ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602782A - Command, Control, Communications Technology

	COST (In Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
	Total Program Element (PE) Cost	22130	21150	18728	18696	19816	20105	21387	22138
779	C2 & PLAT ELEC TECH	7645	9221	8006	8367	9364	9862	10327	10791
H92	COMMUNICATIONS TECH	14485	11929	10722	10329	10452	10243	11060	11347

A. Mission Description and Budget Item Justification: Communications and Command & Control technologies must continue to advance in order to realize the changes in operations and doctrine anticipated for the FCS Objective Force. This program element (PE) researches advanced communications technologies and expands scientific knowledge of command and control (C2), and electronics systems/subsystems. 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. Research includes the investigation of 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, network-centric battlefield environment. This PE will provide technologies that allow Objective Force field commanders to communicate on-the-move (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 Objective Force to achieve overmatch with agility and versatility. In addition, portions of the research are directed to supporting the Joint Tactical Radio System (JTRS) evolutions. The cited work is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. Work in this PE is related to and fully coordinated with efforts in PE 0603006A (Space Applications Advanced Technology), PE 0603008A (Command, Control and Communications Advanced Technology), PE 0602783A (Computer and Software Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), PE 0603734A (Military Engineering Advanced Technology), and PE 62705 (Electronics & Electronics Technology. The PE contains no duplication with any effort within the Military Departments. Work is performed by the US Army Communications-Electronics Command, Fort Monmouth, NJ. This program supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

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B. Program Change Summary	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	24123	21821	22349	23519
Current Budget (FY 2004/2005 PB)	22130	21150	18728	18696
Total Adjustments	-1993	-671	-3621	-4823
Congressional program reductions				
Congressional rescissions		-1857		
Congressional increases		1500		
Reprogrammings	-1610	-121		
SBIR/STTR Transfer	-383	-193		
Adjustments to Budget Years			-3621	-4823

Change Summary Explanation: Funding – FY 2004/2005: Funds realigned to higher priority requirements.

FY03 Congressional Adds:
Mobile Emergency Broadband System, Project H92 ($1500)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

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

COST (In Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
779	C2 & PLAT ELEC TECH	7645	9221	8006	8367	9364	9862	10327	10791

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 Objective Force. The Objective 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 enables commanders at all echelons to have better and more timely information and allows them to command from anywhere on the battlefield, freed from their command posts and while on-the-move. 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 Agile Commander Advanced Technology Demonstration (ATD) matures digital hardware and software technologies that provide agile, rapidly deployable, split-based C2 operations. The Information Warfare Protect and Attack program provides a modeling and simulation/stimulation environment for man-in-the-loop evaluation and warfighter training for network protection. The Networked Sensors for the Objective Force ATD will model a lower echelon C2 information infrastructure to optimize information flow between dispersed C2 nodes and a series of unmanned platforms. The Battle Space Tactical Navigation program will mature technology and integration concepts that improve the robustness of navigation systems and minimize registration errors between sensors and databases. The Soldier/Squad Level Communications effort matures tactically mobile and lightweight C2 subsystems and applications to enable dismounted tactical commanders at brigade and below to achieve information dominance and precision maneuver. This project supports the Objective Force transition path of Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

Accomplishments/Planned Program	FY 2002	FY 2003	FY 2004	FY 2005
Battle Space Awareness & Positioning: In FY02, conducted lab test to determine the benefit of GPS anti-jam, GPS pseudolite and navigation/electro-optic system integration technologies. Conducted a distributed simulation at the Training & Doctrine Command (TRADOC) Analysis Center, Fort Leavenworth, KS using live troops and multiple sites to assess the quality of the simulation and improve model performance. Investigated C2 applications at battalion to squad levels for a mobile software agent situational awareness subsystem, including distributed battle planning and visualization, decision support aids, and human-machine interfaces through enhanced speech recognition. In FY03, conduct a field test with DARPA to evaluate GPS direct P(Y) acquisition and GPS pseudolite aiding in a high electronic counter measures/jamming environment. Conduct laboratory tests for limited speech recognition, intelligent software agents for alerts, and collaborate planning. In FY04, identify suitable emerging low power timekeeping technology; characterize ultra-wide band transmission through terrain and walls for position location; an architecture for network assisted GPS receivers for the military code; investigate modeling and simulation capability to evaluate enhanced dead-reckoning sensor technology and body motion models, define necessary battle language management and graphical concept representation construct interfaces; instrument visualization display mechanisms. Demonstrate in an operational environment speech recognition capabilities within a wearable computer platform and distributed wireless environment with voice-controlled applications. In FY05, design, breadboard, and conduct technical tests and evaluations a low power time-keeping device; investigate sensitivity enhancements for ultra-wide band navigation/identification tags to achieve a 10 times range extension; design a network assisted GPS receiver; select sensor technologies for a low cost dead-reckoning device.	2850	2983	3142	3418

