

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

February 2002

BUDGET ACTIVITY
2 - Applied Research

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

COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
Total Program Element (PE) Cost	22987	24123	21821	22349	23519	24009	24609
779 C2 & PLAT ELEC TECH	9601	8022	10296	10348	11310	11639	11905
H92 COMMUNICATIONS TECH	13386	16101	11525	12001	12209	12370	12704

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. The intent is to provide the Army's Objective Force with enhanced capabilities for secure communications and assured information delivery and presentation. 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 minimize registration errors, and improvements to man-machine interfaces and decision aids for a network-centric battlefield environment. This PE will provide Objective Force field commanders the ability 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). 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), and PE 0603734A (Military Engineering Advanced 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 TCP.

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<u>B. Program Change Summary</u>	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2002 PB)	23101	24342	20290
Appropriated Value	23314	24342	0
Adjustments to Appropriated Value	0	0	0
a. Congressional General Reductions	0	-219	0
b. SBIR / STTR	-378	0	0
c. Omnibus or Other Above Threshold Reductions	0	0	0
d. Below Threshold Reprogramming	264	0	0
e. Rescissions	-213	0	0
Adjustments to Budget Years Since FY2002 PB	0	0	1531
Current Budget Submit (FY 2003 PB)	22987	24123	21821

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602782A - Command, Control, Communications Technology	PROJECT 779					
COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
779 C2 & PLAT ELEC TECH	9601	8022	10296	10348	11310	11639	11905

A. Mission Description and Budget Item Justification: This project researches and applies new concepts and techniques in C2 to achieve new and enhanced military functional capabilities. Emphasis is on mission planning, rehearsal, execution and monitoring; precision positioning and navigation; and C2 technologies to support the Objective Force. New enabling technologies that support the current thrusts are also explored, such as advanced displays, multi-modal interactive technology, visualization, decision aids and tactical planning tools, data transfer, distributed data bases, advanced open system architectures, and integration concepts which contribute to more mobile operations. The project serves as a direct technology feed to Advanced Warfighting Experiments (AWEs), Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations (ACTDs) and Defense Technology Objectives (DTOs), including the following: Logistics C2 (Log C2) ATD; Agile Commander ATD; Consistent Battlespace Understanding DTO; Forecasting, Planning, and Resource Allocation DTO; Integrated Force and Execution Management DTO; and Future Command Post Technologies DTO. This project supports the Objective Force transition path of the TCP.

FY 2001 Accomplishments:

- 2050 - Researched and lab-tested a real-time prototype of the navigation sensor/database registration error minimization algorithm.
- 2294 - Evaluated improved C2 protect capabilities in a virtual environment to support maturation and training for C2 protect capabilities.
- 323 - Researched, adapted and enhanced a prototype collaborative logistics planning capability that covers two logistics asset classes and operates within the emerging framework of the Defense Advanced Research Projects Agency's (DARPA) Advanced Logistics Project(ALP).
- 1800 - Conducted laboratory experiments of a squad-based collaborative planning software tool for whiteboarding, mapping and text collaboration; specified software intelligent agent architecture and tested mobile agent technology at the squad level; enhanced man-machine interface concepts through speech recognition and voice control integration of software applications; selected a portable testbed; evaluated concepts toward feasible solutions for smaller, lighter, energy efficient, soldier-worn computing systems. Concepts showed proof-of-principle improvement in battlespace SA and decision-making processes for commanders from battalion to squad levels.
- 2653 - Determined the upper-level knowledge-based interfaces for a distributed analysis and visualization infrastructure (DaVinci) for command, control, communications, computers and intelligence (C4I). Specified the initial critical requirements for course of action (COA) development and analysis, intelligent agents, information visualization, knowledge management, modeling and simulation, and adaptive applications
- 481 - Conducted flight test evaluation for command, control, communications, computers, intelligence, and electronic warfare (C4IEW) systems.

