Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army										DATE: February 2012	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*							
COST ($ in Millions)	**FY 2011**	**FY 2012**	**FY 2013 Base**	**FY 2013 OCO**	**FY 2013 Total**	**FY 2014**	**FY 2015**	**FY 2016**	**FY 2017**	**Cost To Complete**	**Total Cost**
Total Program Element	24.914	26.075	28.852	-	28.852	29.171	28.036	28.172	27.364	Continuing	Continuing
779: *Command, Control and Platform Electronics Tech*	10.325	10.742	13.086	-	13.086	13.214	12.323	12.407	11.421	Continuing	Continuing
H92: *Communications Technology*	14.589	15.333	15.766	-	15.766	15.957	15.713	15.765	15.943	Continuing	Continuing

Note

FY 13 increased funding for Integrated Decision Manking Capabilities in Dynamic Environments.

A. Mission Description and Budget Item Justification

This program element (PE) researches and investigates communications, command and control (C2), 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 C2 software, algorithms, protocols and devices that enable management of information across the tactical and strategic battle space; provides automated cognitive reasoning and decision making aids; and allows timely distribution, presentation/display and use of C2 data on Army platforms. Project H92 supports research in communications components, software, algorithms and protocols which potentially 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 is complimentary of PE 0602705A (Electronics and Electronic Devices), PE 0603008A (Electronic Warfare Advanced Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and is fully coordinated with PE 0602120A, (Sensors and Electronic Survivability), PE 0602783A (Computer and Software Technology), and PE 0602874A (Advanced Concepts and Simulation).

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 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 2013 Army					DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*		R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*			
B. Program Change Summary ($ in Millions)	**FY 2011**	**FY 2012**	**FY 2013 Base**	**FY 2013 OCO**	**FY 2013 Total**
Previous President's Budget	25.573	26.116	26.710	-	26.710
Current President's Budget	24.914	26.075	28.852	-	28.852
Total Adjustments	-0.659	-0.041	2.142	-	2.142
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.299	-			
• Adjustments to Budget Years	-	-	2.142	-	2.142
• Other Adjustments 1	-0.360	-0.041	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*	PROJECT 779: *Command, Control and Platform Electronics Tech*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
779: *Command, Control and Platform Electronics Tech*	10.325	10.742	13.086	-	13.086	13.214	12.323	12.407	11.421	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project researches components, software and algorithms that enable commanders at all echelons to have better and timelier information and allows them to execute mission command from potentially anywhere on the battlefield. Emphasis is on data management and automated analysis to provide course-of-action determination, mission planning and rehearsal, mission execution monitoring and re-planning, and precision positioning (pos) and navigation (nav). 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, data transfer, distributed data bases, open system architectures, service oriented architecture (SOA), language translation, and integration concepts which contribute to more mobile operations.

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

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 (RDECOM), Communications - Electronics Research, Development, and Engineering Center (CERDEC), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Title: Battle Space Awareness and Positioning	2.005	2.150	2.223
Description: This effort investigates positioning (pos), navigation (nav) and timing sensor/integration technologies to provide position, velocity, and time information to support operational and training requirements, especially in hostile electro-magnetic interference and other radio frequency (RF) degraded/denied environments. Work being accomplished under PE 0603772A/ project 101 compliments this effort.			
FY 2011 Accomplishments: Evaluated candidate pos/nav sensors including micro-electrical mechanical and vision based sensors; evaluated integration techniques and navigation enhancing radio technologies for improved urban and indoor position performance.			
FY 2012 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*	PROJECT 779: *Command, Control and Platform Electronics Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Develop sensor integration algorithms to combine the selected pos/nav sensors in radios both with and without radio based nav technologies; begin assessing brassboard sensor/radio system/suite in a laboratory environment. ***FY 2013 Plans:*** Will investigate and identify sources of error impacting the performance of the integrated radio and sensor navigation brassboard demonstrator, code advanced algorithms to perform navigation error mitigation in the demonstrator; investigate alternative/ emerging technologies for enhancing navigation in challenged environments such as exploiting Signals Of Opportunity (SOO) from RF sources like broadcast television stations or natural phenomena such as lightning strikes.			
Title: Command and Control (C2) On-The-Move (OTM) Enabling Technologies ***Description:*** This effort investigates, designs and codes software to improve the Warfighter's ability to access, use, present and understand relevant mission command information. Work on this effort transitions to PE 0603772A/project 101. ***FY 2011 Accomplishments:*** Expanded machine translation services to include speech-to-speech translation capabilities; integrated additional translation engines for increased language coverage; continued to investigate enhancement of unmanned collaboration and coordination between multiple assets and sensors, more complex unmanned ground vehicle/unmanned aerial system (UGV/UAS) platform behaviors, and mission planning in urban and complex environments to produce technologies capable of dynamic mission management for multiple robotic assets; investigated workflow analyses to identify and assess technology to augment human cognition while performing Battle Command processes and evaluate methods to improve information sharing, decision-making, and collaboration in network-enabled operations; investigated techniques to enable users to share Warfighter composed software via a web-based gallery. ***FY 2012 Plans:*** Refine how human understanding can be measured and improved; refine how large and differing amounts of information can be presented to best align with human processing; continue to improve technologies to enable collaborative mission execution and C2 for near-autonomous and autonomous unmanned systems; investigate and devise techniques to automate portions of the governance and accreditation process for edge-enabled applications; code and integrate intelligent agent technology for language translation services, which will provide automated intelligent reasoning of foreign language data. ***FY 2013 Plans:*** Will investigate software and algorithms to enable complex interactions between UAS, UGV and manned platforms to facilitate collaborative mission execution, increase efficiency of simultaneous use of multiple unmanned systems and reduce cognitive burden on Soldeirs while managing multiple unmanned assets; research fundamental human centered design principles to reduce information overload in Army mission command software; assess the cognitive impact on Soldiers of software applications operating on different computing platforms (e.g. viewing maps on computers, tablets, and smart phones); investigate the	8.320	8.592	10.863

