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 0603772A *I Advanced Tactical Computer Science and Sensor 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	-	34.042	39.149	38.163	-	38.163	40.239	45.246	46.085	46.997	-	-
101: *Tactical Command and Control*	-	23.644	19.134	14.992	-	14.992	14.997	15.539	17.178	17.514	-	-
243: *Sensors And Signals Processing*	-	10.398	20.015	23.171	-	23.171	25.242	29.707	28.907	29.483	-	-

A. Mission Description and Budget Item Justification

This program element (PE) matures and demonstrates technologies that allow the Warfighter to effectively collect, analyze, transfer and display situational awareness information in a network-centric battlefield environment. It matures and demonstrates architectures, hardware, software and techniques that enable synchronized mission command (MC) during rapid, mobile, dispersed and Joint operations. Project 101 matures and develops software, algorithms, services and devices to more effectively integrate MC across all echelons and enable more effective utilization of Warfighter resources through accelerated information to decisions and rapid MC on the move. Project 243 matures and demonstrates signal processing and information/intelligence fusion software, algorithms, services and systems for Army sensors; radio frequency (RF) systems to track and identify enemy forces and personnel; and multi-sensor control and correlation software and algorithms to improve reconnaissance, surveillance, tracking, and target acquisition.

Work in this PE is complimentary of PE 0602120A (Sensors and Electronic Survivability), PE 0602270A (Electronic Warfare Technology), PE 0602303A (Missile Technology), PE 0602705A (Electronics and Electronic Devices), PE 0602782A (Command, Control, Communications Technology), and PE 0603270A (Electronic Warfare Technology); and fully coordinated with PE 0602783A (Computer and Software Technology) and PE 0603008A (Electronic Warfare Advanced 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 in this PE 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 I* BA 3: *Advanced Technology Development (ATD)*			**R-1 Program Element (Number/Name)** PE 0603772A *I Advanced Tactical Computer Science and Sensor Technology*		

B. Program Change Summary ($ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	32.995	39.164	41.296	-	41.296
Current President's Budget	34.042	39.149	38.163	-	38.163
Total Adjustments	1.047	-0.015	-3.133	-	-3.133
• Congressional General Reductions	-	-0.015			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.750	-			
• SBIR/STTR Transfer	-0.703	-			
• Adjustments to Budget Years	-	-	-3.133	-	-3.133

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 0603772A / *Advanced Tactical Computer Science and Sensor Technology*					**Project (Number/Name)** 101 / *Tactical Command and Control*	

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
101: *Tactical Command and Control*	-	23.644	19.134	14.992	-	14.992	14.997	15.539	17.178	17.514	-	-

A. Mission Description and Budget Item Justification

This project matures and demonstrates software, algorithms, services and devices that move and display timely and relevant information across the battlefield to provide commanders at all echelons with situational awareness (SA) that allows them to understand, decide and act faster than their adversaries. This project also matures and demonstrates software, algorithms and devices supporting information storage and retrieval; digital transfer and display of battlefield SA, with an emphasis on navigation (nav), position (pos) location and resource information while keeping in mind the cognitive limit of the Soldier; synchronization of combined and Joint force operations; software, algorithms and services optimized for mission command on-the-move (MCOTM).

This project supports Army science and technology efforts in the Command, Control, Communications and Intelligence portfolio.

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, 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: Integrated Mission Command (MC) *Description:* This effort matures and demonstrates technologies to reduce command post (CP) and command vehicle complexity by simplifying the MC software and hardware, and by managing required power systems to increase efficiency. Work accomplished under PE 0602782A/project 779 compliments this effort. *FY 2014 Accomplishments:* Developed and architecture for, designed, fabricated, coded and integrated a platoon level MC demonstration suite to provide actionable intelligence and timely information sharing over the Army's low bandwidth small unit tactical edge network; coded and integrated additional decision support and collaboration tools, including knowledge management and the necessary database connections, and deliver information pertinent to a small unit's mission to increase situational awareness/understanding and decrease tactical surprise; demonstrated this suite's capability to allow Soldiers to access and use all relevant information available on the network most effectively, accounting for the Soldier's cognitive abilities and contextual framework for ease of use and to ensure relevance of the delivered information to the unit's mission; analyzed social networks and identified in near real-	13.730	15.107	10.414

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 0603772A / *Advanced Tactical Computer Science and Sensor Technology*	**Project (Number/Name)** 101 / *Tactical Command and Control*		

