| 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 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)
PE 0602782A *I Command, Control, Communications 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	-	33.580	33.807	36.160	-	36.160	38.461	38.592	38.989	39.757	-	-
779: *Command, Control And Platform Electronics Tech*	-	13.502	14.681	15.805	-	15.805	17.102	17.363	17.482	17.826	-	-
H92: *Communications Technology*	-	20.078	19.126	20.355	-	20.355	21.359	21.229	21.507	21.931	-	-

A. Mission Description and Budget Item Justification

This program element (PE) researches and investigates communications, mission command (MC), and electronics components, sub-components, software and protocols that provide the Army with enhanced capabilities for secure, mobile, networked communications, assured information delivery, and presentation of information that enables decision-making. Commercial technologies are continuously investigated and leveraged where possible. Project 779 researches and develops MC software, algorithms, protocols, architectures, and devices that enable management of information across the tactical and strategic battle space; provides automated cognitive reasoning and decision making aids; and allows timely distribution, presentation/display and use of MC 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 0601104A (University and Industry Research Centers), PE 0602270A (Electronic Warfare Technology) , PE 0602705A (Electronics and Electronic Devices), PE 0603008A (Electronic Warfare Advanced Technology), PE 0603270A (Electronic Warfare Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and PE 0603794A (Command, Control and Communications Advanced Technology), and is fully coordinated with PE 0601104A (University and Industry Research Centers), 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 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.

UNCLASSIFIED

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 2: Applied Research*			**R-1 Program Element (Number/Name)** PE 0602782A *I Command, Control, Communications Technology*		

B. Program Change Summary ($ in Millions)	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**
Previous President's Budget	34.191	33.817	36.423	-	36.423
Current President's Budget	33.580	33.807	36.160	-	36.160
Total Adjustments	-0.611	-0.010	-0.263	-	-0.263
• Congressional General Reductions	-	-0.010			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.611	-			
• Adjustments to Budget Years	-	-	-0.263	-	-0.263

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040 I 2				**R-1 Program Element (Number/Name)** PE 0602782A I *Command, Control,* *Communications Technology*					**Project (Number/Name)** 779 I *Command, Control And Platform* *Electronics Tech*			
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
779: *Command, Control And* *Platform Electronics Tech*	-	13.502	14.681	15.805	-	15.805	17.102	17.363	17.482	17.826	-	-

A. Mission Description and Budget Item Justification

This project researches components, software and algorithms that enable commanders at all echelons to have more accurate, useful, and timely information and allows them to execute mission command (MC) from anywhere on the battlefield: in the command post, in vehicles, or dismounted. Emphasis is on advancements to MC computing platforms with a specific emphasis on positioning, navigation, and timing (PNT), user/computing platform interaction and cognitive burden reduction; informed operations/data to decisions; MC warfighting function advancement and commander-centric capabilities; using automation to augment or supply staff capabilities. This project researches technologies that support multi-modal man-machine interaction, battle space visualization, positioning and navigation in degraded environments (poor Global Positioning System (GPS) performance), automated cognitive decision aids, real-time collaborative tactical planning tools, data transfer, distributed data bases, open system architectures, and integration concepts which contribute to more efficient mobile operations.

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 (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: Battle Space Awareness and Positioning *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 Global Positioning System (GPS) denied environments such as those with hostile electro-magnetic interference and other radio frequency (RF) degradation, in buildings, and during subterranean operations. Work being accomplished under PE 0603772A/project 101 compliments this effort. *FY 2014 Accomplishments:* Researched and investigated sensors based on emerging advances in micro-electromechanical systems (MEMS) and exploitation of signals of opportunity (SOO) to reduce dependence upon GPS as a sole navigation source; investigated advanced anti-jam antennas and pseudo-lite sources to protect and enhance weak GPS signals; examined modernized GPS signals for potential	3.689	4.767	3.870

