

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2004

BUDGET ACTIVITY

3 - Advanced technology development

PE NUMBER AND TITLE

0603008A - Electronic Warfare Advanced Technology

| COST (In Thousands) | | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---------------------------------|------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Total Program Element (PE) Cost | | 28662 | 59170 | 41760 | 47260 | 49687 | 42494 | 44950 |
| TR1 | TAC C4 TECHNOLOGY INT | 13883 | 12245 | 17840 | 22908 | 25174 | 15864 | 16208 |
| TR2 | DIGITAL BATTLEFLD COMM | 14779 | 37443 | 23920 | 24352 | 24513 | 26630 | 28742 |
| TR8 | C3 DEMONSTRATIONS (CA) | 0 | 9482 | 0 | 0 | 0 | 0 | 0 |

A. Mission Description and Budget Item Justification: The name of this program element (PE) was changed in FY03 to Command, Control, and Communications Advanced Technology. The goal of this PE is to provide a secure, mobile, wireless network that operates in diverse and complex terrain all the time, in all environments for the Army's Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Technologies will be matured in this PE to address this challenge with distributed, mobile, secure, self-organizing communications networks. A key goal of the work is to demonstrate the capability to seamlessly integrate communications technologies across all network tiers, ranging from unattended networks and sensors, through maneuver elements and airborne/space assets. To accomplish the goal this PE will investigate and leverage external communication technologies and combine technology options in a series of annual Command, Control, Communications, and Computers Intelligence, Surveillance and Reconnaissance (C4ISR) On-The-Move (OTM) demonstrations to measure the battlefield effectiveness for Future Combat Systems (FCS) and the Future Force. This PE also provides: protection technologies for tactical wireless networks against modern network attacks; smart communication technologies to network and control unmanned systems anywhere on the battlefield enabling timely sensor-decider-engagement linkage to defeat critical targets; advanced antenna technologies for greater communications mobility, range and throughput; and automated network management aids. Several tasks are conducted in conjunction with the Defense Advanced Research Projects Agency (DARPA) and the other Services. Adaptive Joint C4ISR Node (AJCN) Advanced Concept Technology Demonstrations (ACTD) makes a significant contribution to this program by providing critical links in the ability to communicate and move large amounts of information across the force structure in a seamless, integrated manner conducive to a highly mobile force spread over wide areas.

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). It is related to, and fully coordinated with, efforts in PE 0602782A (Command, Control and Communications Technology), PE 0203740A (Maneuver Control Network), PE 0203726A (Advanced Field Artillery Tactical Data Network), PE 0602783A (Computer and Software Technology), PE 0602702E (Tactical Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and PE 0603789F (C3I Technology Development). Work is performed by the Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

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| <u>B. Program Change Summary</u> | FY 2003 | FY 2004 | FY 2005 |
|---|----------------|----------------|----------------|
| Previous President's Budget (FY 2004) | 26931 | 40347 | 41982 |
| Current Budget (FY 2005 PB) | 28662 | 59170 | 41760 |
| Total Adjustments | 1731 | 18823 | -222 |
| Congressional program reductions | | -554 | |
| Congressional rescissions | | | |
| Congressional increases | | 19600 | |
| Reprogrammings | 1731 | -223 | |
| SBIR/STTR Transfer | | | |
| Adjustments to Budget Years | | | -222 |

Significant Change Explanation.

FY04 - Four FY04 Congressional adds totaling \$19600 were added to the PE.

FY04 Congressional Adds with no R-2A:

(\$5369) Networking Environment for C3 Mobile Services (NECMS), Project TR8: The purpose of this one year Congressional add is to demonstrate a field communication system for mobility testing and the phased implementation of an automated Data Collection/Sensor architecture for rapid assessment of developing C4 systems. No additional funds are required to complete this project.

(\$2876) Portable Emergency Broadband Systems, Project TR8: The purpose of this one year Congressional add is to mature an in-building position location capability, and reduce the hardware size for increased portability. No additional funds are required to complete this project.