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*	PROJECT 779: *Command, Control and Platform Electronics Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
application of computer learning techniques to capture human experience and apply it in similar but different situations to enable non-expert Soldiers to function at or near expert level; investigate the advantages of cloud technology (e.g. centralized management of distributed computing resources) in the disadvantaged, intermittent and low bandwidth tactical mission area; develop software algorithms to analyze audio speech, automatically identify the language and the intended domain or application (e.g. medical, checkpoint, intelligence), such that the algorithms have ability to select the appropriate translation engine to improve translation accuracy; investigate software applications that facilitate execution of C2 and distribution of intelligence information to Soldiers in small units using hand held devices; investigate architectures and techniques for storage and distribution of software applications for tactical handheld devices.			
Accomplishments/Planned Programs Subtotals	10.325	10.742	13.086

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*	PROJECT H92: *Communications Technology*	

COST ($ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H92: *Communications Technology*	14.589	15.333	15.766	-	15.766	15.957	15.713	15.765	15.943	Continuing	Continuing

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 focuses development in wireless transport (e.g. mobile radio based communications systems) to develop new techniques for improving communications in high radio frequency (RF) interference environments and to increase the communications capacity of terrestrial and satellite communications systems. This project also investigates enabling antenna components, materials, designs and configurations to reduce the visual signature of antennas on Soldier, vehicular and airborne platforms and reduce co-site interference on platforms with multiple transceivers such as radios and jammers. Additionally this project investigates cyber security devices, software and techniques to harden narrow band, wireless communications networks against cyber attacks; new mobile networking protocols to make wireless, on-the-move (OTM) communications networks more responsive to user needs. This project also investigates network operations software and techniques that improve the ability of the Soldier to manage and maintain complex, dynamic networks; and improved spectrum management software tools to make more efficient use of over-subscribed RF spectrum.

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

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 (RDECOM), Communications-Electronics Research, Development, and Engineering Center (CERDEC), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
Title: Antenna Technologies	5.550	6.370	5.734
Description: This effort fabricates and assesses low cost, power efficient, conformal and directional antenna technologies for terrestrial, airborne, and tactical satellite ground terminals to enable them to operate OTM over multiple frequency bands, and further investigates armor embedded antenna technologies. Work being accomplished under PE 0602270A/project 906, PE 0603008A/project TR1, and PE 0603270A/project K15 compliments this effort. ***FY 2011 Accomplishments:*** Completed K/Ka/Q multi-beam low profile electronically steered SATCOM components and aperture development; integrated the SATCOM aperture with a drive and tracking system; developed single package Ka/Q band integrated power amplifiers; developed			

