ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602782A - Command, Control, Communications Technology**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		28774	49242	21193	23488	24089	24521	25056
779	C2 & PLAT ELEC TECH	8220	8922	8718	9088	9560	9864	10287
H92	COMMUNICATIONS TECH	10013	12473	12475	14400	14529	14657	14769
TR9	C3 COMPONENT TECHNOLOGY (CA)	10541	27847	0	0	0	0	0

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, presentation of information and decision-making. This will be achieved by improving the command, control, and communication systems (e.g. man-machine interface, 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 research on infrastructures that allow timely distribution, display, and use of C2 data on Army platforms. This research also includes enhancements to the Global Positioning System (GPS) user equipment to provide a more robust, anti-jam capability, and improvements to man-machine interfaces and decision aids for increased operation 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 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2006)	27416	21787	22792
Current BES/President's Budget (FY 2007)	28774	49242	21193
Total Adjustments	1358	27455	-1599
Congressional Program Reductions		-297	
Congressional Rescissions		-498	
Congressional Increases		28250	
Reprogrammings	1358		
SBIR/STTR Transfer			
Adjustments to Budget Years			-1599

Fourteen FY06 Congressional adds totaling $28250 were added to this PE.

FY06 Congressional adds with no R-2A (appropriated amount is shown):
($500) All Digital Transceiver (ADT) Development
($1000) Center for Integrated Systems in Sensing, Imaging and Communications at Michigan Technology University
($2000) Center for Urban Warfare Preparedness and Response
($1000) Digital Alert Display for Army Commanders
($6000) Enhanced Wireless Digital Communications for Urban First Responders
($1000) HEAT - Heterogeneous Agent Teams for FCS Command and Control
($2400) High Mobile Large-Scale C4ISR Command Post Systems, C-130 Compatible Command Trailer
($3400) Improved Bandwidth for Battle Communications
($1750) Integrated Lightweight Electronics Shelter
($4300) Lightweight Inter-theater Transportation Tactical Operations Center
($1500) Portable Flexible Communication Display Device
($1000) Software Defined Radio Interoperability Initiative
($1400) Ultra Wideband Chip Set
($1000) USB Data Acquisition for Voice Recognition/Response

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602782A - Command, Control, Communications Technology**	**779**

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
779 C2 & PLAT ELEC TECH	8220	8922	8718	9088	9560	9864	10287

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 situational awareness to make informed and rapid critical decisions to "shoot, move and communicate" more quickly than the adversaries. This project does 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, freed from their command posts and while On-the-Move (OTM). Emphasis is on course of action determination and analysis, 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 advanced high resolution and large screen displays, 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 & 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 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 the Future Combat System (FCS) Brigade Combat Team (BCT) 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.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Battle Space Awareness & Positioning: In FY05, began integration of network assisted Global Positioning System (GPS), 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; performed laboratory evaluation, and prepared for field testing of breadboard system; conducted investigation in performance improvements for MEMS IMUs for integration within the context of an integrated navigation system for dismounted soldier and tactical vehicle applications. In FY06, complete integration, prepare and conduct field test assessments of the integrated dismounted urban position/navigation technology; continue the investigation of performance improvements for MEMS IMUs for dismounted soldier and tactical vehicle applications. In FY07, will investigate advanced positioning/navigation sensor and integration technologies and will conduct trade studies to determine applicability of advanced network algorithms and processes within the context of emerging FCS BCT architectures.	3418	3316	2782
- C2 OTM Enabling Technologies: In FY05, matured selected tactical decision aids transitioned from the Army Research Laboratory; identified requirements for a distributed collaboration environment, and constructed a network-centric software environment for mobile decision tools to support C2 functions in complex and urban terrain; conducted an assessment of intelligent agent technology within CERDEC, National Labs, industry and academia and determined candidate applications for agents in Command, Control,	1802	1537	1406

Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR). In FY06, implement intelligent agent based C4ISR applications and conduct initial technical experiments to quantify performance. In FY07, will mature the intelligent agent based applications and frameworks with the goal to provide a repository for agent technology and its subsequent re-use.			
- Networked Enabled Battle Command: In FY05, investigated software technology for automated retrieval of mission-relevant Battle Command information across heterogeneous Service-Based Architectures. In FY06, design and develop 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, such that network performance is maintained while optimizing net-centric information flow across echelons; investigate 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, will 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; will investigate automated wargaming tools that allow commanders to project potential effects of decisions and assess sensitivity of alternate options on future battle state.	2000	4069	4530
- Networked Sensors for the Future Force: In FY05, integrated the Battle Command software infrastructure with Battle Command applications and unmanned systems controller and tested in field experimentations with unmanned networked sensors and platforms.	1000	0	0
Total	8220	8922	8718

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February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602782A - Command, Control, Communications Technology**	**H92**