(\$960) Galaxy Vue Image, Video and Data Compression Technology, Project TR8: The purpose of this one year Congressional add is to demonstrate near/real time video compression technology to enable real-time high resolution, live feed of tactical data/video for dismounted Soldiers and Unmanned Aerial Vehicles. No additional funds are required to complete this project.

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0603008A - Electronic Warfare Advanced Technology

PROJECT

TR1

| COST (In Thousands) | | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---------------------|-----------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| TR1 | TAC C4 TECHNOLOGY INT | 13883 | 12245 | 17840 | 22908 | 25174 | 15864 | 16208 |

A. Mission Description and Budget Item Justification: This project matures key communications, mobile networking, and information assurance technologies for the Dismounted Soldier; Future Combat Networks, embedded network communications, and the Future Force. The project enables commanders and individual soldiers to survive and fight by providing secure, reliable, mobile communications network solutions that function in complex and diverse terrain. The Soldier/Squad-Level Communications program will leverage and mature the DARPA Small Unit Operations Situation Awareness System (SUO SAS) communications technology to provide a Joint Tactical Radio System (JTRS) Software Communications Architecture (SCA) compliant waveform. This effort addresses the size, weight and power issues for sensors, network munitions, and dismounted soldier communications. The Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) program matures and demonstrates Quality of Service and resource allocation technologies for the network. The Multi-Dimensional Assured, Robust, Communications for an OTM (MARCON-I) Network effort matures and integrates directional networking technologies that address the barriers of insufficient bandwidth and limited spectrum to provide the warfighter with a robust, efficient, high capacity Anti-Jam Low Probability of Intercept (AJ/LPI) directional communications network. The On-The-Move (OTM) SATCOM and Advanced Antennas programs utilize protocols developed in the MOSAIC effort. OTM SATCOM enables mobile satellite communications through the application of blockage mitigation algorithms, thus enabling a robust reachback capability and a reduced in theatre footprint. Advanced Antennas matures a family of efficient and affordable antennas across a wide spectrum (30 MHz to 44 GHz) for increased throughput and range. This will include a robust and dynamic reachback capability to enable Global Information Grid (GIG) connectivity. The Tactical Wireless Network Assurance program provides network protection for mobile wireless ad hoc networks and provides safeguards against modern network attacks. It provides network assurance through enhanced net access controls. It also focuses on Wireless Intrusion Detection to detect unauthorized access attempts. The program matures and demonstrates mobile data security solutions and protection of secure database elements. The National Security Agency provides management of these critical security components that provide centralized remote control and visualization of network security health.

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 Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

| ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit) | | February 2004 | | |
|---|--|--|---------|----------------|
| BUDGET ACTIVITY 3 - Advanced technology development | | PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology | | PROJECT TR1 |
| <u>Accomplishments/Planned Program</u> | | FY 2003 | FY 2004 | FY 2005 |
| - MOSAIC ATD: In FY03, enabled and participated in the FCS Lead System Integrator (LSI) field demo of scaleable mobile networks with enhanced Quality of Service (QoS) at the C4ISR testbed. Conducted laboratory demonstration of the integration of the bandwidth adapting protocols, voice over Internet Protocol (IP), IP QoS, mobile networking protocols and communications technologies. Enhanced and modified MOSAIC communications and mobile ad-hoc networking protocols to support self organized wireless 15-20 node cluster with QoS (specified by latency, delayed jitter, and bit error rate). Integrated and evaluated enhanced mobile networking protocols and end-to-end quality of service mechanisms in a laboratory/field environment. Demonstrated robust wireless network access controls with validation on three mobile nodes to mitigate wireless intrusions attacks close to 60% of the time. Conducted research to detect intrusions into mobile tactical networking environment. In FY04, demonstrate ad hoc mobility, reduced network initialization and recovery time, in a 20-25 node wireless OTM network with 56kbps-3 Mbps. Perform integration of all MOSAIC networking and QoS technologies. Model and demonstrate the integrated network with an airborne node, space based assets, and terrestrial networks. | | 8000 | 6969 | 0 |
| - Soldier/Squad-Level Communications: In FY04, mature lightweight Joint Tactical Radio System (JTRS) Core Framework to support Soldier Radio Waveform insertion into JTRS Cluster 1 and 5 configurations based upon DARPA Small Unit Operations Situation Awareness System (SUO SAS) technology. Perform laboratory test and functional design verification. Produce network-on-chip design of a dual channel modem. In FY05, will perform initial validation of Software Communications Architecture compliance of Soldier Radio Waveform and integrate into software programmable radio prototype. Will mature a re-programmable Application Specific Integrated Circuit (ASIC) (Network-on-a-Chip) implementation for modem and networking processor components and integrate in laboratory brassboard environment to demonstrate size, weight, and power consumption reduction for Objective Force Warrior communications. | | 0 | 1500 | 8550 |
| - OTM SATCOM: In FY03, matured and demonstrated Wideband OTM blockage mitigation protocol for rapid recovery from signal blockage due to buildings, foliage, etc. Completed field-testing of Milstar OTM narrowband blockage mitigation protocol in a variety of field environments. Used Milstar OTM terminal to characterize representative field environments and to validate assumptions used in protocol design and modeling and simulation. In FY04, integrate Wideband OTM capability into the FY04 MOSAIC ATD and C4ISR Testbed demonstrations, integrate blockage mitigation algorithms and demonstrate them on CERDEC/SPAWAR Ka-band OTM Terminal. Mature Milstar OTM blockage mitigation approach for networks of MILSTAR terminals. | | 2849 | 1968 | 0 |