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		**Date:** February 2015
Appropriation/Budget Activity 2040 *I* 2	**R-1 Program Element (Number/Name)** PE 0602782A *I Command, Control, Communications Technology*	**Project (Number/Name)** 779 *I Command, Control And Platform Electronics Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
integration into Army systems; designed, coded and developed interfaces, protocols and software for handheld devices to access secure GPS through emerging modernized code (M-Code) capable GPS chips. *FY 2015 Plans:* Investigate and analyze new sensor technologies for potential navigation and timing applications such as atomic sensors, multi-Global Navigation Satellite Systems (multi-GNSS), emerging SOOs, and MEMS focusing on improvements to individual sensors and methods for improved manufacturing techniques allowing the potential for smaller integrated navigation systems; examine vision based sensors and other aiding techniques such as human motion classification and network assisted navigation to enable navigation in the absence of GPS signals; investigate GPS augmentation systems to evaluate compatibility with new M-Code receiver chips and the ability to make GPS user equipment for ground vehicles and dismounted Soldiers less susceptible to interference sources. *FY 2016 Plans:* Will investigate MEMS sensors, anti-jam/anti-spoof antennas, multi-GNSS receivers that incorporate M-code capability; research the application of laser-based LIDAR (light-radar) as an improvement over visible light vision systems; investigate a common interface for PNT applications to enable the seamless incorporation of new sensors; research the application of atomic sensors for gyros, accelerometers and clocks for independent location information using no external signals; explore the feasibility of integrating star trackers with terrestrial PNT systems; research performance effects on navigation solutions when incorporating a variety of emerging PNT technologies such as cameras with rolling vs. global shutters; mature Blue Force Electronic Attack (BFEA) models and simulations to emulate and account for M-code enabled GPS receivers; conduct experiments with various technologies to provide PNT for Autonomous vehicles.			
Title: Mission Command (MC) Next Generation Technologies (formerly named Command and Control (C2) On-The-Move (OTM) Enabling Technologies) **Description:** This effort investigates, designs and codes software to enable a uniform MC capability and experience for the commander in the command post, on the move in vehicles, or dismounted. Work in this effort transitions to PE 0603772A/project 101. *FY 2014 Accomplishments:* Investigated software and developed algorithms to increase unmanned platform autonomy and improve multi-platform autonomous collision avoidance; designed and refined MC systems that learn and adapt based on the users' preferences and mission needs in order to reduce required training; investigated self-forming MC software solutions to reduce setup/tear-down effort and provide some zero-time (initial startup) capability; architected automated troubleshooting tools to reduce MC field service representative support costs and improve system utility; improved upon advanced computing platform display technologies by researching methods of supporting additional points of touch for multiple simultaneous users, and wireless	9.813	9.914	11.935

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015		
Appropriation/Budget Activity 2040 I 2		R-1 Program Element (Number/Name) PE 0602782A I Command, Control, Communications Technology	Project (Number/Name) 779 I Command, Control And Platform Electronics Tech		

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
interface technology to connect to portable computing devices; architected and designed a portable, tactical, distributed computing and storage solution to manage the distributed system and data to improve command post (CP) mobility and accessibility from vehicles and dismounts; developed and coded a single common cross-platform software interface demonstrator that supports dismounted, mounted, and CP operations to reduce software design and support costs. *FY 2015 Plans:* Research and brassboard the required data, system architectures, and leader tools needed to provide continuously available MC capabilities from tactical through strategic echelons; investigate and design multi-echelon, unified MC software with a particular emphasis on enabling small unit commander-centric operations; design and code 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; design and code software tools that enable Soldiers to explore data, visualize relationships, and create and modify workflows to update and modify MC software applications without re-programming and revalidation; design MC software that analyzes unstructured and structured data from discourse, social media, and computer systems to provide alerts, suggest collaboration opportunities, and deliver expert level decision support to the commander; design and code software that measures individual and staff workload to facilitate more agile team operation and that applies distributed computing to solve a complex, multi-element problem within a small group of Soldiers without reach back to higher echelons. *FY 2016 Plans:* Will design and validate an infrastructure and software architecture that permits a single source code base to deploy MC applications across different platforms in the command post, mounted and dismounted environments; investigate a virtual staff capability to supply staff-like functionality to the commander; mature software that enables small unit commander-centric operations by helping the commander to drive the operations process and assist in unit to unit and cross coalition interaction; investigate how to include human factors engineering early into MC software designs in order to simplify user interactions with the software and reduce cognitive load on the Soldiers; design software to perform MC of teams of humans and multiple autonomous systems to augment unit effectiveness and unburden Soldiers by eliminating multiple complex interfaces with the autonomous systems.			
Accomplishments/Planned Programs Subtotals	13.502	14.681	15.805

