Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Predictive Risk Assessment and Management for Army Ranges and Training Lands – In FY04, analyzed selected range design features and recommend improvements to reduce environmental compliance requirements; assessed range munitions load and environmental factors that may impact long term sustainability of range operations. In FY05, prepare an engineering analysis of costs associated with life-cycle operations and maintenance of environmentally compliant range designs to reduce and facilitate maintenance, cleanup of munitions and scrap, and erosion control; refine design and operation of maintenance criteria for sustainable ranges that incorporate environmental compliance considerations. In FY06, will complete a range compliance monitoring and carrying capacity module focusing on munitions that will be incorporated into the modeling platform consistent with the Installation Training and Maintenance (ITAM) Army Training and Testing Area Carrying Capacity (ATTACC) methodology.	2580	1605	166	0
Reconfigurable and Joint Ranges – In FY04, formulated particulate matter emission estimation models for tactical vehicle engines and chemical/physical particulate matter control technologies for unpaved surfaces; linked mission-use constraints to a community growth model. In FY05, complete noise dose-response model augmentation and noise mitigation practice development for typical training operations; mature technology for field measurement of particulate matter concentrations from Army training activities that enable estimates of impacts of training on local and regional air quality; mature Military Landuse Evolution and impact Assessment Model (MLEAM) to facilitate strategic plans to support long term military landuse sustainment. In FY06, will conduct cost benefit analysis for land rehabilitation projects that will improve erosion control practices and prioritization of sites for land rehabilitation in support of sustainable training lands. In FY07, will develop ATTACC protocols that incorporate non-military land and natural resource stressors.	2780	2780	3167	3820
Installation Operations/Hazardous Air Pollutants (HAP) – In FY04, matured demilitarization furnace air emission control system that will include metal adsorption and high temperature filtration; transitioned HAP applied research products to advanced technology demonstration.	201	0	0	0
Totals	8724	7941	7118	6805

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	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		18416	27416	21787	22792	24384	24804	25021	25207
779	C2 & PLAT ELEC TECH	7708	8252	9051	9614	10178	10475	10566	10643
H92	COMMUNICATIONS TECH	10708	10056	12736	13178	14206	14329	14455	14564
TR9	C3 COMPONENT TECHNOLOGY (CA)	0	9108	0	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 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 2005)	18604	19705	20001
Current Budget (FY 2006/2007 PB)	27416	21787	22792
Total Adjustments	8812	2082	2791
Net of Program/Database Changes			
Congressional Program Reductions	-259		
Congressional Rescissions			
Congressional Increases	9500		
Reprogrammings			
SBIR/STTR Transfer	-429		
Adjustments to Budget Years		2082	2791

Change Summary Explanation:
FY06 - Increased funding ($2082K) supports improved fidelity modeling & simulation for network design
FY07 - Increased funding ($2791K) supports improved fidelity modeling & simulation for network design

Three FY05 Congressional adds totaling $9500 were added to this PE.

FY05 Congressional Adds with no R-2A:
($1438) All Digital Transceiver (ADT) Development, TR9: The purpose of this one year Congressional add is to develop an All Digital Transceiver to replace the Joint Tactical Radio System (JTRS) Cluster 1's existing analog transceiver. No additional funding is required to complete this project.

($5754) Enhanced Wireless Digital Communications for Urban First Responders, TR9: The purpose of this one year Congressional add is to develop wearable wireless RF-location and digital communications system development of the First Responder Communication System. No additional funding is required to complete this project.

($1918) Portable Flexible Communication Display Device, TR9: The purpose of this one year Congressional add is to develop a portable flexible

electronic display communication device which can be rolled up into a small, light-weight package and unrolled for on-the-move commanders. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	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	7708	8252	9051	9614	10178	10475	10566	10643

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. 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 Unit of Employment (UE) and Future Combat Systems (FCS) Unit of Action (UA). Networked Sensors for the Future Force designs and develops a C2 information infrastructure to prioritize information flow, based on user requirements and a standardized technique of tasking networked sensors and unmanned platforms.

