

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY		PE NUMBER AND TITLE						
2 - Applied Research		0602782A - Command, Control, Communications Technology						
COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total Program Element (PE) Cost	45044	48412	22215	24046	24521	25056	25607	26171
779 C2 & PLAT ELEC TECH	7710	8483	7926	9543	9864	10287	10513	10745
H92 COMMUNICATIONS TECH	10258	12337	14289	14503	14657	14769	15094	15426
TR9 C3 COMPONENT TECHNOLOGY (CA)	27076	27592						

A. Mission Description and Budget Item Justification: This program element (PE) researches advanced communications technologies and expands scientific knowledge of Command and Control (C2), and electronics systems/subsystems for use in the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The intent is to provide the Army with enhanced capabilities for secure, mobile, networked communications, assured information delivery, and presentation of information that enables decision-making. This will be achieved by improving the command, control, and communication systems (e.g. man-machine interfaces, information management, data analysis, mobility, security, capacity, safety, reliability, and survivability) for both air and ground platforms, including the dismounted Soldier. Commercial technologies are continuously investigated and leveraged where possible. Project 779, C2 and Platform Electronic Technology, funds applied research on infrastructures and technologies that enable management of information across the tactical and strategic battle space, provide automated cognitive reasoning and decision making, and allow timely distribution, display, and use of C2 data on Army platforms. This applied research also includes enhancements to the Global Positioning System (GPS) user equipment to provide more robust, anti-jam position and navigation capabilities, and improvements to man-machine interfaces and decision aids for increased operational tempo in an On-the-Move (OTM), network-centric battlefield environment. Project H92, Communications Technology, funds research that will provide technologies that allow Current and Future Force field commanders to communicate OTM to/from virtually any location, in a seamless, secure, self-organizing, self-healing, network. Integrated networks of unmanned remote sensors, maneuver and fire support elements, and situational awareness (SA) tools will allow the Future Force to achieve overmatch with agility and versatility. In addition, portions of the research support the Joint Tactical Radio System (JTRS) evolutions. Project TR9 funds congressional special interest efforts.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this program element (PE) contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0603008A (Electronic Warfare Advanced Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology). Work in this PE is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

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<u>B. Program Change Summary</u>	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	49242	21193	23488	24089
Current BES/President's Budget (FY 2008/2009)	45044	48412	22215	24046
Total Adjustments	-4198	27219	-1273	-43
Congressional Program Reductions		-325		
Congressional Rescissions				
Congressional Increases		27900		
Reprogrammings	-4198	-356		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1273	-43

Sixteen FY07 congressional adds totaling \$26742 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

- (\$3835) Enh Wireless Digital Com f/Urban First Responders
- (\$1055) Portable Flexible Communication Display Device
- (\$1870) Digital Alert Display for Army Commanders
- (\$1582) Highly Mobile Large-Scale C4ISR Cmd Post Sys
- (\$3067) Improved Bandwidth for Battle Communications
- (\$958) Integrated Lightweight Electronics Shelter
- (\$3451) Lightweight Inter-Theater Transportable TOC
- (\$958) Ultra Wideband Chip Set
- (\$958) USB Data Acquisition for Voice Recognition/Respons
- (\$958) C4ISR Integ Digital Env Service Model (IDESM)
- (\$958) Dynamically Managed Data Dissemination (DMDD)
- (\$958) Innovative Wireless Technologies
- (\$958) Lightweight 10-meter Antenna Mast
- (\$958) Nanophotonic Device Development
- (\$2684) Ruggedized Cylinders f/Expandable Mobile Shelters
- (\$1534) Tac B-width Booster for Mobile Net-Centric Warfare

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A - Command, Control, Communications Technology						PROJECT 779	
COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
779 C2 & PLAT ELEC TECH	7710	8483	7926	9543	9864	10287	10513	10745