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

February 2004

BUDGET ACTIVITY

3 - Advanced technology development

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0603008A - Electronic Warfare Advanced Technology

PROJECT

TR1

Accomplishments/Planned Program (continued)

- Advanced Antennas: In FY03, matured technologies that reduced the number of antennas and the visual signature for a ground vehicular Joint Tactical Radio System (JTRS) Network Multiband OTM antenna covering the 30 to 2500 MHz frequency band. In FY04, demonstrate reduction in interference caused by collocation of equipment on the same vehicle (also known as cosite) for reconfigurable VHF antenna and reduce three beam phased array receive antenna signature. In FY05, will perform technical evaluation and integration for: (1) Multibeam Phased Array antenna technologies, maintain simultaneous multibeam OTM links over rolling terrain; (2) multiband antennas for rotary wing platforms, reduce range degradation due to cosite interference and platform interactions; (3) body borne helmet and vest antennas (at a 1 to 5 Km range) and perform RF assessment to ensure integration of environmental/ radiation safety; (4) Multiband reconfigurable band switched antenna technologies, tuned IAW JTRS interface operating between 30-450 MHz with reduction in cosite interference; (5) Low Profile antennas on ground and rotary wing platforms with reduced visual signature at 300 ft.

FY 2003

870

FY 2004

1000

FY 2005

3000

- Tactical Wireless Network Assurance (TWNA): In FY03, developed network assurance mechanisms to deter intruders and recognize attempts to attack/exploit mobile wireless systems and networks. In FY05, will mature and test advanced network assurance via Tactical Public Key Infrastructure (PKI, a secure protocol) on dynamic wireless ad hoc networks. Will expand wireless intrusion detection to detect cyber attacks against distributed mobile hosts and networks that exploit mobile wireless protocols more than 60% of the time. Will mature and test database access control and authentication of mobile data elements that restrict unauthorized modification to mobile code. Will mature and perform laboratory testing of adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time. Other work related to this project is performed under PE 63606 project 608 and PE 63270 project K16.

2164

0

2795

- Multi-Dimensional Assured, Robust, Comms for OTM Network (MARCON-I): In FY04, begin architecture design trades and technology analysis for directional networking. Leverage DARPA FCS-Communications program for directional networking technologies and extend these technologies to work as a JTRS Software Communications Architecture compliant waveform. In FY05, will begin system design and waveform development of a directional networking capability. Will conduct Modeling & Simulation (M&S) to support directional networking waveform development. Will conduct evaluation of QoS policy management technologies.