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 2004	FY 2005	FY 2006	FY 2007
- Battle Space Awareness & Positioning: In FY04, evaluated positioning, navigation, and tracking prototype-integrated systems including RF ranging (hardware and algorithms), an enhanced pedometer system, and a network assisted Global Positioning System (GPS) in laboratory environments; conduct field test on components to evaluate potential use in military operations in urbanized terrain. In FY05, integrate best performing components into a complete positioning, navigation and tracking system for dismounted soldiers in complex and urban terrain; perform laboratory evaluation, and prepare for field testing of breadboard system; conduct investigation in performance improvements for Micro-Electro Mechanical System (MEMS) Inertial Measurement Units (IMUs) for integration within the context of an integrated navigation system for dismounted soldier and tactical vehicle applications. In FY06, will conduct field test assessments of the integrated dismounted urban position/navigation technology; will complete the investigation of performance improvements for MEMS IMUs for dismounted soldier and tactical vehicle applications. In FY07, will mature positioning/navigation sensor and integration technologies to support robust affordable configurations for manned/unmanned tactical vehicles and dismounted soldiers.	1475	3418	3381	2802
- C2 OTM Enabling Technologies: In FY04, investigated intelligent agent software for execution monitoring of 100 events and matured mobile adaptive computing capabilities for dispersed and on-the-move C2 operations; identified tactical scenarios to evaluate decision aids and mobile C2 tools, and provided early prototypes utilizing an information management scheme based upon information exchange requirements for use in C2 functions in complex and urban terrain. In FY05, mature selected tactical decision aids transitioning from the Army Research Laboratory; identify requirements for a distributed collaboration environment, and construct a network-centric software environment for mobile decision tools to support C2 functions in complex and urban terrain; conduct an assessment of intelligent agent technology within CERDEC, National Labs, industry and academia and determine candidate applications for agents in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR). In FY06, will implement intelligent agent based C4ISR applications and conduct initial technical experiments to quantify performance. In FY07, will conduct operational experiments to support the transition, integration and validation of intelligent agent technology and provide a repository for agent technology and re-use.	3733	1834	1537	2282

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Networked Enabled Battle Command: In FY05, investigate software technology for automated retrieval of mission-relevant Battle Command information across heterogeneous Service-Based Architectures. In FY06, will design and develop software technology capable of intelligently regulating/prioritizing flow of information between low bandwidth (UA) and higher bandwidth (UE) networks based on understanding of network status and battle context, such that UA network performance is maintained while optimizing net-centric information flow across echelons; will 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 COP and mission to knowledge base of recommended decisions for a given situation; will investigate automated wargaming tools that allow UE commanders to project potential effects of decisions and assess sensitivity of alternate options on future battle state.	0	2000	4133	4530
- Networked Sensors for the Future Force: In FY04, modeled the behavior of the C2 information system using Unified Modeling Language to demonstrate the flow of information between operators, the collaboration between networked subsystems, and the information exchange with unmanned platforms; evaluated Common Object Request Broker Architecture as a means of information exchange using a publish/subscribe model. In FY05, integrate the infrastructure and test in field experimentations with unmanned networked sensors and platforms.	2500	1000	0	0
Totals	7708	8252	9051	9614

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H92	COMMUNICATIONS TECH	10708	10056	12736	13178	14206	14329	14455	14564

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). Dynamic Readdressing and Management for the Army (DRAMA) investigates mobile ad hoc protocols and network management technologies enabling, robust, on-the-move communications. The Advanced Antennas effort designs and develops tactical antenna technologies to reduce cost, the number required, and increase the range and throughput, while increasing platform survivability by reducing the antenna visual signature. Free Space Optical/Near-Optical Communications (FOCUS) investigates wireless technologies for hostile mobile environments using laser communications. The Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) and Modeling & Simulation (M&S) for Network Designs efforts develop 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. Radio Enabling Technologies and Nextgen Applications (RETNA) designs and develops affordable radio components and enabling technologies to improve Cluster 1 Joint Tactical Radio range, throughput and reliability performance. The Next Generation Satellite Communications effort investigates low cost, low profile OTM Ka and EHF band satellite communications hardware and software. 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. Future Force Antennas designs and develops affordable directional antenna systems to support directional networking communications in mobile terrestrial (line of sight) environments. The Joint Tactical Radio System (JTRS) Squad-Level Communications effort develops mobile wireless technologies for emerging wideband waveforms to meet the size, weight and power needs of the individual dismounted soldier and unattended ground sensors.