A. Mission Description and Budget Item Justification: This project researches and applies new concepts and techniques in Command and Control (C2) to achieve enhanced military capabilities for the Future Force, and where applicable for the Current Force. The Future Force will require leaders at all levels to have continuous and accurate situational awareness to make informed and rapid critical decisions to "shoot, move, and communicate" more quickly than the adversaries. This project performs the applied research that will enable commanders at all echelons to have better and more timely information and will allow them to command from anywhere on the battlefield. Emphasis is on two critical cornerstones of Battle Command; data management and automated analysis, to provide course of action determination, mission planning and rehearsal, mission execution monitoring and replanning, and precision positioning and navigation. New enabling technologies that support the current thrusts also are explored, such as multi-modal man-machine interactive technology, battle space visualization, automated cognitive decision aids, real-time collaborative tactical planning tools, data transfer, distributed data bases, advanced open system architectures, and integration concepts which contribute to more mobile operations. The Battle Space Awareness and Positioning program investigates positioning, navigation, and tracking 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 environments. The C2 OTM enabling technologies effort designs and develops technologies and decision aids that enable course of action (COA) generation and analysis that enables C2 OTM. The Networked Enabled Battle Command effort investigates and evaluates information search, retrieval, and decision models to enable seamless interoperability between tactical battle command and echelons above brigade.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

<u>Accomplishments/Planned Program:</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Battle Space Awareness and Positioning: In FY06, completed initial integration of Global Positioning System (GPS) with three prototype auxiliary navigation technologies: RF ranging, enhanced dead reckoning, and Micro Electro Mechanical System (MEMS) Inertial Measurement Units (IMUs) into a complete positioning, navigation, and tracking system for dismounted Soldiers in complex and urban terrain; prepared and conducted field test assessments of the integrated dismounted urban position/navigation technology to show its capability to provide enhanced situational awareness even when GPS is unavailable; continued the investigation of performance improvements for MEMS IMUs for dismounted Soldier and tactical vehicle applications. In FY07, develop improvements for MEMS navigation sensors for dismounted Soldier and tactical vehicle applications and evaluate human (loco)motion modeling compensation for dismounted Soldier operations in urban areas. In FY08, will investigate advanced positioning/navigation sensor technologies and will conduct trade studies to determine applicability of advanced network algorithms and processes within the context of emerging brigade combat team (BCT) architectures; will continue the investigation of performance improvements in order to improve the accuracy in MEMS IMUs for dismounted Soldier and tactical vehicle applications. In FY09, will downselect the sensor suite and will demonstrate advanced positioning/navigation sensor integration techniques with advanced network algorithms and processes compatible with BCT architectures to enable robust position information for enhanced situation awareness in GPS denied, urban, and other complex	3202	1932	2933	2000

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environments. Work on this effort is also being accomplished under PE/Project: 0603772A/101.				
C2 OTM Enabling Technologies: In FY06, planned and designed the architecture of an intelligent agent software toolkit that will generate Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) software agents that can interoperate with each other on a common framework. In FY07, construct the intelligent agent software toolkit and develop an intelligent agent testbed to integrate, test, and validate all software agents used in C4ISR. In FY08, will partner with the Space and Missile Defense Command (SMDC), Space Technology division on an effort to develop intelligent software agents that operates in both space and strategic (e.g. Missile Defense) as well as terrestrial domains; will design, develop, and transition software agents that can be user defined and interoperable in the operational environments for battle command, intelligence, surveillance, and reconnaissance (ISR), and logistic customers. In FY09, will continue to work with SMDC to further the development of intelligent software agent services with the addition of automatic discovery which enables agents to reduce the need for user intervention by automatically searching and retrieving data from other agent services; will apply automatic discovery intelligent software agent technology to help optimize data initialization and information management in all domains and transition intelligent agent services to PEO C3T will evaluate machine language translation tools and parsing techniques for the purpose of text-to-text and speech-to-speech translation in order to provide enhanced collaboration among joint coalition forces.	676	2100	4993	7543
Network Enabled Battle Command: In FY06, designed and developed software technology capable of intelligently regulating/prioritizing flow of information between low bandwidth and higher bandwidth networks based on understanding of network status and battle context, evaluated software to assure net-centric information flow across echelons was optimized; investigated knowledge acquisition and representation technology to capture experienced/expert commander's battle decision, as a function of situation and mission, in a form that computers can read and process. In FY07, investigate advanced effects based decision models that automatically match emerging patterns in the common operating picture and the mission to those in the knowledge base of recommended decisions for a given situation; develop automated wargaming tools that allow commanders to project potential effects of decisions and assess sensitivity of alternate options on future battle state; design a running estimate process for the Joint Tactical Common Operating Picture Workstation that compares a plan with actual situational awareness data and recommends adjustments to the plan. Work on this effort is also being accomplished under PE/Project: 0603772A/101.	3832	4396		
Small Business Innovative Research/Small Business Technology Transfer Programs		55		
Total	7710	8483	7926	9543