Total 9601

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FY 2002 Planned Program

- 1000 - Conduct lab test and prepare for field test, with a Battle Lab, PM or DARPA partner, to determine the benefit of GPS anti-jam, GPS pseudolite and navigation/electro-optic system integration technologies matured in the preceding two years.
- 1000 - Integrate brigade and above communications models in the core Distributed Interactive Simulation (DIS) Facilities (CDFs); conduct a distributed simulation at the Training & Doctrine (TRADOC) Analysis Center, Fort Leavenworth, KS using live troops and multiple sites to support maturation and training for integrated C2 protect capabilities; extend network and information operations security architecture to small unit operations by conducting virtual experiments using the modeling and simulation/stimulation capabilities in the CDFs.
- 1000 - Conduct proof-of-principle evaluation and laboratory tests of C2 applications at battalion to squad levels for mobile software agent SA, distributed battle planning and visualization, decision support aids, and human-machine interfaces through enhanced speech recognition.
- 4522 - Investigated a task expansion engine as a component within DaVinci to provide low level detail and synchronization data within a COA. Mature intelligent agents to enable linkage of different intelligent agents by action officers and end-users to provide enhanced C2 capabilities. Mature proper provisioning and filtering of information to support the commander in the decision making process.
- 500 - Conduct flight test evaluation for C4IEW systems.

Total 8022

FY 2003 Planned Program

- 1000 - Conduct field test, with a Battle Lab, PM or DARPA partner, to determine the benefit of GPS anti-jam, GPS pseudolite and navigation/electro-optic system integration technologies matured in the preceding three years.
- 2000 - Test, in the laboratory, a C2 SA subsystem for the dismounted tactical commander; conduct early user field experiment and assessment of the C2 SA subsystem and refine prototype hardware and software.
- 5156 - Investigate and test 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; develop 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 products and concepts into DaVinci, the primary software environment for the Agile Commander ATD.
- 754 - Create detailed design plan and C2 data framework/protocol design to test automated, knowledge-based capabilities enabling critical C2 SA information retrieval and assessment and presentation in a manner that enhances the commander's ability to use remote unattended sensors and unmanned system assets.

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FY 2003 Planned Program (Continued)

- 1386 - Conduct flight test evaluation for C4IEW systems.

Total 10296

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Technology**

PROJECT
H92

COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H92 COMMUNICATIONS TECH	13386	16101	11525	12001	12209	12370	12704

A. Mission Description and Budget Item Justification: This project researches and applies 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 maturation efforts on those areas not addressed by the commercial industry (e.g. mobile radio based infrastructures and backbones, security in narrowband environments, multiband OTM transmit and receive antennas, adaptive protocols and low probability of interception/low probability of detection (LPI/LPD)). Maximum use is made of the Dual Use Science & Technology (DUST) program through FY02. Key areas of research include: adaptation of mobile wireless technologies for hostile mobile environments; quality of service techniques for mobile wireless internet protocol (IP) and IP networks; the adaptation of and interface with commercial personal communications technology leveraging DARPA and commercial technologies for sensor networking; and development of realistic models for emerging communications services systems in dynamic field environments. In addition, this project investigates tactical antenna technologies; ferroelectric materials for phased array antennas; open systems design for wideband networking waveforms; and mobile internet protocols operating across different networks. This project also partially funds the communications networking for Network Sensors for the Objective Force (NSOF) ATD, to provide the Objective Force with the ability to task unmanned sensors and transport data and images from them to data fusion points and tactical commanders. NSOF will leverage a variety of efforts including the DARPA Sensor Information Technology (SensIT) program as well as technologies developed by Army Research Laboratory (ARL). These efforts directly support the information systems and DTOs outlined in the Defense Technology Area Plan. This program supports the Objective Force transition path of the TCP.

FY 2001 Accomplishments:

- 5352 - Conducted detailed technical assessment and high level design of mobile agent based dynamic addressing algorithms and protocols, dynamic network constitution and reconstitution algorithms, and protocols for tactical survivable dynamic mixed networks.
- Designed a distributed network management architecture, using intelligent "super agents" for semi-automated end-to-end network management, targeted for the lower Tactical Internet (TI) and Objective Force.
- Tested JTRS multiband OTM antenna prototypes and downselected to three promising designs.
- Continued maturation of the Ka band subarray, for wideband on-the-move affordable antenna.
- Successfully fabricated and tested positioner/tracker for EHF OTM low profile antenna.
- Achieved TRL 4 for VHF prototype soldier body borne antenna into soldier's vest; and reduced size and weight of L Band helmet array antenna.

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FY 2001 Accomplishments: (Continued)

- 2277 - Characterized performance of Broadband Antennas on Soldier Platform for wearable and chassis mounted installations.

- Conducted sensor communications needs analysis and developed sensor communications architecture for Network Sensors for the Objective Force ATD. Investigated DARPA Global Mobile (GloMo) and Small Unit Operations (SUO) protocols and waveforms for applicability to extreme low power conditions required by unmanned sensor communication networks.

