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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2017 Army **Date:** February 2016

<b>Appropriation/Budget Activity</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0603008A / <i>Electronic Warfare Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	-	43.416	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-
TR1: <i>TAC C4 Technology Int</i>	-	28.801	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-
TR2: <i>Secure Tactical Information Integration</i>	-	14.615	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

**Note**

Efforts in this Program Element (PE) were transferred to PE 0603794A beginning in Fiscal Year (FY) 2016 for the purposes of correctly identifying the efforts as Command, Control and Communications Advanced Technology. Project TR1 efforts were transferred to PE 0603794A Project EL4 and Project TR2 efforts were transferred to PE 0603794A Project EL5.

**A. Mission Description and Budget Item Justification**

This 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 complementary 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.

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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017 Base</b>	<b>FY 2017 OCO</b>	<b>FY 2017 Total</b>
Previous President's Budget	44.851	0.000	0.000	-	0.000
Current President's Budget	43.416	0.000	0.000	-	0.000
Total Adjustments	-1.435	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.435	-			

**UNCLASSIFIED**

**Exhibit R-2A, RDT&E Project Justification:** PB 2017 Army **Date:** February 2016

<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603008A / <i>Electronic Warfare Advanced Technology</i>	<b>Project (Number/Name)</b> TR1 / <i>TAC C4 Technology Int</i>
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COST (\$ in Millions)	Prior Years	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
TR1: <i>TAC C4 Technology Int</i>	-	28.801	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

**Note**

Efforts in this Project were transferred to Program Element (PE) 0603794A Project EL4 beginning in Fiscal Year (FY) 2016.

**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)**

<b>Title:</b> Antenna and Hardware Technologies	FY 2015	FY 2016		FY 2017
<b>Description:</b> 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 complements this effort. This effort transitioned to PE 0603794A Project EL4 in FY16.	1.771	-		-

**UNCLASSIFIED**

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<b>Appropriation/Budget Activity</b> 2040 / 3	<b>R-1 Program Element (Number/Name)</b> PE 0603008A / <i>Electronic Warfare Advanced Technology</i>	<b>Project (Number/Name)</b> TR1 / <i>TAC C4 Technology Int</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
<p><b><i>FY 2015 Accomplishments:</i></b> Designed, fabricated and evaluated 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; developed a Government standard architecture for distributed SATCOM arrays to enable interoperability between various transceivers and antenna arrays.</p>				
<p><b><i>Title:</i></b> RF Interoperability Through Convergence</p> <p><b><i>Description:</i></b> 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 complements this effort. This effort transitioned to PE 0603794A Project EL4 in FY16.</p>		3.000	-	-
<p><b><i>FY 2015 Accomplishments:</i></b> Matured 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; demonstrated, in a lab environment, a subset of communication systems components in an integrated package using the matured specification and API; investigated expansion of the reference architecture to include EW systems.</p>				
<p><b><i>Title:</i></b> C4ISR On-The-Move (OTM)</p> <p><b><i>Description:</i></b> 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 TRLs of candidate Army science and technology (S&amp;T) and best of Industry efforts to support tactical network modernization. This effort transitioned to PE 0603794A Project EL4 in FY16.</p>		8.578	-	-
<p><b><i>FY 2015 Accomplishments:</i></b> 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; conducted red team assessment of network technologies and architectures, assess the next generation of Army technologies and facilitate transition of S&amp;T efforts with particular emphasis on enhancing field robustness and simplifying network set up and maintenance processes; performed risk mitigation and TRL assessment of Army S&amp;T programs and best of industry efforts maturing in the FY15 timeframe; supported the associated programmed increments of Warfighter Information Network-Tactical (WIN-T) and Nett Warrior Programs of Record.</p>				
<p><b><i>Title:</i></b> Communication Networking Technologies</p>		7.962	-	-