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H92 COMMUNICATIONS TECH	10013	12473	12475	14400	14529	14657	14769

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 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 Force's 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. 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.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Communications Planner for Operational and Simulation Effects with Realism (COMPOSER): In FY05, investigated and designed open system architecture to ensure interoperability with multiple waveforms and systems; performed analysis of technologies for the predictive network planner and dynamic 2D/3D visualization tools to integrate into COMPOSER architecture; developed and demonstrated an open architecture proof of concept communications planner, consisting of network visualization tool and Communications Effects Simulator (CES); evaluated spectrum management technologies to support WIN-T program. In FY06, conduct laboratory testing of COMPOSER technology and evaluate technology in the Training & Doctrine Command (TRADOC) Battle Lab Collaborative Simulation Environment (BLCSE); utilize parallel and distributed computing technologies to analyze network behavior; assess and characterize performance of the higher physical data link and network layers through M&S. In FY07, will perform analysis of available radio models and waveforms and integrate the waveforms to test interoperability with COMPOSER tools; develop Release III Version of COMPOSER, improving CES and enhance network visualization tool; will complete spectrum management architecture and interface document.	1031	2789	1610
- Radio Enabling Technologies and Nextgen Applications (RETNA): In FY05, leveraged traditional and wide bandgap power amplifier technologies to develop an efficient Wideband Power Amplifier (WBPA) for Joint Tactical Radio System (JTRS) ground applications; evaluated the suitability of applying passive graphite foam thermal management technology to JTRS ground radios; initiated design of a high efficiency WBPA for Manpack and embedded JTRS Cluster 5 radio variants. In FY06, begin design of the Cluster 5 WBPA	909	2913	1772

subsystems; plan, develop, and test breadboard layouts of complex RF filter banks, diplexer systems, low-loss power conditioner modules, interface and control electronics, and core wideband power amplification subsystems; begin design of a system-level WBPA breadboard by simulating then physically placing validated subsystems onto breadboard prototype. In FY07, will continue development of Cluster 5 Manpack WBPA form fit prototype; will validate the WBPA's component performance and associated system-level capability.			
- Antenna Technologies: In FY05, investigated technologies for a family of Rotary Wing Aircraft multi-band antennas, lightweight body-wearable antennas (helmet and vest) for Future Force Warrior (FFW), and low profile vehicular antennas to comply with JTRS communications requirements for various ground and air platforms; conducted OTM demonstration of K/Ka band phased array; designed and demonstrated the 3 port Multiband Antenna design, WNW Multiport Antennas and Body Wearable Antenna. In FY06, investigate and develop gallium nitride monolithic microwave integrated circuit technologies used in development of high efficiency power amplifiers (PAs); develop methods of integrating low noise amplifiers, PAs, up and down converters into SATCOM antenna assemblies. In FY07, will develop low cost options for electronic/mechanical scanning antennas; will evaluate and analyze low profile versus performance and affordability of Ku/Ka single beam antenna system and conduct modeling & simulation to validate networking directional antenna parameters/link connectivity.	1268	2344	3032
- Tactical Wireless Network Assurance (TWNA): In FY06, provide intrusion detection algorithms for Future Combat System Brigade Combat Team; evaluate 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; test adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time. In FY07, will investigate and develop advanced information assurance techniques; will expand wireless intrusion detection to detect attacks against mobile hosts and networks.	0	2000	2485
- M&S for Network Designs and programmable encryption technologies: In FY06, perform assessment to address the challenges of mobile wireless, ad hoc communication network performance capabilities related to capacity, connectivity, and scalability; assess and characterize behavior and performance of the network (higher physical, data link and network layers) through M&S; solidify new cryptological embedded chip design requirements and develops a hardware design. In FY07, will evolve analytical and M&S processes and technologies by using a surrogate future force network as a baseline to validate principles and rules that govern the behavior and performance of complex communication network; will complete integration of cryptological embedded chip design and provide testbed verification of the performance specifications.	0	2427	3576
- Dynamic Readdressing and Management for the Army (DRAMA): In FY05, evaluated enhanced automated network management tools for large, tactical, OTM networks to include integration with net management agents, enhanced intelligent agents, and scalability of dynamic readdressing and Internet Protocol (IP) multicast protocols along with network management tools; researched, analyzed, and evaluated conceptual technical architecture/framework, advanced technologies, correlation algorithms, and dynamic database mapping techniques to support the Network Operation concept of an integrated Network Management, Information Assurance, and Information Dissemination Management capability.	4777	0	0
- Free Space Optical/Near-Optical Communications (FOCUS) and Sensors Networking: In FY05, conducted early laboratory experiments to establish performance against program goals and evaluation criteria for ground sensors and conducted laboratory experiments emphasizing subsystem investigation.	2028	0	0
Total	10013	12473	12475