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
time team strengths, weaknesses, and vulnerabilities and highlighted collaboration opportunities which could be leveraged more effectively to foster the efficient use of combat power. *FY 2015 Plans:* Code, integrate, and validate a Company level (dismounted, mounted, CP) MC suite to provide actionable intelligence and timely information sharing over a Company level low bandwidth tactical network; code and integrate additional decision support and collaboration tools, including knowledge management and necessary database connections, that will increase situational awareness/understanding, decrease tactical surprise and deliver pertinent mission information from dismounted to CP; validate this suite's capability to allow Soldiers to access relevant information available on the network most effectively, accounting for Soldier cognitive abilities and contextual framework for ease of use and to ensure relevance of the delivered information to the upper echelons; for company level low bandwidth environments code, integrate, and validate an enhanced MC suite of collaborative software tools that allows for faster and more accurate target identification and handoff, real time alerts, freeform information collection, Soldier-composable leader tools, and support for operations across diverse human, geographical and Global Positioning System (GPS)-denied terrains. *FY 2016 Plans:* Will mature and demonstrate modular extensible common hardware, commander focused MC software applications and next generation tactical software architectures resulting in smaller, simpler, and less complex command; will demonstrate reduction in the complexity of MC software by focusing on specific commander tasks (e.g. visualize an end state, understand the current situation, and direct resources) rather than general staff functions and by providing data optimized for those tasks; will demonstrate both command post and vehicle instantiations of the mission equipment package to examine strength/weaknesses and trade-offs between the two; will mature and demonstrate MC software that dynamically assesses the mission and the battle space to help maximize mission success by managing limited and distributed resources, including operational energy, bandwidth and cognitive processing.			
Title: Battle Space Awareness and Positioning *Description:* This effort demonstrates position and navigation tools to mitigate the impacts of jamming, terrain features and obstacles such as buildings and caves that limit the performance of GPS receivers to enhance the performance of navigation systems in a GPS denied or degraded environment. Work being accomplished under PE 0602782A/project 779 compliments this effort. *FY 2014 Accomplishments:* Enhanced and demonstrated navigation sensors such as pedometry, human motion classification, and visual odometry fused with radio frequency and smart phone approaches to enhance pos/nav and improve positional situation awareness; integrated navigation sensor and network algorithms into personal Android based smart phones or tablets and demonstrate situational	3.644	4.027	4.578

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 0603772A / *Advanced Tactical Computer Science and Sensor Technology*	**Project (Number/Name)** 101 / *Tactical Command and Control*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
awareness in a representative platoon size Soldier network; matured, integrated and demonstrated interfaces, software and protocols that will allow handheld electronics to integrate with emerging Modernized Code (M Code) capable secure GPS chips. *FY 2015 Plans:* Demonstrate sensor fusion for navigation systems for dismounted Soldiers and ground vehicles to allow modular and scalable system designs providing configuration flexibility to meet Soldier specific needs for navigation; integrate mature sensors into navigation systems such as radio frequency ranging sensors, vision based sensors, pseudolite receivers and sensors for signals of opportunity to reduce dependence upon GPS; evaluate advanced anti-jam antennas and M Code GPS receivers integrated with multi-global navigation satellite system receivers; design, code, and develop interfaces, protocols and software for networked navigation devices to share information and enhance navigation solutions for network users. *FY 2016 Plans:* Will mature multiple sensor fusion techniques to improve overall system performance for PNT on mounted, dismounted, and unmanned platforms; demonstrate aiding technologies such as cameras, ranging sensors, and velocimeters to augment the performance of inertial measurement unit (IMU)-based navigation when integrated into PNT systems to reduce GPS dependency; mature personal navigation system components for dismounted Soldier applications, including smaller IMUs, anti-jam antennas, and more efficient multi-Global Navigation Satellite System receivers requiring less power to operate; validate M-Code GPS receiver component performance for integration into PNT systems; optimize and improve pseudolite for both ground and airborne platforms and anti-jam antenna performance while reducing size, weight and cost for mounted and dismounted platforms.			
Title: Collaborative Battle Management *Description:* This effort matures and demonstrates mission command (MC) software to improve sharing and understanding of data between the intelligence and operations communities. *FY 2014 Accomplishments:* Designed, coded, fabricated and demonstrated an enhanced mission command capability with collaborative software tools that allows for faster and more accurate target identification and handoff, real time alerts, natural information collection, Soldier-composable leader tools, and support for operations across diverse human and geographic terrains to enable tactical overmatch for the small units by acting before the adversary can respond; developed these capabilities to operate in a platoon level low bandwidth tactical network using planned Army infrastructure.	6.270	-	-
Accomplishments/Planned Programs Subtotals	23.644	19.134	14.992