0

500

3495

Small Business Innovative Research/Small Business Technology Transfer Programs

0

308

0

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|---|--|---|---------|-----------------------|
| BUDGET ACTIVITY 3 - Advanced technology development | | PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology | | PROJECT TR1 |
| <u>Accomplishments/Planned Program (continued)</u> | | FY 2003 | FY 2004 | FY 2005 |
| Totals | | 13883 | 12245 | 17840 |
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603008A - Electronic Warfare Advanced Technology

PROJECT
TR2

| COST (In Thousands) | | FY 2003 Actual | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | FY 2008 Estimate | FY 2009 Estimate |
|---------------------|------------------------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| TR2 | DIGITAL BATTLEFLD COMM | 14779 | 37443 | 23920 | 24352 | 24513 | 26630 | 28742 |

A. Mission Description and Budget Item Justification: This project matures and demonstrates an integrated C4ISR On-The-Move (OTM) (sensor to shooter) capability for Future Combat Systems (FCS), the Future Force, and where feasible, exploits opportunities to enhance Current Force capabilities. It seeks to provide the ability to move large amounts of data over extended ranges with minimal infrastructure, tying in networks of unattended sensor fields. The efforts here concentrate on two major goals: provide a series of technology demonstrations of C4ISR capabilities to significantly reduce the risk associated with the networks of networks approach to the FCS integrated on-the-move lethal force structure; and provide critical links in the ability to communicate and move large amounts of information across the force structure in a seamless, integrated manner conducive to a highly mobile manned and unmanned force structure. Three key programs support the second goal: 1) Adaptive Joint C4ISR Node (AJCN) ACTD for mobile airborne communication nodes; 2) Network Sensors for the Future Force (NSFF) Communications solution, enabling adaptable, self healing, low power, integrated communication nodes for unmanned sensor networks and 3) Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC), providing mobile protocols and seamless handoff (quality of service addressed in TR-1) capabilities to ensure the right information at the right time at the right place. The C4ISR OTM test bed provides a venue for the early demonstration of emerging C4ISR technologies that will increase the survivability and lethality of FCS platforms. The demonstrations will expand both the functionality and complexity of the integrated C4ISR system-of-systems, including the participation of Joint, Current, and dismounted elements and provides an evolutionary view of integrated C4ISR functionality and its impact on Battlefield Effects. AJCN ACTD seeks to provide assured communications for UoA. It provides critical links in the ability to communicate and move large amounts of information across the force structure in a seamless, integrated manner conducive to a highly mobile force spread over wide areas. AJCN also has the capability to perform signals intelligence, information warfare and electronic attack missions simultaneously. AJCN matures technology under the DARPA Adaptive C4ISR Node program and leverages Joint Service funds from OSD, DARPA and the Air Force. AJCN started in FY03 with Army contributions commencing in FY04. The AJCN will host communications waveforms (JTRS compliant) for extended range voice and data and enable interoperability between different types of radio platforms. It also enables data to be relayed between deployed manned/unmanned sensors and decision makers. The NSFF Communications improves survivability by networking unattended sensors for real time local situation awareness and targeting. Several efforts enable efficient routing and low power ad-hoc communications for the sensor suite, including the DARPA Small Unit Operations (SUO) and Sensor Information Technology (SensIT) programs as well as technologies matured by the Army Research Laboratory (ARL). The MOSAIC ATD facilitates battle command mobility, by providing multiple wireless solutions and seamless handoff to different networks for user flexibility in varied terrain over wide areas with improved network robustness.

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 Communications-Electronics Research Development and Engineering Center (CERDEC), Fort Monmouth, NJ, and the Army Research Laboratory, Adelphi, MD.