Accomplishments/Planned Program (continued)	FY 2002	FY 2003	FY 2004	FY 2005
C2 On-The-Move Enabling Technologies: This effort investigates technologies that enable course of action (COA) generation and analysis. In FY02, investigated a task expansion engine as a component within distributed analysis and visualization tool set for C4I to provide low level detail and synchronization data within a COA. Matured intelligent agents to enable linkage of different intelligent agents by action officers and end-users to provide enhanced C2 capabilities. Matured proper provisioning and filtering of information to support the commander in the decision making process. In FY03, expand and evaluate a robust tool set optimized for the commander and staff informational needs, capable of operating in a distributed environment, using a variety of structured and unstructured data sources; investigate bi-directional links between these tools, intelligent agents, and other analytical or course of action tools to provide an integrated tool suite for the command and staff. Complete on-going technology efforts and transition and integrate products and concepts into the Distributed Analysis Visualization Infrastructure for C4I (DaVinci) tool set. Create detailed design plan and C2 data framework/protocol design to test automated, knowledge-based capabilities enabling critical C2 situation awareness information retrieval and assessment and presentation in a manner that enhances the commander's ability to use remote unattended sensors and unmanned system assets. In FY04, investigate and evaluate the C2 data framework/protocol through low fidelity modeling and simulation, leverage ARL and DARPA robotic technologies, and mature C2 applications to enable systems management of these robotic elements. In FY05, integrate C2 data framework / protocol into a rudimentary C2 system and test it against a representation of unmanned networked sensors,model C2 applications to task sensor assets, receive a fused "Red" picture and network effects.	4310	5756	4298	4285
- Airborne Engineering Support: Conduct flight test evaluation for C4IEW systems.	485	482	566	664
Totals	7645	9221	8006	8367

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February 2003

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

COST (In Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H92	COMMUNICATIONS TECH	14485	11929	10722	10329	10452	10243	11060	11347

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 Objective 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 main effort of this project concentrates on Dynamic Readdressing and Management (DRAMA), Advanced Antennas, C4ISR OTM Demo, Soldier/Squad Level Communications, Networked Sensors for the Objective Force (NSfOF), and Free space Optical /Near-Optical Communications Systems (FOCUS). These programs focus on key areas of research include: Mobile wireless technologies for hostile mobile environments (FOCUS), and to meet the size, weight and power needs of the individual dismounted soldier (Soldier/Squad Level Comms); quality of service techniques that enable efficient, automatic bandwidth management for mobile, wireless networks (DRAMA); open systems designs for wideband networking waveforms; and mobile internet protocols operating across different networks; networking technologies that support unattended sensors with the ability to task unmanned sensors and transport data and images from them to data fusion points and tactical commanders(NSfOF Comms); research realistic models for emerging communications systems in dynamic field environments and network protection technologies. It leverages a variety of efforts including the DARPA Sensor Information Technology (SensIT) program as well as technologies developed by Army Research Laboratory. In addition, this project investigates tactical antenna technologies to reduce the number required, and increase the range and throughput; Ferroelectric materials for reduced cost wideband on-the-move phased array antennas; and technology to increase survivability by reducing the antenna visual signature. In FY02, this project also investigated technology to support C3 OTM Demo (63008/TR2), which provides early and continuing demonstrations of enhanced survivability and lethality of Future Combat Systems (FCS) platforms through the effective employment of an integrated C4ISR On-the-Move system.

This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

Accomplishments/Planned Program	FY 2002	FY 2003	FY 2004	FY 2005
Dynamic Readdressing and Management (DRAMA) – This effort investigates advanced networking protocols and management enabling robust on the move communications. In FY02, matured initial dynamic addressing protocols and network management software leading to the Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) interim demo. Designed, implemented, and performed laboratory evaluation of an Artificial-Intelligence (AI) based fault isolation decision aid system to inter-operate with mobile agents, resulting in more efficient network management capability. Enhanced fault isolation decision aid system for incorporation into C4ISR OTM demo to mitigate risk for FCS milestone B decision. In FY03, investigate dynamic addressing and IP multicast protocols, investigate Automated Net Management software to include on-the-move network components. In FY04, investigate intelligent agents and mobile agents software to operate with wireless OTM tactical network components. In FY05, investigate enhanced Automated Net Management tools to include integration with net management agents, enhance Intelligent agents and mobile agents to operate in wireless OTM tactical network environment, and scalability of dynamic readdressing and IP multicast protocols in large tactical OTM networks. 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.	2685	3677	4334	7229