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, **RDT&E Project Justification:** PB 2016 Army		**Date:** February 2015
Appropriation/Budget Activity 2040 *I* 3	**R-1 Program Element (Number/Name)** PE 0603772A *I Advanced Tactical Computer Science and Sensor Technology*	**Project (Number/Name)** 101 *I Tactical Command and Control*

C. Other Program Funding Summary ($ in Millions)

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 *I* 3				R-1 Program Element (Number/Name) PE 0603772A *I Advanced Tactical Computer Science and Sensor Technology*						Project (Number/Name) 243 *I Sensors And Signals Processing*	

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
243: *Sensors And Signals Processing*	-	10.398	20.015	23.171	-	23.171	25.242	29.707	28.907	29.483	-	-

A. Mission Description and Budget Item Justification

This project matures and demonstrates improved radar, sensor fusion, and correlation software, services, devices and systems for wide area reconnaissance, surveillance, tracking and targeting of platforms and individuals in all terrains, including complex and urban environments. Sensor fusion efforts mature and demonstrate software, algorithms and services for sensor management, data correlation, and relationship discovery for a multi-intelligence fusion system. Sensor and simulated sensor candidates may include moving-target-indicator/synthetic aperture radar, electro-optical/infrared (EO/IR), signals intelligence (SIGINT), measurements and signatures intelligence (MASINT), human intelligence (HUMINT) and biometrics.

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

The cited work is consistent with the Assistant Secretary of Defense, 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, 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: Collaborative ISR Sensors *Description:* This effort fabricates multi-function ISR sensors and sensor management systems that act collaboratively to improve their individual performance and increase the effectiveness and action-ability of battlespace awareness/intelligence data in an area of operations. Efforts focus on existing, modified and emerging radar technologies in support of air defense & area/base camp protection. This effort implements an open architecture that is extensible to multiple base sizes and environments and allows growth for future ISR sensors. Work being accomplished under PE 62270/906 complements this effort. *FY 2014 Accomplishments:* Demonstrated improved target recognition, identification and classification for Counter-Target Acquisition (CTA) and air defense surveillance radars (lightweight counter-mortal radar (LCMR) and Enhanced Firefinder Radar (EQ-36)); demonstrated increased detection, identification and classification range and accuracy gained from correlating short (LCMR) and long range (EQ-36) radar systems; developed a method to allow ground sensors to cue airborne radars to events on the ground and allowed them to track	4.834	10.466	9.075

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 I 3	R-1 Program Element (Number/Name) PE 0603772A I *Advanced Tactical Computer Science and Sensor Technology*	Project (Number/Name) 243 I *Sensors And Signals Processing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
the scene in that area (i.e. cueing a ground moving target indicator radar to follow insurgents away from a rocket launch point after CTA radar has discovered the rocket's point of origin). *FY 2015 Plans:* Conduct an assessment of a variety of moving target indicator (MTI) data sources to establish metrics for quality of MTI data sets to improve radar design; establish a software development process to mature new and alternative concepts for increasing the information content of radar data and tracks; conduct an assessment to determine an optimal design of a multi-static beamforming radar; assess current counterfire and ISR radar programs of record to determine component, configuration and software modifications to design a more accurate multistatic (separated multiple transmit/receive elements) radar and to determine their potentials to search, track and classify small unmanned aerial systems (UAS); develop requirements for doppler resolution, search volume and update rate for improvements that are necessary for the system to perform a counter UAS mission; develop requirements for a low size, weight and power, man portable system to detect and locate small arms fire, dismounts and vehicles over a 360 degree search area; research the advantage of using existing gunshot detection systems to cue a radar to provide a more precise location of the shooter and reduce the probability of a false alarm. *FY 2016 Plans:* Will examine methods for enriching meta-data from moving target indicator (MTI) tracks and develop quality standards for MTI track data that will be used to quantify track confidence and information content; enhance existing algorithms to improve tracks by correlating data from other sources (SIGINT, full motion video, etc.) with MTI track data; conduct lab assessments of various hardware and software components of a low size, weight and power radar system capable of 360 degree search to detect and locate small arms fire, dismounts and vehicles; configure necessary interfaces to integrate radar capabilities with EO\IR pre-shot detection sensors; encode and mature software to implement the Army Mode 5 Level 2-Broadcast Identify Friend or Foe (IFF) capability, integrate it on existing ground based radar platforms and perform initial validation of IFF software.			
Title: Omni-directional Situational Awareness (SA) (Airborne) radar technologies *Description:* This effort matures and demonstrates low power multi-function SA sensors for small UAS and other aircraft to improve sensing and detection capabilities in support of wide-area persistent surveillance. *FY 2015 Plans:* Design a stationary airborne moving target indicator (MTI) penetrating radar capability for use on a fixed wing, moving platform; conduct modeling and simulation to evaluate processing techniques that could be applied to the fixed wing MTI scenario. *FY 2016 Plans:* Will mature modeling and simulation of subsystem and component level designs for the Ground Moving Target Indicator (GMTI) Penetrating radar system; identify standards and interface requirements necessary to facilitate integration into a next generation airborne intelligence, surveillance and reconnaissance platform; mature and analyze radar modes in synthetic aperture radar	-	3.000	5.157

