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

**June 2001**

| BUDGET ACTIVITY | PE NUMBER AND TITLE |
|---|---|
| **2 - APPLIED RESEARCH** | **0602782A - Command, Control and Communications Technology** |

| COST (In Thousands) | FY 2000 Actual | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element (PE) Cost | 19185 | 23101 | 24342 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 779   C2 & PLAT ELEC TECH | 7569 | 9735 | 8095 | 0 | 0 | 0 | 0 | 0 | 0 | 70 |
| H92   COMMUNICATIONS TECH | 11616 | 13366 | 16247 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## A. Mission Description and Budget Item Justification:

**PLEASE NOTE:  This administration has not addressed FY2003-2007 requirements.  All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

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 system (e.g. man-machine interface, mobility, security, capacity, safety, reliability, and survivability) for both air and ground platforms to include 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 (ASTMP), the Army Modernization Plan, and Project Reliance.  Work in this PE is related to and fully coordinated with efforts in PE 0603006A (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 (CECOM), Fort Monmouth, NJ.

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Exhibit R-2
Budget Item Justification

| BUDGET ACTIVITY | PE NUMBER AND TITLE |
| --- | --- |
| **2 - APPLIED RESEARCH** | **0602782A - Command, Control and Communications Technology** |

| **B. Program Change Summary** | FY 2000 | FY 2001 | FY 2002 | FY 2003 |
| --- | --- | --- | --- | --- |
| Previous President's Budget (FY2001 PB) | 19519 | 23314 | 20796 | 0 |
| Appropriated Value | 19613 | 23314 | 0 | |
| Adjustments to Appropriated Value | 0 | 0 | 0 | |
| a. Congressional General Reductions | 0 | 0 | 0 | |
| b. SBIR / STTR | -334 | 0 | 0 | |
| c. Omnibus or Other Above Threshold Reductions | -51 | 0 | 0 | |
| d. Below Threshold Reprogramming | 0 | 0 | 0 | |
| e. Rescissions | -43 | -213 | 0 | |
| Adjustments to Budget Years Since FY2001 PB | 0 | 0 | 3546 | |
| Current Budget Submit (FY 2002/2003 PB ) | 19185 | 23101 | 24342 | 0 |

Change Summary Explanation:  Funding - FY 2002: Additional funds (+5000) were added for command and control on-the-move technology development.

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Exhibit R-2
Budget Item Justification

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit) | June 2001

| BUDGET ACTIVITY<br>**2 - APPLIED RESEARCH** | PE NUMBER AND TITLE<br>**0602782A - Command, Control and Communications Technology** | PROJECT<br>**779** |
|---|---|---|

| COST  (In Thousands) | FY 2000 Actual | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| 779     C2 & PLAT ELEC TECH | 7569 | 9735 | 8095 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**A. Mission Description and Budget Item Justification:** This project researches and applies new concepts and techniques in C2 to achieve new and enhance 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 Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 1049 - Evaluated Global Positioning System (GPS) enhancement technologies (e.g., advanced filters, low power clocks, advanced antennas) and prepared for the testing and evaluation of these technologies in air and ground platforms.  Concluded simulation of navigation system/database registration error minimization.

- 4881 - Matured a common operating environment (COE) compliant 3D visualization capability for the First Digitized Division (FDD); matured a next generation graphics terrain engine for future battlespace visualization applications.

   - Matured course-of-action (COA) enhancements, including optimization routines and forecasting; transitioned to the Battlespace C2 ATD and the Agile Commander ATD the initial increment of mobile/autonomous intelligent agents to support hasty planning and COA analysis.

   - Integrated voice recognition and natural language processing (NLP) into the collaboration environment; matured techniques to speed up the donor enrollment process for speech recognition.

- 698 - Integrated a C2 attack simulator with CECOM's Digital Integration Laboratory (DIL) and core distributed interactive simulation (DIS) facilities (CDFs); conducted a distributed simulation to support development and training for integrated C2 protect capabilities.

- 485 - Matured future C2 information and process models in support of the Agile Commander ATD.

- 456 - Matured an experimentation plan and testbed environment to evaluate future C2 needs of tactical commanders from battalion through platoon.

Total   7569

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - APPLIED RESEARCH** | **0602782A - Command, Control and Communications Technology** | **779** |

**FY 2001 Planned Program**

- 2050 - Mature and lab-test a real-time prototype of the navigation sensor/database registration error minimization algorithm.