Accomplishments/Planned Program (continued)	FY 2002	FY 2003	FY 2004	FY 2005
Advanced Antennas: In FY02 matured a low cost controller architecture for OTM multi-beam phased array antenna and investigated new controller tracking algorithms and a low cost antenna pointing system. This capability will enable automatic positioning of the antenna's beams on the intended satellite systems regardless of the vehicle's speed or position. In FY03, investigate low profile antennas for ground/rotary wing aviation platforms leveraging component technologies from conformal body borne antenna efforts to provide low observable antennas covering the 30-200MHz communication bands. Investigate the radio frequency (RF) radiation hazard safety assessments for the conformal body borne vest and helmet antennas to determine specific absorption rates (SAR) and safety compliance levels. In FY04, enhance and modify the modeling algorithms for Advanced Antennas to assess antenna design to include the body borne, low profile and multiband antennas, platform antenna placement, cosite interference mitigation, and complete human RF Safety Assessment. In FY05, investigate technologies for the Multi-beam Phased Array antenna to enable multi-mission simultaneous communications with the Global Broadcast System (GBS), Wide-band Gapfiller and MILSTAR satellite systems while on-the-move. Investigate technologies for a family of Rotary Wing Aircraft multi-band antennas, lightweight body borne antennas (helmet and vest), and low cost reconfigurable band switched antennas to comply with JTRS communications requirements for various ground and air platforms.	1400	2500	2167	1000
C4ISR OTM Demo - Conducted a technology selection across CERDEC, AMRDEC, ARDEC and DARPA programs. Matured integrated software (S/W), hardware (H/W), communication, and sensor architectures including 1.) Baseline wireless communication network (LAN / Voice) for the On-The-Move test-bed 2). Baseline Command and Control (C2) architecture for the OTM Test-bed. Integrated LSI input into the H/W, S/W and communications architectures.	5898	0	0	0
Soldier/Squad Level Communications: In FY02, Investigated and designed a SUO SAS modeled waveform for tactical radio communications in laboratory environment. In FY03, conduct performance trade-off and affordability analyses for Small Unit Operations Situational Awareness System (SUO SAS) tactical radio communications leading to a communications reference architecture supporting hardware and software portability to JTRS. In FY04, mature and integrate a scaleable (multi-band, multi-channel) RF front-end and programmable radio modem and link-layer intranet processor, Wideband Networking Waveform (WNW) hardware and software components with JTRS-compliant application programming interfaces.	1875	2600	788	0

Accomplishments/Planned Program (continued)	FY 2002	FY 2003	FY 2004	FY 2005
Free Space Optical/Near-Optical Communications (FOCUS) and Sensors Networking: In FY02, investigated sensor communications breadboard models in a limited (20 node) network with anti-jam (AJ), low probability of intercept (LPI), low probability of detection (LPD) and secure modes. Investigated adaptive optics based on 1.5 um Wavelength Division Multiplexing (WDM) system and topology control, CONOPS model based on ground/airborne links. Linked model incorporating adaptive optics, and commenced model architecture for tracking hardware for free space optical communications system. Performed limited integration of internet protocol quality of service and security into MOSAIC systems architecture. In FY03, extend FCS architecture to include maneuver layer interoperability to sensor communication relays and gateways under the Networked sensor for Objective Force (NSfOF) effort, investigate Comm-Node Effort for Terrestrial/Airborne System and investigate limited tracking using modulating retroreflector. Investigate advanced wireless network access control technologies. In FY04, refine sensor communications requirements; integrate protocols and waveforms into model hardware, commence design of subsystem including transmitter laser, tracking hardware, down conversion (extract data from laser) unit for FOCUS. In FY05, conduct early laboratory experiments to establish performance against program goals and evaluation criteria for NSfOF, and conduct laboratory demonstration emphasizing subsystem investigation for FOCUS.	2627	1745	3433	2100
Mobile Emergency Broadband System: The purpose of this one year congressional add is to investigate emerging wireless technology to enable rapidly deployable voice and data communications for connectivity between emergency personnel in the "hot zone" and to the command center. No additional funds are required to complete this project.	0	1407	0	0
Totals	14485	11929	10722	10329