Exhibit R-2A, **RDT&E Project Justification:** PB 2016 Army		**Date:** February 2015
Appropriation/Budget Activity 2040 *I* 3	**R-1 Program Element (Number/Name)** PE 0603772A *I Advanced Tactical Computer Science and Sensor Technology*	**Project (Number/Name)** 243 *I Sensors And Signals Processing*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2014**	**FY 2015**	**FY 2016**
and GMTI for optimized utility under anticipated operational conditions; identify techniques for waveform optimization to mitigate spectrum challenges.			
Title: Advanced All Source Fusion	5.564	6.549	6.939
Description: This effort develops software technologies for intelligence/mission command (Intel/MC) mission collaboration to provide faster and higher quality decision making support for the commander and his key staff. Specific efforts focus on integrating intelligence, surveillance and reconnaissance (ISR) planning and execution at the Task Force/Battalion through troop-level, as well as efforts that provide the capability to identify, fuse, and trace/track specific targets in an asymmetric environment. Work accomplished under PE 0602270A/project 906 compliments this effort. *FY 2014 Accomplishments:* Continued to assess the utility of automated exploitation and fusion analysis tools for tactical edge users in a network constrained environment; matured data transformation services to provide intelligence data as SA reports for a small unit; employed correlation and pattern analysis algorithms to provide actionable and timely intelligence that is relevant to small units based on their geographic area, mission type and objective; integrated automated exploitation and fusion analysis tools, intelligence/ SA transformation services, threat prediction software, and enterprise data feeds into a proactive data service framework that supports timely situation understanding for a small unit; conducted networked laboratory experiments to validate this framework and gather user feedback. *FY 2015 Plans:* Develop software tools and analytics to produce intelligence products from big data sets (e.g. biometric databases); integrate Company Intelligence Support Team workflow tools, predictive analytics and data distribution services into the previously defined, network constrained environment; demonstrate integrated automated exploitation and fusion analysis tools, intelligence to SA transformation services, threat prediction software, and enterprise data feeds, quantify the improved ability of the end users to execute their missions and document the performance of the capabilities being demonstrated. *FY 2016 Plans:* Will develop integration specifications for a virtualized, automated, full spectrum analytic agent for big data sources; integrate and mature software and algorithms to visualize (location, orientation, field of view, etc) and virtually task all collection assets, across echelons and classification domains, in synchronization with MC and title authority control systems; mature Intel fusion software and algorithms to best tailor data streams, collection management processes and information displays to improve user understanding based on collected customer feedback and input from Soldiers.			
Title: Multi-mode Air Defense Radar Demonstration	-	-	2.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015	
Appropriation/Budget Activity 2040 *I* 3	**R-1 Program Element (Number/Name)** PE 0603772A *I Advanced Tactical Computer Science and Sensor Technology*	**Project (Number/Name)** 243 *I Sensors And Signals Processing*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Description: This effort investigates and develops the architectures, processing and components necessary to deliver next generation capability, flexibility and supportability to the fires family of radar systems. Efforts focus on development of a modular and scalable open architecture that is extensible to multiple radar systems technologies in support of air defense & area/base camp protection. Work being accomplished under PE 62270/906, 62120/H16, 62705/EM8/H94, and 62303/214 complements this effort. *FY 2016 Plans:* Will develop and mature hardware and software interface specifications that will serve as the basis for a scalable radar open system architecture that is intended for use in multiple configurations and mission scenarios; develop a Government owned data model standard for fires radar data at multiple levels of the data processing stack, from raw radar track data to processed targeting (meta) data, to enable netted sensor interoperability.			
Accomplishments/Planned Programs Subtotals	10.398	20.015	23.171

C. Other Program Funding Summary ($ in Millions)
 N/A
Remarks

D. Acquisition Strategy
 N/A

E. Performance Metrics
 N/A