**UNCLASSIFIED**

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
<p><b>Description:</b> 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 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/Project TR2 complements this effort. This effort transitioned to PE 0603794A Project EL4 in FY16.</p> <p><b>FY 2015 Accomplishments:</b> Completed 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, demonstrated SATCOM spectrum monitoring and control, and integrated RF signal modulation techniques to enable improved SATCOM performance against jamming; completed implementation of signals management module software; completed modifications to Soldier Radio Waveform (SRW) and radio operating environment to support frequency hopping at timeslot boundaries using parameters chosen by the software; integrated, tested, and demonstrated signal management software with SRW modifications to support simultaneous communications and blue force jamming.</p>				
<p><b>Title:</b> Network Operations (NetOps)</p> <p><b>Description:</b> 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.</p> <p><b>FY 2015 Accomplishments:</b> Completed integration of decision software tools and processes for configuring tactical network components with existing network monitoring tools and demonstrated the capability to visualize the function and health of the multi-tiered network; demonstrated reduced cycle times to automatically generate network configurations and anomaly corrections.</p>		2.692	-	-
<p><b>Title:</b> Networking technologies for Wireless Personal Area Networks (WPAN)</p> <p><b>Description:</b> 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.</p>		4.798	-	-

**UNCLASSIFIED**

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
<b><i>FY 2015 Accomplishments:</i></b> Conducted evaluation of multiple WPAN design solutions for performance, reliability and security; developed specification and architecture of WPAN hardware interfaces and software; established studies for WPAN standards for security and interface development; performed lab, RF chamber, and field electromagnetic compatibility, low probability of intercept and low probability of detection validation; conducted field evaluations of selected design(s) on multiple Soldier Systems.			
<b>Accomplishments/Planned Programs Subtotals</b>	28.801	-	-

**C. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

N/A

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<b>Appropriation/Budget Activity</b> 2040 / 3					<b>R-1 Program Element (Number/Name)</b> PE 0603008A / <i>Electronic Warfare Advanced Technology</i>				<b>Project (Number/Name)</b> TR2 / <i>Secure Tactical Information Integration</i>			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017 Base</b>	<b>FY 2017 OCO</b>	<b>FY 2017 Total</b>	<b>FY 2018</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
TR2: <i>Secure Tactical Information Integration</i>	-	14.615	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

**Note**

Efforts in this Project were transferred to Program Element (PE) 0603794A Project EL5 beginning in Fiscal Year (FY) 2016.

**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)**

<b>Title:</b> Tactical Defensive Cyber (formerly named Information Assurance)	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
<b>Description:</b> 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 0602782A/H92, 0602783A/Y10 and 0603008A/TR1 complement this effort. This effort transitioned to PE 0603794A Project EL5 in FY16.	14.615	-	-
<b>FY 2015 Accomplishments:</b>			

**UNCLASSIFIED**

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>
<p>Matured and coded software algorithms to differentiate between stealthy attacks and software coding errors to reduce the vulnerability in software applications; demonstrated dynamic moving target defense internet protocol (IP) and port network hopping techniques; demonstrated software to dynamically modify operating systems and applications to make it more difficult for an adversary to exploit Army networks; demonstrated moving target defense capability management software tools; demonstrated integration of IP and port hopping with existing protection capabilities; encoded and demonstrated user behavior and operating system anomaly sensors, and anomaly based learning algorithms to provide protection against zero day malware; demonstrated ability to leverage tactical systems to augment local cyber situational awareness; demonstrated dissemination and correlation of offensive and defensive cyber data within the intelligence enterprise to enable tactical defensive cyber operations; investigated 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; matured, fabricated and demonstrated an anti-tamper key loader for devices that use subscriber identity modules and smart cards; designed and instantiated security architectures for multi-functional waveforms and converged communications and electronic warfare transceivers.</p>				
<b>Accomplishments/Planned Programs Subtotals</b>		14.615	-	-
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				
<b>E. Performance Metrics</b>				
N/A				