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BUDGET ACTIVITY

3 - Advanced technology development

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|---|------------|
| PE NUMBER AND TITLE | PROJECT |
| 0603008A - Electronic Warfare Advanced | TR2 |

TR2

| Accomplishments/Planned Program | FY 2003 | FY 2004 | FY 2005 |
|---------------------------------|---------|---------|---------|
|---------------------------------|---------|---------|---------|

12659

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|--|--|--|---------|----------------|
| BUDGET ACTIVITY 3 - Advanced technology development | | PE NUMBER AND TITLE 0603008A - Electronic Warfare Advanced Technology | | PROJECT TR2 |
| Accomplishments/Planned Program (continued) | | FY 2003 | FY 2004 | FY 2005 |
| - AJCN ATCD: In FY04, design and integrate a multifunction aerial payload capability (increase data throughput from 288 to 900 kbps with range extension form 20 to 30 km) that provides integrated communications relay, signals intelligence (SIGINT), electronic warfare and information operations capabilities. Perform modeling and simulation of payload performance to mitigate risk in technology maturation. Conduct interim Joint Military Utility Assessment. Integrate MOSAIC ATD networking communications capabilities so that range extension and continuous coverage between disparate units can be achieved. Host software defined radio (JTRS compatible) waveforms, demonstrating voice and data interoperation between different types of radio platforms (from 3 to 9 waveforms). Enable data to be relayed between deployed manned/unmanned sensors and the users of that data. Integrate capability into both Army (2 Hunter with payload of 200lbs or less) and Air Force (2 KC-135) platforms to demonstrate scalability of capability. In FY05, will conduct joint military utility assessment of technology. Will demonstrate increased bandwidth and frequency range operating at multiple independent levels of security. Will integrate Ku band transmitter into platform payload. Will incorporate additional software defined radio waveforms such as tactical common data link and HAVEQUICK. Will mature interference cancellation, co-site channel interference, and SIGINT capabilities. Will conduct technical assessment to verify metrics are met and participate in Joint Forces Command exercises to demonstrate the capability on the operational platforms in the field environment. | | 0 | 10000 | 7000 |
| - MOSAIC ATD: In FY03, MOSAIC ATD integrated and demonstrated automated network management technologies to provide dynamic network control and to minimize manpower. Completed modeling and simulation for scalability of individual network protocols to larger networks. In FY04, demonstrate a 20-25 node ad hoc mobility and heterogeneous Quality of Service exit demonstration. | | 4379 | 4253 | 0 |

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| <u>Accomplishments/Planned Program (continued)</u> | | FY 2003 | FY 2004 | FY 2005 |
| - Networked Sensors for the Future Force (NSFF) Communications: In FY03 NSFF Comms updated the communications architecture for unattended sensors. Conducted a 10-node demonstration using the Small Unit Operations Situation Awareness System radio prototypes with the NSFF Low Probability of Detection waveform. Conducted the SLICE NSFF System Requirements and Design Reviews. In FY04, demonstrate a 20 node (scalable to 100 node thru simulation) robust, self-healing, jam-resistant, Low Probability of Intercept/ Low Probability of Detection, energy-efficient (less than 500 milliwatt) network with networking protocols for internode unmanned ground sensor communications with a range of 200 meters and sensor to gateway connectivity to 3 kilometers. Mature low cost, JTRS software compliant architecture (SCA) compatible sensor communications breadboard models. In FY05, NSFF Comms will integrate and test a 50-node network with advanced sensors providing situational awareness to demonstrate communications range 200-400m and sensor connectivity of 3-10km. | | 700 | 1700 | 4261 |
| - Countermine Test Bed: In FY03, conducted a series of technology evaluations to demonstrate sensor systems working cooperatively to locate mines and distribute the information with future Command and Control (C2) applications. Conducted initial data collection with three proposed aircraft/sensor systems (Organic Aerial Vehicle (OAV), Tactical Unmanned Aerial Vehicle electro-optic infrared sensor (TUAV-EO/IR), and mod UAV (small-unmanned helicopter). Designed software to allow the change detection work station (CDWS) to output imagery and messages. | | 2200 | 0 | 0 |
| - Applied Communications & Information Networking (ACIN): The objective of this one year Congressional add is to mature and demonstrate emerging commercial communications technologies in the areas of Information Assurance, Software Defined Radio, Modeling and Simulation, Subterranean Communications, Ultra Wideband Amplifier, and SATCOM On-the Move. No additional funds are required to complete this effort. | | 0 | 9642 | 0 |
| Small Business Innovative Research/Small Business Technology Transfer Programs | | 0 | 1045 | 0 |
| Totals | | 14779 | 37443 | 23920 |