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
a blue force tracking (BFT) SATCOM antenna and modem architecture; investigated meta-materials for miniaturized antenna technologies; developed conformal antenna systems for ground and air platforms. ***FY 2012 Plans:*** Complete integrated K/Ka/Q band low profile electronically steered SATCOM antenna; integrate single package Ka/Q band integrated power amplifier into the K/Ka/Q band SATCOM antenna; complete development of blue force tracking (BFT) SATCOM antenna and modem; develop wafer scale and distributed antenna components and architecture for very small profile on-the-move SATCOM antennas; assess the Ku Band Simple Manufacturing Array Technology (SMArT) card antenna on an unmanned aerial system; execute antenna performance and ballistic assessment on armor embedded antenna candidates. ***FY 2013 Plans:*** Will design wafer scale/smart card antenna for low profile SATCOM OTM and unmanned aerial system antennas; adjust embedded antenna designs to improve performance observed from ballistic assessments; investigate new metamaterials for broadband low profile antennas and nanotechnology for low visual signature armor and ballistic glass embedded transparent antennas; design antenna modifications for interference mitigation to reduce radio frequency (RF) communications and electronic warfare (EW) cosite interference between EW and blue force communication systems.			
Title: Wireless Information Assurance (IA) ***Description:*** This effort investigates, codes and fabricates software, algorithms and devices to protect wireless tactical networks against computer network attacks. Effort includes technologies that are proactive rather than reactive in countering attacks against tactical military networks. Work being accomplished under PE 0603008A/project TR2 compliments this effort. ***FY 2011 Accomplishments:*** Developed tactical intrusion detection system (IDS) to accommodate the small tactical bandwidth environment along with a common operational picture that provides a homogenous view of the IDS activity on the network. ***FY 2012 Plans:*** Research and code IDS technology to proactively ascertain local threats on tactical host systems and networks using minimal system resources; code technologies to automatically self-inoculate these systems to limit impact and contain spread of malicious activity; devise suitable IDS agent collaboration schemes to ensure that trusted decisions are made in response to malicious behavior; configure IDS agents to share actionable security information with sustaining base assets for further analysis while still allowing the Warfighter to maintain mission focus and continuity while operating at the resource-constrained tactical edge. ***FY 2013 Plans:*** Will research different types of frameworks upon which future cyber security can be developed to remove redundancies and conflicts between disparate software tools and techniques; design and develop communications architecture that standardizes	2.422	3.331	2.771

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602782A: *Command, Control, Communications Technology*	PROJECT H92: *Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
how cyber-security tools and applications should share information (e.g., messages, protocols, cryptography, concealing communications); investigate techniques, limitations and risks of protecting networks by using software methods that obscure the network details to prevent cyber attackers from mapping networks and traffic in preparation for an attack.			
Title: Cognitive Networking ***Description:*** This effort investigates, evaluates and creates a set of advanced networking devices, software and algorithms to enable wireless networks to sense the dynamic and uncertain nature of mobile ad-hoc multi-tiered, multi-band network environments and spectrum conditions, and automatically adapt network topologies or traffic flows to increase overall performance while reducing the time and human effort required to operate the network. Work being accomplished under PE 0601104A/project H50 and PE 0603008A/project TR1 compliments this effort. ***FY 2011 Accomplishments:*** Developed and refined a cognitive network design tool set; designed and developed initial protocol function and capability for cognitive networking; conduct modeling and simulation on small scale networks to evaluate protocol functionality. ***FY 2012 Plans:*** Exercise the Cognitive Network Engineering Design Analytic Toolset (CNEDAT) with 10 cognitive radios in a coordinated fashion through a set of assessments; use the CNEDAT to design a cognitive network to meet a set of performance goals or requirements (such as robustness to node or link outage); implement these designs in the radio hardware/software, and under the same set of traffic loads; compare the measured network parameters (i.e., throughput, delay, loss, etc) with those predicted by the design tool; conduct specific experiments in total applied traffic load, and/or various traffic mixes (voice, video, data, imagery, chat) as well as different mobility rates, mobility patterns, and different node/link outages due to simulated jamming and/or node destruction. ***FY 2013 Plans:*** Will research methods based upon game theory coupled with statistical estimation and machine learning to design new network control protocols and software that improves the ability of wireless communications networks to change behavior, network topology and traffic flow based on changing RF environments and network congestion; design and code new software algorithms that increase the efficiency of current internet protocols; analyze the potential performance improvements using the CNEDAT toolset.	3.690	4.004	4.143
Title: Dynamic Spectrum and Network Technologies ***Description:*** This effort investigates and fabricates components and codes software for radios and network management systems to enable access to spectrum that is unavailable because of current inefficient spectrum management methods. This includes new management and visualization modalities as well as improved radio frequency modulation techniques, devices and software. Work being accomplished under PE 0603008A/project TR1 compliments this effort.	2.927	1.628	3.118

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2011	FY 2012	FY 2013
FY 2011 Accomplishments: Expanded the Dynamic Spectrum Access (DSA) policy generation design to include parameters for co-existence operations of DSA enabled radios with tactical communications and Intelligence, Surveillance and Reconnaissance (ISR) systems; integrated the DSA policy generation tool with existing spectrum database. ***FY 2012 Plans:*** Code DSA software and algorithms and add them to the automatic frequency channel sensing and selection capabilities of cellular base stations in order to assist the network planners to set the frequencies for mobile base station setup. ***FY 2013 Plans:*** Will research new software and algorithms to visualize/present and alert soldiers to the operational state of wireless networks at the company, battalion and brigade levels; use distributed multi-agent software and algorithms to integrate situation awareness of networks (mission and cognitive) with real-time event correlation by timestamp/location to provide Soldiers with correlated event alerts; investigate new SATCOM waveforms to increase communications capacity and improve anti-jam performance.			
Accomplishments/Planned Programs Subtotals	14.589	15.333	15.766

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.