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A - Command, Control, Communications Technology						PROJECT H92		
COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
H92 COMMUNICATIONS TECH	10258	12337	14289	14503	14657	14769	15094	15426	

A. Mission Description and Budget Item Justification: This project researches and applies advanced communications and network technologies to meet the network-centric battlefield needs of the Future Force, including the dismounted Soldier. The strategy is based on leveraging and adapting commercial technology to the maximum extent possible and focusing research efforts on those areas not addressed elsewhere (e.g. mobile radio based infrastructures, security in narrowband environments, multiband On-the-Move (OTM) transmit, and receive antennas, adaptive protocols, and low probability of interception/low probability of detection). The Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) effort develops software tools that enable the Warfighter to dynamically plan, predict, and visualize network communications performance due to maneuver and environmental effects faster than real time and proven through modeling and simulation. Modeling and Simulation (M&S) for Network Design effort will design and mature a software tool to conduct computer aided design, assessment and analysis of, multi-tiered, mobile-wireless ad hoc network designs, alternative designs, and design options for large military networks. The programmable encryption technologies effort will design and develop solutions to address emerging requirements for Joint Forces secure and dynamic high speed communications cryptography requirements. Radio Enabling Technologies and Nextgen Applications (RETNA) designs and develops affordable radio components and enabling technologies to improve Joint Tactical Radio System (JTRS) range, throughput, and reliability performance. The Antenna Technologies effort investigates low cost, low profile omni directional, and directional antennas and antenna components for line-of-sight (LOS) and OTM satellite communications (SATCOM). Tactical Wireless Network Assurance (TWNA) funds research in network protection and wireless intrusion detection technologies for mobile wireless ad hoc networks and provides safeguards against modern network attacks.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

<u>Accomplishments/Planned Program:</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Communications Planner for Operational and Simulation Effects with Realism (COMPOSER): COMPOSER consists of the following software modules: Communication Effects Simulator (CES), Network Visualizer (NV), Spectrum Manager, and Architecture Framework. In FY06, conducted laboratory testing of COMPOSER technology and evaluated technology in the Training and Doctrine Command (TRADOC) Battle Lab Collaborative Simulation Environment (BLCSE); enhanced the CES which provides communications realism by calculating the performance of each communication link faster than real time for planning purposes and man in the loop experimentation and visualization capability; developed spectrum manager capability resulting in a beta version of COMPOSER. In FY07, perform analysis of available radio models and waveforms and integrate the waveforms to test interoperability with COMPOSER tools; mature spectrum management capability, improve the speed and accuracy of the CES. In FY08, will complete enhancements to CES; will increase the integration of waveform models to CES; will complete spectrum management capability; will develop final version of COMPOSER for transition to the Coalition Joint Spectrum Management Planning Tool Joint Concept Technology Demonstrations. Work on this effort is also being accomplished under PE/Project 0603008A/TR1.	2789	1544	300	
Radio Enabling Technologies and Nextgen Applications (RETNA): In FY06, designed the Handheld Manpack Small Form Fit (HMS)	3046	1699	1844	