- 2294 - Evaluate improved C2 protect capabilities in a virtual environment to support maturation and training for C2 protect capabilities; integrate brigade and above communications models; conduct a distributed simulation using live troops and multiple sites to support maturation and training for integrated C2 protect capabilities.

- 310 - Mature, adapt and enhance 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 - Conduct laboratory and field experiments with candidate collaborative planning, tactical display, and man-machine interface concepts, built within a portable testbed; evaluate concepts toward feasible solutions for smaller, lighter, energy efficient, and software reprogrammable applications. Concepts will show proof-of-principle improvement in battlespace SA and decision-making processes for commanders from battalion to squad levels

- 2653 - Determine the upper-level knowledge-based interfaces for a distributed analysis and visualization infrastructure for C4I (DaVinci). Specify the initial critical requirements for COA development and analysis, intelligent agents, information visualization, knowledge management, modeling and simulation, and adaptive applications.

- 482 - Conduct flight test evaluation for command, control, communications, computers, intelligence, and electronic warfare (C4IEW) systems.

- 146 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9735

**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 to situation awareness of GPS anti-jam, GPS pseudolite and navigation/electro-optic system integration technologies matured in the preceding two years.

- 1000 - 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 of C2 applications at battalion to squad levels for knowledge-based situational awareness, course of action development, distributed battle planning and visualization, decision support aids, and human-machine interfaces.

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C2 & PLAT ELEC TECH

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Exhibit R-2A  
Budget Item Justification

| BUDGET ACTIVITY<br>**2 - APPLIED RESEARCH** | PE NUMBER AND TITLE<br>**0602782A - Command, Control and Communications Technology** | PROJECT<br>**779** |

**FY 2002 Planned Program (Continued)**

- 4595    - Mature 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  8095

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Exhibit R-2A
Budget Item Justification

| ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit) | | June 2001 |
|---|---|---|

| BUDGET ACTIVITY<br>**2 - APPLIED RESEARCH** | PE NUMBER AND TITLE<br>**0602782A - Command, Control and Communications Technology** | PROJECT<br>**H92** |
|---|---|---|

| COST  (In Thousands) | FY 2000 Actual | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| H92      COMMUNICATIONS TECH | 11616 | 13366 | 16247 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**A. Mission Description and Budget Item Justification:** This project researches and applies communications and network technologies required 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, low probability of interception/low probability of detection).  Maximum use is made of the Dual Use Science & Technology (DUST) program.  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; photonic controls and ferroelectric materials for phased array antennas; and mobile internet protocols operating across different networks.  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 Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**
- 4864    - Integrated, assessed, prototyped, tested in testbed, and documented enhanced dynamic resource allocation based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multimedia systems using emulated airborne base stations.

    - Integrated, assessed, prototyped, tested in lab testbed, and documented enhanced IP multicasting, IP over asynchronous transfer mode (ATM) multicasting protocols for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers.

    - Matured an intelligent IP reachability capability for network management that determines root source of network failures.  Transitioned this capability to the Joint Contingency Force (JCF) Brigade Subscriber Node (BSN).

    - Designed advanced intelligent modules that inter-operate with fielded network node managers and conducted field-testing.

    - Designed very high frequency (VHF)/ultra high frequency (UHF) band for the body borne antenna concept/technologies in support of potential dismounted applications.

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COMMUNICATIONS TECH

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Exhibit R-2A
Budget Item Justification

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - APPLIED RESEARCH** | **0602782A - Command, Control and Communications Technology** | **H92** |

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**FY 2000 Accomplishments (Continued)**

- Matured an extremely high frequency (EHF) OTM satellite communications (SATCOM) antenna self-steering positioner/tracker.

- Identified JTRS multiband OTM antenna prototypes.

- Completed design and initial development of a communications OTM phased array antenna using reduced cost techniques.

- Modeled and simulated photo injection pin diode switch off-state capacitance effects upon the voltage standing wave ratio (VSWR) performance of a structure tuned VHF folded monopole antenna.

- 1791    - Completed transition of virtual simulations and performance transition models to Common Modeling Environment (CME) to facilitate model enhancements for evolving digitized communications in the Objective Force.

- 4961    - Matured protection techniques for the tactical internet with emphasis on malicious code detection and eradication.

- Established a small unit operations/situational awareness system (SUO/ SAS) system environment to support the analysis and evaluation of advanced prototypes.

- Matured future generation dismounted soldier personal communications under DARPA SUO/SAS program. Continued maturation of technology transition strategies to JTRS ground forces domain (handheld and dismounted warrior configurations). Matured a universal handset architecture/design.

