments. ***FY 2015 Plans:*** Complete integration of all digital strategic ground terminal components and demonstrate improved bandwidth utilization at reduced size, weight and power; using the all digital strategic ground terminal, demonstrate SATCOM spectrum monitoring and control, and integrate RF signal modulation techniques to enable improved SATCOM performance against jamming; complete implementation of signals management module software; complete modifications to Soldier Radio Waveform (SRW) and radio operating environment to support frequency hopping at timeslot boundaries using parameters chosen by the software; integrate, test, and demonstrate signal management software with SRW modifications to support simultaneous communications and blue force jamming.			
Title: Network Operations (NetOps) ***Description:*** This effort matures network operations tools (network management, information dissemination management and cyber security) to simplify the planning, management and troubleshooting of complex tactical communications networks. Focus is on network visualization, incident correlation and decision aids that assist soldiers with managing the complexity inherent with wireless, On-the-Move communications networks. ***FY 2014 Accomplishments:*** Developed and demonstrated software for automating the decision and implementation processes for configuring and re-configuring network components; developed a collaborative execution environment in an effort to provide a decision enhancing capability enabling unit signal officers to collaborate when managing tactical communication resources. ***FY 2015 Plans:*** Complete integration of decision software tools and processes for configuring tactical network components with existing network monitoring tools and demonstrate the capability to visualize the function and health of the multi-tiered network; demonstrate reduced cycle times to automatically generate network configurations and anomaly corrections.	3.921	2.750	-
Title: Networking technologies for Wireless Personal Area Networks (WPAN) ***Description:*** This effort develops and matures wireless personal area network (WPAN) technology for the Soldier in a manner approved by the National Security Agency (NSA) for up to Secret data traffic. This effort is coordinated with PE 0603001A/Project J50. This effort transitioned to PE 0603794A Project EL4 in FY16. ***FY 2014 Accomplishments:*** Designed and analyze networking architectures, frameworks and protocols to link devices into individual WPANs while allowing multiple WPANs to operate concurrently without interference; designed and coded a tactical standard waveform and protocols	4.853	5.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603008A / *Electronic Warfare Advanced Technology*	**Project (Number/Name)** TR1 / *TAC C4 Technology Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
for up to Secret short range wireless communication between WPAN nodes that meet NSA security requirements; matured, integrated and demonstrated wireless hardware components for integration onto Soldier-borne equipment such as hand held computing platforms, radios, weapon sites, information displays and Soldier-borne sensors to develop a WPAN without impacting the size, weight power and cost of these devices. ***FY 2015 Plans:*** Conduct evaluation of multiple WPAN design solutions for performance, reliability and security; develop specification and architecture of WPAN hardware interfaces and software; establish studies for WPAN standards for security and interface development; perform lab, RF chamber, and field electromagnetic compatibility, low probability of intercept and low probability of detection validation; conduct field evaluations of selected design(s) on multiple Soldier Systems.			
Accomplishments/Planned Programs Subtotals	29.287	29.788	-

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 2016 Army			Date: February 2015
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603008A / *Electronic Warfare Advanced Technology*	Project (Number/Name) TR2 / *Secure Tactical Information Integration*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
TR2: *Secure Tactical Information Integration*	-	11.058	15.063	-	-	-	-	-	-	-	-	-

Note

Efforts in this project were transferred to PE 0603794A Project EL5 beginning in FY16.

A. Mission Description and Budget Item Justification

This project matures and demonstrates software, algorithms and services that focus on tactical cyber situational awareness, autonomous network defense, cross domain security and encryption solutions to secure the Army's tactical network. Efforts focus on configuration, operation, monitoring, defense and network reconstitution in bandwidth constrained tactical environments while reducing the operator workload required to conduct these functions. This project codes, optimizes, and demonstrates software based technologies for intrusion detection, high assurance internet protocol (IP) encryption, seamless communications across security boundaries, as well as information sharing across operations and intelligence functions. These capabilities to automate, protect, monitor, report and access cyber elements of the tactical network are intended to greatly reduce Soldier burden and protect the Army's tactical network by building upon enterprise solutions from commercial, Department of Defense, Department of the Army and other government agencies. This project cumulatively builds science and technology capabilities in accordance with Army Cyber Material Development Strategy and the Office of the Secretary of Defense Cyber Community of Interest.

This project supports Army science and technology efforts in the Command, Control, Communications and Intelligence, Ground Maneuver, Air and Soldier/Squad portfolios.

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

Work in this project is performed by the Army Research, Development, and Engineering Command (RDECOM), Communications Electronics Research Development and Engineering Center (CERDEC), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Tactical Defensive Cyber (formerly named Information Assurance)	11.058	15.063	-
Description: This effort matures and demonstrates technologies that create new methods for proactively defending resource constrained tactical wireless networks against cyber attack using nontraditional methodologies. Work being performed under PE / projects 0602782/H92, 0602783/Y10 and 0603008A/TR1 complement this effort. This effort transitioned to PE 0603794A Project EL5 in FY16.			
FY 2014 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603008A / *Electronic Warfare Advanced Technology*	**Project (Number/Name)** TR2 / *Secure Tactical Information Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Matured dynamic moving target defense internet protocol (IP) and ported network hopping techniques; designed and coded software to dynamically modify operating systems and applications to increase an adversary's work factor to exploit Army networks; designed and coded moving target defense capability management software tools; demonstrated integration of IP and port hopping, with protection capabilities within the Army's communications network devices (CND) common operating environment; developed cyber attack prediction techniques to include associated consequences to help reason on adversarial intent and motivation to predict cyber related attacks on Army networks and associated consequences; utilized polymorphic and metamorphic transformation engines to develop new techniques to detect malware variants; designed and coded algorithms to assess software at the binary code level to detect malicious intent; demonstrated software assurance capability to seamlessly integrate Army software assurance tools with those developed by other DoD laboratories; designed and coded protection software tools for server components and design and code network security controls for the tactical cloud computing environment. ***FY 2015 Plans:*** Mature and code software algorithms to differentiate between stealthy attacks and software coding errors to reduce the vulnerability in software applications; demonstrate dynamic moving target defense internet protocol (IP) and port network hopping techniques; demonstrate software to dynamically modify operating systems and applications to make it more difficult for an adversary to exploit Army networks; demonstrate moving target defense capability management software tools; demonstrate integration of IP and port hopping with existing protection capabilities; encode and demonstrate user behavior and operating system anomaly sensors, and anomaly based learning algorithms to provide protection against zero day malware; demonstrate ability to leverage tactical systems to augment local cyber situational awareness; demonstrate dissemination and correlation of offensive and defensive cyber data within the intelligence enterprise to enable tactical defensive cyber operations; investigate cloud based security architectures to enable self monitoring and healing of cloud security services that can perform rapid battle damage assessment and rapidly apply security services against threats; mature, fabricate and demonstrate an anti-tamper key loader for devices that use subscriber identity modules and smart cards; design and instantiate security architectures for multi-functional waveforms and converged communications and electronic warfare transceivers.			
Accomplishments/Planned Programs Subtotals	11.058	15.063	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603008A / *Electronic Warfare Advanced Technology*	**Project (Number/Name)** TR2 / *Secure Tactical Information Integration*

E. Performance Metrics

N/A