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Joint Tactical Radio Systems (JTRS) Manpack Power Amplifier (PA) subsystems; planned, developed, and tested breadboard layouts of complex RF filter banks, diplexer systems, low-loss power conditioner modules, interface, and control electronics, and core wideband power amplification (WBPA) subsystems; developed a system-level WBPA breadboard by simulating then physically placing validated subsystems onto breadboard prototype. In FY07, develop HMS JTRS Manpack PA form-fit brassboard; validate the PAs component performance and associated system-level capability; identify root causes of waveform porting difficulties through failure and risk analyses to software defined radio (SDR). In FY08, will perform detailed investigation and experimentation into the development of HW/SW and porting of waveforms onto JTRS representative SDR platforms; will develop capability to reduce the complexity of porting software waveforms onto SDR hardware.				
Antenna Technologies: In FY06, developed a Ku band baseline antenna; developed methods of integrating radio frequency (RF) electronics into SATCOM antenna assemblies; initiated development of low cost transmit/receive, X-band OTM antenna systems. In FY07, conduct modeling and simulation to validate terrestrial directional antenna (TDA) parameters/link connectivity; develop innovative methods for integrating radio frequency (RF) electronics into X-band antenna assembly; develop methods of integrating Ku and Ka band transmit/receive into one OTM ground antenna system; develop methods of integrating power amplifiers into antenna assemblies; and investigate various low profile antenna technologies. In FY08, will complete development of TDA technologies for mobile ground platforms providing air interface for terrestrial directional networking and beam steering protocols; will investigate hybrid scan and phased array antenna technologies for a low profile multi-beam OTM SATCOM antenna for use with military Ka band and commercial Ku band satellites. In FY09, will develop multi-beam low profile OTM SATCOM antenna in a single frequency band (Military Ka or Commercial Ku); will investigate adding the second SATCOM frequency band; will develop tri-band low profile (Ka, Ku, Q Band) OTM SATCOM vehicle antenna.	2344	2907	4651	6903
Programmable Objective Encryption Technologies (POET): POET is a jointly funded effort with US Navy, Air Force, Marine Corps, to develop high speed, 4-channel, remotely programmable, embeddable crypto device. In FY06, solidified new cryptological embedded chip design requirements and developed initial design. In FY07, develop and deliver emulator version of the cryptological embedded chip design to the High Capacity Communications Capability (HC3), the Navy Multiband Terminal (NMT), and the Air Forces Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) program offices; provide testbed verification of the performance specifications of the emulator; perform a critical design review to determine the merits of continuing development effort into the next phase. In FY08, will develop Engineering Development Model (EDM) and deliver Non-Certified EDMs for start of Government Lab Evaluation/Test with a simulated host terminal; will perform initial NSA Certification testing and implement design changes based on test results. In FY09, will conduct a Lab Evaluation and certification, effort will complete with a Certified EDM delivery.	557	815	1500	1500
M&S for Network Designs: In FY06, performed assessment and initiated development to address the challenges of connectivity, maintaining desired capacity, and ensure survivability in large-scale mobile ad hoc networks; investigated application and demonstration of initial prototype code for preliminary robust optimization to network design, and design scenario. In FY07, baseline the network design capability to validate principles and rules that govern the behavior and performance of complex communication networks; assess and characterize the behavior and performance of the network (higher physical, data link and network layers) through analytical and M&S processes and technologies. In FY08, will evaluate the network design capability on a surrogate future force network; will interface network design algorithms with simulation; will characterize detailed end-to-end user performance metrics; will assess effectiveness of new networking technologies. In FY09, will extend the ad hoc network design tool to include modeling and representation of the C4ISR nodal functionalities; will develop a comprehensive representation of the internal operation and performance of network data dissemination mechanisms; will improve the network traffic characterization model.	1522	2663	2700	3500
Tactical Wireless Network Assurance (TWNA) / wireless information assurance (IA): In FY06, provided intrusion detection algorithms		2552	3294	2600

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<p>for Future Combat System brigade combat team; evaluated database access control and authentication of mobile data elements that restrict unauthorized modification to mobile code by preventing unauthorized access on a 20 mobile node ad hoc network; tested adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time. In FY07, develop advanced IA techniques; expand wireless intrusion detection to detect attacks against mobile hosts and networks. In FY08, will investigate a suite of IA technologies to enable enhanced tactical battlefield information sharing across all security domains to meet emerging threats; these include cross domain boundary services with trusted labeling and data sanitization to enforce data release to lower classified domains and smart pull information requests from higher domains, software partitioning with controlled interface filtering to enforce push/pull of information across security domains, and malicious code detection that uses proactive, automated techniques to find vulnerabilities and software flaws via source code analysis and reverse engineering. In FY09, will investigate and develop jam resistant and low signal detection communication technologies including space-time adaptive techniques, cross layer algorithms, cognitive disruptive tolerant networking, and signal processing techniques; will develop IA technologies enabling information exchange across security domains, ensuring robust survivability of tactical networks and critical information against info warfare attacks.</p>				
Small Business Innovative Research/Small Business Technology Transfer Programs		157		
Total		10258	12337	14289