- Tested and evaluated advanced wireless mobile networking protocols for dismounted soldier personal communications using laboratory test and field experiment environments. Implemented networking protocols in computer modeling and simulation environment for evaluation of system scalability and performance issues. Demonstrated peer-to-peer and multihop relaying capabilities in laboratory and field experiments.

- Analyzed and evaluated design and engineering approaches for reducing power, weight and size requirements while improving performance of future generation dismounted soldier personal communications.

- Assessed, characterized, and matured DARPA Global Mobile (GloMo) network protocol routing algorithms.

- Identified JTRS software communications architecture for SUO SAS design to support technology transition.

- Evaluated the developmental broadband antennas (800-2500 MHz) for a body borne application to validate modeling and simulation analysis.

- Used modeling and simulation to evaluate specific absorption radiation and gain pattern analysis for body borne antennas.

Total 11616

| BUDGET ACTIVITY<br>**2 - APPLIED RESEARCH** | PE NUMBER AND TITLE<br>**0602782A - Command, Control and Communications Technology** | PROJECT<br>**H92** |
|---|---|---|

**FY 2001 Planned Program**

- 5352    - Conduct 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.

     - Design 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.

     - Test JTRS multiband OTM antenna prototypes.

     - Complete maturation and evaluation of an X-band subarray. Mature Ka band subarray.

     - Fabricate and test positioner/tracker for EHF OTM low profile antenna.

     - Conduct test of prototype soldier body borne antenna; expand the frequency of low band (20-120MHz) antenna; reduce size and weight of helmet array antenna.

- 2277    - Conduct sensor communications requirements analysis. Investigate DARPA GloMo and SUO protocols and waveforms for applicability to extreme low power conditions required by unmanned sensor communication networks.

     - Mature architecture and implement Defense Information Systems Agency (DISA) dissemination tools into an Army beta solution.

     - Mature architecture and first order evaluation of adaptive optics for laser communications over 1 mile airpath.

- 5505    - Evolve protection techniques for the TI with focus on automated security management.

     - Analyze JTRS software communications architecture for SUO/SAS design to support technology transition and complete SUO/SAS technology transition plan.

     - Conduct independent government test and evaluation in laboratory and modeling environments of SUO/SAS engineering models.

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

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

     - Mature personal communication system/ mobile support system (PCS/MSS) breadboard of universal handset technology.

     - Mature broadband body borne antenna and mid-band (250-800 MHz) log periodic dipole array on artificial magnetic conductor substrate.

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

- 232    - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 13366

| BUDGET ACTIVITY<br>**2 - APPLIED RESEARCH** | PE NUMBER AND TITLE<br>**0602782A - Command, Control and Communications Technology** | PROJECT<br>**H92** |
|---|---|---|

**FY 2002 Planned Program**

- 5134    - Evolve and ensure proper operation of 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.

  - Mature 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 TI and Objective Force.

  - Conduct an RF safety assessment of body borne antennas and mature slow wave spiral antenna technologies to achieve antenna size reduction with substantial bandwidth.

  - Mature a dual beam Ka band phased array antenna; apply thin film ferroelectric and micro electronic mechanical system (MEMS) technologies to reduce phase shifter losses in Ka band phased array antenna.

- 1674    - 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 internet with emphasis on data mining and security event cross correlation.

  - Complete JTRS software communications architecture analysis for SUO/SAS design to support technology transition. Upgrade SUO/SAS engineering model units to final prototype configuration and begin independent government test and evaluation in lab and field environments.

  - Conduct SUO/SAS system-level performance test and evaluation in lab and field environments.

  - Evaluate wireless radio chip breadboard and conduct lab test for application to dismounted soldier.

  - Evaluate Personal Communications System (PCS) and Mobile Satellite Services (MSS) breadboard and demonstrate universal handset technology in laboratory environment.

  - Complete maturation and begin integration of IP QoS into Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) systems architecture.

- 5000    - Develop low latency communications for line-of-sight and beyond line-of-sight C2 on-the-move for multi-functional networked manned and robotic platforms.

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

**June 2001**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **2 - APPLIED RESEARCH** | **0602782A - Command, Control and Communications Technology** | **H92** |

**FY 2002 Planned Program (Continued)**

  - Develop three dimensional real time line-of-sight and beyond line-of-sight sensor to shooter LPI/LPD communications network modeling and simulation for manned and robotic vehicle communications to support C2 on-the-move.

Total 16247

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COMMUNICATIONS TECH

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