- Assessed Information Dissemination Management-Tactical (IDM-T) architecture and implemented Defense Information Systems Agency (DISA) dissemination tools into an Army beta solution; transitioned to Program Executive Office (PEO) Command, Control & Communications Systems (C3S) .

- Researched architecture and first order evaluation of adaptive optics for laser communications over 1 mile airpath.
- 5757 - Evolved protection techniques for the tactical networks with focus on automated security management. Improved host based intrusion detection, lowered false alarm rate, enhanced alarm reporting framework for tactical networks, and provided security passphrase design.

- Continued ongoing analysis of SUO/Situational Awareness System (SAS) design to support technology for JTRS software communications architecture; complete in FY02.

- Acquired DARPA SUO/SAS engineering models for independent government tests and evaluation in laboratory and modeling environments.

- Validated SUO/SAS radio frequency (RF) communications agility, network formation and routing manager functions, modem adaptability, and featureless waveform cover in laboratory environment.

- Matured wireless radio chip breadboard for application to dismounted soldier interface.

- Continued analysis of peer-to-peer waveforms integrated into a secure personal communication system (PCS) handset.

- Evolved IP Quality of Service (QoS) implementation to provide multihop wireless communications across dissimilar networks.

Total 13386

FY 2002 Planned Program

- 5134 - Evolve and verify the design of the active networks and mobile agent based dynamic re-addressing protocols and algorithms. Conduct analytic modeling, emulation and simulation to fully assess the proposed dynamic re-addressing protocols and algorithms.

- Research an intelligent system that reasons based upon data supplied by mobile agents and security management tools. This will provide the tactical network manager with assistance and suggested courses of action with respect to fault analysis, performance, configuration and security. Target environments are the Objective Force.

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PROJECT
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FY 2002 Planned Program (Continued)

- Conduct an RF safety assessment of body borne antennas and mature slow wave spiral antenna technologies to achieve antenna size reduction with substantial bandwidth.
- Complete maturation and evaluation of an X band subarray.
- Complete maturation (fabrication and test) of the single beam K band (20GHz) receive subarray.
- Begin maturation (design and initial fabrication) of a three beam K band (20 GHz) receive phased array antenna; apply thin film ferroelectric technology to reduce phase shifter losses in K band phased array antenna.
- Investigate JTRS On-the-Move (OTM) airborne multiband antenna options.
- Create and test JTRS OTM multiband, ground vehicle antenna prototype brassboards.
- 1528 - Extend sensor communications architecture to include maneuver layer interoperability including relays and gateways.
- Refine sensor communications requirements; integrate protocols and waveforms into prototype hardware.
- Conduct early laboratory experiments to establish performance against program goals and evaluation criteria.
- Mature a subsystem design for adaptive optics communications.
- 4439 - Evolve protection techniques for the tactical networks with emphasis on data mining and security event cross correlation.
- Complete analysis of SUO/SAS design for applicability to JTRS. Begin independent government test and evaluation in lab and field environments of SUO/SAS engineering model units; integrate with MOSAIC ATD FY02 demonstration.
- Evaluate wireless radio chip breadboard and conduct lab test for application to dismounted soldier.
- Evaluate PCS and peer-to-peer Universal Handset breadboard and demonstrate in laboratory environment.
- Complete maturation and begin integration of IP QoS into Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) systems architecture.
- 5000 - Integrate multiple networking and wireless technologies into a coherent mobile architecture for demonstration of C3 on the move capabilities to support the Army Transformation decision.

Total 16101

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PROJECT
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FY 2003 Planned Program

- 6403 - Implement dynamic re-addressing protocols and algorithms and evaluate in a lab environment.
 - Demonstrate, an automated self-healing network capability that can reconfigure network elements, to overcome failures caused by network anomalies, via automated means in a limited field environment.
 - Research a safety approved body borne antenna design.
 - Complete dual beam Ka band phased array antenna.
 - Fabricate JTRS OTM multiband antenna (airborne).
- 1270 - Validate sensor communications breadboard models in a limited network with anti-jam (AJ), low probability of intercept (LPI), low probability of detection (LPD) and secure modes.
 - Test adaptive optics communications in a Subsystem Lab environment.
 - Assess and evaluate DARPA fault tolerance and intrusion tolerance technologies.
- 3852 - Complete trade-off analysis of SUO/SAS wideband networking waveform technologies/components and develop system-on-a-chip/board design to reduce size, weight, and power for Objective Force Warrior networking digital radio.
 - Conduct breadboard implementation of SUO/SAS design optimization and size, weight, and power design changes.

Total 11525