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 *I* 2	**R-1 Program Element (Number/Name)** PE 0602782A *I Command, Control, Communications Technology*	**Project (Number/Name)** 779 *I Command, Control And Platform Electronics Tech*

E. Performance Metrics

 N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army											Date: February 2015	

| Appropriation/Budget Activity
2040 / 2 | | | | R-1 Program Element (Number/Name)
PE 0602782A / Command, Control,
Communications Technology | | | | Project (Number/Name)
H92 / Communications Technology | | | | |

COST ($ in Millions)	Prior Years	FY 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
H92: Communications Technology	-	20.078	19.126	20.355	-	20.355	21.359	21.229	21.507	21.931	-	-

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 such as in the presence of electronic warfare (EW) and to increase the communications capacity of terrestrial and satellite communications (SATCOM) systems. This project also investigates 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 wireless communications networks against cyber attacks; and new mobile networking protocols to make wireless, on-the-move (OTM) communications networks more responsive to user needs. 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 also provides new technology capabilities to lower the size, weight, power (SWAP) and cost of networking systems deployed on Army platforms through rapid technology improvements in hardware and software convergence.

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 (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)	6.627	3.948	2.787
Description: This effort investigates low cost, power efficient, conformal and directional antenna technologies for terrestrial, airborne, and tactical SATCOM ground terminals to enable them to operate OTM over multiple frequency bands, and further investigates armor embedded antenna and distributed array technologies. Together these efforts will improve ground forces electronic protection, increase signal power and range and provide greater connectivity for both mounted and dismounted forces. This effort also provides new technology capabilities to lower the SWAP and cost of networking systems deployed on			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 I 2	R-1 Program Element (Number/Name) PE 0602782A I *Command, Control, Communications Technology*	Project (Number/Name) H92 I *Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Army platforms through hardware and software convergence. Work being accomplished under PE 0602270A/project 906, PE 0603008A/project TR1, PE 0603270A/project K15 and PE 0603794A/project EL4 compliments this effort. *FY 2014 Accomplishments:* Developed optically non-intrusive antenna arrays for transparent Armor; investigated and advanced smart switching for distributed antenna system arrays enabling higher output power, interoperability and improved link connectivity for terrestrial and SATCOM communications and electronic warfare (EW); investigated and evolved antenna systems that provide capacity to support simultaneous EW jamming and communications without interference; established standard interface for distributed terrestrial and SATCOM antenna systems to support interchange of communications modes on battlefield platforms. *FY 2015 Plans:* Design and mature a smart switching system for distributed antenna arrays enabling higher output power, interoperability and improved link connectivity for SATCOM; investigate and mature antenna systems and arrays that provide improved communications performance and reliability through EW jammed environments; develop and finalize a government standard architecture to provide standard form-fit and electronic interfaces for distributed terrestrial and SATCOM antenna systems to support interchange of communications modes on battlefield platforms. *FY 2016 Plans:* Will complete and demonstrate in a lab environment a smart switch for distributed antenna arrays enabling higher output power, interoperability and improved link connectivity for SATCOM; complete and demonstrate in a lab environment antennas and antenna arrays that provide improved communications performance and reliability through EW jammed environments; design/ develop a government standard architecture to provide standard form-fit and electronic interfaces for distributed terrestrial antenna systems.			
Title: Tactical Information Assurance (IA) and Cyber Defense (formerly named Wireless 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 and 0603794A/ project EL5 compliments this effort, and is fully coordinated with the Army Research Lab Cyber Security Collaborative Research Alliance, PE 0601104A/ project EA6. *FY 2014 Accomplishments:* Designed and coded sophisticated software assurance algorithms to differentiate between stealthy life cycle attacks and software coding errors; designed and assessed secure coding methodologies that can detect and self correct against malicious code insertion; investigated theoretical control graph techniques for improvements in malware detection that can detect malware	9.244	9.321	8.654