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 2004	FY 2005	FY 2006	FY 2007
- Dynamic Readdressing and Management for the Army (DRAMA): In FY04, conducted experiments to determine the maturity of intelligent agent and mobile agent software network management tools using an intelligent agent framework for automated network control and management of traffic flow (voice, data, video) over the network; determined the operational capabilities of dynamic addressing and network reconfiguration based upon the intelligent agent assessment of network dynamics. In FY05, will evaluate 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; will research, analyze, and evaluate 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.	4000	4847	0	0
- Advanced Antennas: In FY04, completed modeling for body-wearable, multi-band antennas, and platform antenna placement; conducted initial human radio frequency safety assessment model; completed K/Ka band array development platform. In FY05, investigate technologies for a family of Rotary Wing Aircraft multi-band antennas, lightweight body-wearable antennas (helmet and vest), and low profile vehicular antennas to comply with JTRS communications requirements for various ground and air platforms. In FY06, will complete design of body-wearable, low profile and rotary wing aviation antennas.	2100	1100	1200	0
- Free Space Optical/Near-Optical Communications (FOCUS) and Sensors Networking: In FY04, refined sensor communications requirements; integrated protocols and waveforms into model hardware; designed subsystem including transmitter laser, tracking hardware, down conversion (extract data from laser) unit. In FY05, conduct early laboratory experiments to establish performance against program goals and evaluation criteria for ground sensors and conduct laboratory experiments emphasizing subsystem investigation.	3820	2100	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) and Modeling & Simulation (M&S) for Network Designs: In FY05, investigate and design open system architecture to ensure interoperability with multiple waveforms and systems; perform analysis of technologies for the predictive network planner and dynamic 2D/3D visualization tools to integrate into COMPOSER architecture. In FY06, will conduct laboratory testing of COMPOSER technology and evaluate technology from Training & Doctrine Command (TRADOC) Battle Lab Collaborative Simulation Environment (BLCSE) experiment result data; will utilize parallel and distributed computing technologies to analyze performance behavior; will perform assessment to address the challenges of ad hoc communication network performance capabilities; will 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 into the COMPOSER architecture; will evolve modeling and simulation processes and technologies by using the FCS network as a baseline to enable the understanding and validation of the principles and rules that govern the behavior and performance of complex communication network of the future; will assess and characterize RF environment; characterize detailed end-to-end user performance metrics; assess implementation of new networking technologies and influence emerging network designs with M&S.	0	1069	4789	4410
- Radio Enabling Technologies and Nextgen Applications (RETNA): In FY05, leverage existing Wideband Power Amplifier (WBPA) technology to develop a WBPA for risk reduction for JTRS Cluster 1 that is capable of meeting the link closure requirements for ground applications; evaluate the application of passive graphite foam thermal management technology by testing against a Cluster 1 emulated circuit board with hot spots. In FY06, will begin the Cluster 1 rotary wing Electromagnetic Interference (EMI) filter effort concentrating on new design techniques and compact filters that enable the reduction of filter size, weight, and power while maintaining the required military standard interference suppression requirements; will begin design of an integrated superconducting-based all-digital transceiver that enables increased performance, sensitivity, and channel capacity in same package as the existing analog design. In FY07, will begin laboratory development and integration of the all-digital transceiver by integrating products of multiple Army, Navy, and Air Force investments.	0	940	2846	2922

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Next Generation Satellite Communications (SATCOM): In FY06, will develop a passive receiver assembly for a low cost, low profile, wideband (Ka and EHF) on-the-move satellite antenna; will begin design of a K-band (20-30Ghz) superconducting-based all-digital receiver for satellite communications based on developments in the RETNA program; will begin design of network and processing satellite aware OTM blockage mitigation and avoidance protocols. In FY07, will evaluate an active transmit assembly for a low cost, low profile, wideband (Ka and EHF) on-the-move satellite antenna; will develop the analog to digital converter component of the K-band superconducting-based all-digital receiver; will analyze and evaluate performance of network and processing satellite aware OTM blockage mitigation and avoidance protocols in a simulated environment.	0	0	2791	2336
- Tactical Wireless Network Assurance (TWNA): In FY06, will provide intrusion detection algorithms for FCS UA; will 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; will laboratory test adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time. In FY07, will design and perform laboratory testing of adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time by providing a 40% reduction in intrusion response time; will evaluate database access control and authentication of mobile data elements that restrict unauthorized modification to mobile code by preventing unauthorized access on a 50 node ad hoc network.	0	0	1110	1611
- Future Force Antennas: In FY07, will M&S to quantify the cost versus performance tradeoffs for directional antennas; will develop directional antenna systems based on the results of M&S effort; will conduct analyses of one dimensional beam steering and elevation beam shaping for ground to air nodes and architectures that lead to affordable systems; will conduct M&S to validate parameters and link connectivities within the directive network; will initiate development of distributed digital signal processing techniques to allow combining of signals from multiple apertures integrated around a platform.	0	0	0	1899
- Joint Tactical Radio System (JTRS) Squad-Level Communications: In FY04, completed software integration of Soldier Radio Waveform (SRW) Increment 0.5 in the JTRS Squad Level Communications Project brassboard to include the Core Framework, SRW application software, digital baseband processing, and the frequency agile RF front-end operating in the 225-1000 MHz band.	788	0	0	0
Totals	10708	10056	12736	13178