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602782A / Command, Control, Communications Technology	Project (Number/Name) H92 / Communications Technology

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
variants incorporating polymorphic and metamorphic transformation engines; researched and designed sophisticated, optimized cyber maneuver capabilities that incorporate the use of reasoning, intuition, and perception while determining the optimal scenario on when to maneuver, as well as the ability to map and manage the network to determine probable attack paths and the likelihood of exploit; investigated dynamically and efficiently altering tactical network services, ports, protocols and systems to inhibit red force ability to perform malicious network reconnaissance to determine location of critical networking services; researched and assessed data sharing and collaboration techniques between offensive and defensive operations to enable advanced warning and response actions. *FY 2015 Plans:* Evaluate and mature optimized cyber maneuver capabilities that incorporate the use of reasoning, intuition, and perception while determining the optimal scenario on when to change network configurations and settings to increase the difficulty for red forces to perform malicious network reconnaissance prior to attack; encode, evaluate and mature software to provide a feedback system to optimize the effectiveness of cyber maneuver and threat assessments; research algorithms and evaluate the effectiveness of dynamically maneuvering computer operating systems and applications to further restrict red force ability to perform malicious reconnaissance on tactical network components and hosts; mature and optimize data sharing and collaboration techniques between offensive and defensive operations and across security boundaries to enable advanced warning and response actions; research trans-disciplinary computer experimentation models that emulate attackers-defenders-users interactions and associated technological and human interrelationships; research a software based encryptor point solution that meets National Security Agency (NSA) formal requirements to eliminate the need for physical encryption devices on Army tactical communications systems. *FY 2016 Plans:* Will design and code software that employs techniques for data sharing and collaboration between offensive and defensive operations and across security boundaries to enable advanced warning and response actions; design and code a software based encryptor that meets NSA formal requirements to eliminate the need for physical encryption devices; mature design of security for network protocols; research, design and develop algorithms to identify, protect, and prevent insider threat negligence and- or malicious actions; research and design software tools and a framework for independent software assessments to easily and quickly identify vulnerabilities during development and integration with third party software to detect potential vulnerabilities well prior to the software being used on Army networks; research, design and code software that incorporates cyber risk assessment, threat detection, cyber response agility and psycho-social behavior prediction to improve network security; design and develop an NSA Type 1 reprogrammable logic single chip cyptographic engine which includes anti-tamper and security boundary technology (both information security functions) and cryptographic engine within the chip design, emphasis is to develop a capability that			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army			Date: February 2015
Appropriation/Budget Activity 2040 I 2	R-1 Program Element (Number/Name) PE 0602782A I Command, Control, Communications Technology		Project (Number/Name) H92 I Communications Technology

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
can be reused, scaled, and-or repackaged to satisfy the particular constraints of different platform developments (e.g., hand held devices, unmanned sensors, satellite systems, key load devices, etc.) without significant redevelopment and recertification efforts.			
Title: Cognitive Networking *Description:* This effort investigates, codes, fabricates and evaluates 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 adapts 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 2014 Accomplishments:* Researched software for self initiating and managing tactical wireless networks that supports spectrum efficiency in austere tactical environments; researched ad-hoc routing, digital voice and disruption tolerant networking to deliver two way voice, data and position-location information to small units.	0.857	-	-
Title: Future Communications and Networking Technologies (formerly named 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 RF modulation techniques, devices and software. This effort investigates technologies for networking protocol development as well as networking technologies for routing and disruption tolerant networks. This effort also investigates RF signal processing, signal transmission and codes software to detect and overcome the interference of SATCOM due to jamming or atmospheric conditions such as scintillation. Work being accomplished under PE 0603008A/project TR1 and 0603794A/ project EL4 compliments this effort. *FY 2014 Accomplishments:* Researched and developed software and hardware techniques allowing electronic warfare (EW) and communications systems to interoperate without mutual interference; researched components, software and algorithms that support a waveform capable of simultaneous automated jamming and communication; investigated coordinated resource allocation, dynamic spectrum access (DSA) and interference cancellation algorithms to support interoperability between different wireless communication networks; investigated spectrum compatibility techniques to enable detection, identification, exploitation, location, disruption and neutralization of adversary RF systems in dense co-channel and multi-path interference environments, while allowing friendly communications and other RF systems to operate effectively in the same spectrum space. *FY 2015 Plans:*	3.350	5.857	8.914

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 I 2	R-1 Program Element (Number/Name) PE 0602782A I *Command, Control, Communications Technology*	Project (Number/Name) H92 I *Communications Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Investigate techniques for managing and self-initiating wireless networks to improve robustness, efficiency and capacity; investigating coordinated scheduling algorithms and efficient architectures, routing protocols etc. and incorporating a range of techniques (including directional networking, multi function waveforms, interference mitigation etc. to achieve efficient spectrum use and enable tactical wireless networks to increase overall performance in hostile and RF environments including spectrum congested and GPS denied environments; research network and physical layer models for tactical networking waveforms to enable the evaluation of the effectiveness of new signal processing and networking technologies to overcome RF interference such as red force jamming; design and code network reasoning software to enable the dynamic selection of signal processing and RF transmission techniques such as adaptive signal cancellation, coordinated scheduling of discontiguous signals, directional networking and multiple input multiple output networks to overcome adversarial RF jamming; develop a waveform architecture to define interfaces between the various RF, networking and signal processing hardware components; evaluate and develop signal analysis algorithms to detect RF interference of SATCOM signals; research and perform system analysis for protected SATCOM architectures to support modulation, coding and redundancy protection methods; research and analyze precision polarization concepts to support multiple communications paths and bandwidth expansion; perform modeling, simulation and emulation of networks to assess performance in contested environments; mature and evaluate performance of a signals management module for integration into the Soldier Radio Waveform to manage communications and blue force jamming RF emissions to prevent cosite interference while maintaining communications/jamming performance. *FY 2016 Plans:* Will continue to develop and mature network and physical layer models for tactical networking waveforms to overcome RF interference; develop digital signal processing and adaptive interference cancellation algorithms to enable efficient utilization of spectrum; investigate and mature a waveform architecture to define interfaces between the various RF, networking and signal processing components; develop directional networking and disruption tolerant networks to protect the network from electronic warfare systems while using spectrum efficiently; continue to perform modeling, simulation and emulation of networks to assess network performance to quantify the efficacy of the various techniques being developed to improve the network capacity and robustness; develop network protocols for operations in contested electromagnetic environment using techniques such as interference cancellation, multifunction waveform and coordinated scheduling algorithms for electronic protection optimization; develop software defined networks for tactical applications; mature and begin implementation of feasible architectures and technologies for increasing tactical network capacity and performance in a dynamic spectrum environment; develop the framework for an adaptive media access code physical layer to evolve the tactical network while improving capacity; develop resilient core and routing protocols to increase performance of the tactical network; begin development of protocols to support mission and user-aware routing and content based networking; begin development of networking frameworks and network abstraction layer for interoperable end to end voice over internet protocol; research feasible approaches to enable networking in Global Positioning			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015	
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602782A / Command, Control, Communications Technology	Project (Number/Name) H92 / Communications Technology	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
System denied environment; develop security framework by investigating multi layer security routing and conduct high assurance internet protocol encryptor bypass study.			
Accomplishments/Planned Programs Subtotals	20.078	19.126	20.355

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

D. Acquisition Strategy
 N/A

E. Performance Metrics
 N/A