

**UNCLASSIFIED**

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)								DATE February 1999		
BUDGET ACTIVITY <b>2 - Applied Research</b>				PE NUMBER AND TITLE <b>0602782A Command, Control, Communications Technology</b>						
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16197	22359	19613	21010	20640	20396	21564	22617	Continuing	Continuing
AH92 Communications Technology	8847	12799	11893	12513	11763	10923	11584	12036	Continuing	Continuing
A779 Command/Control (C2) and Platform Electronics Technology	7350	6779	7720	8497	8877	9473	9980	10581	Continuing	Continuing
J06 Multimedia Tactical Adapter	0	2781	0	0	0	0	0	0	0	2781

**A. Mission Description and Budget Item Justification:** The communications technology project (AH92) conducts research of those advanced communications technologies required to provide a worldwide communications capability. The objective of the command/control (C2) and platform electronics technology project (A779) is to expand scientific knowledge for demonstration of state-of-the-art technologies, including command/control and electronic systems/subsystems, performance reliability, maintainability, safety, survivability, and man-machine interface for all Army air and ground platforms, including soldier systems and equipment. Investigation of an infrastructure that will allow timely distribution, display and use of C2 data on Army platforms will lead to greater battlefield functional capabilities, survivability and total integration into the digitized battlefield. These technologies will provide field commanders with the capability to communicate to and from virtually any place on earth. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. Work in this program element is related to and fully coordinated with efforts in PE 0603006A (Command, Control and Communications Advanced Technology), PE 0602783A (Computer and Software Technology) and PE 0603734A (Military Engineering Advanced Technology).

<b>B. Program Change Summary</b>	FY 1998	FY 1999	FY 2000	FY 2001
Previous President's Budget (FY 1999 PB)	16197	19746	18176	18934
Appropriated Value	16838	22546		
Adjustments to Appropriated Value				
a. Congressional General Reductions	-641	-187		
b. SBIR / STTR				
c. Omnibus or Other Above Threshold Reductions				
d. Below Threshold Reprogramming				
e. Rescissions				
Adjustments to Budget Years Since FY 1999 PB			+1437	+2076

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Current Budget Submit (FY 2000/2001 PB)	16197	22359	19613	21010
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Change Summary Explanation: Funding – FY99 funding (+2800) for Project J06 change due to Congressional increase. FY01 funding (+2076) supports communication range extension efforts.

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COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH92 Communications Technology	8847	12799	11893	12513	11763	10923	11584	12036	Continuing	Continuing
<p><b>Mission Description and Justification:</b> The applied research efforts in this project focus on developing and leveraging/adapting commercial communications technologies required to meet the information needs of the Force XXI battlefield and beyond. Several of the efforts also provide supporting technology for the digital battlefield communications advanced technology demonstration and the battlefield information transmission strategy. Key technologies being addressed include: the adaptation and implementation of asynchronous transfer mode switching technology in a hostile mobile environment, the adaptation and interface with commercial personal communications technology, development of realistic models for emerging communications systems in dynamic field environments, the development and application of several tactical antenna technologies, the development of photonic controls for phased array antennas, and the development of solutions to address problems associated with implementation of mobile internet protocol spread across different networks. These efforts also directly support the information systems and defense technology objectives outlined in the Defense Technology Area Plan and the advanced battlespace information systems study.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 4350 – Completed detailed technical assessment and documentation of baseline dynamic resource allocation-based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multi-media systems using airborne base stations.             <ul style="list-style-type: none"> <li>– Completed detailed technical assessment and documentation of existing multicasting protocols including internet protocol (IP) multicasting, IP over asynchronous transfer mode (ATM) multicasting and ATM multicasting for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers.</li> <li>– Evaluated, selected and installed a commercial off the shelf (COTS) network node manager and development environment for intelligent network management components.</li> <li>– Tested and evaluated a structurally embedded reconfigurable antenna technology (SERAT) conformal antenna mounted on a ground vehicle.</li> <li>– Designed, fabricated and evaluated fixed station multiband very high frequency/ultra-high frequency antennas.</li> <li>– Conducted development of super high frequency on the move antenna positioner/tracker. Developed element topology for structure tuned very high frequency antenna.</li> <li>– Completed design of airborne switching capability to be integrated into super high frequency surrogate satellite communication payload.</li> <li>– Completed design of an airborne ATM switch to be used in conjunction with the Digital Battlefield Communications Radio Access Point (RAP).</li> </ul> </li> <li>• 3338 Prototyped integrated photonic control and RF sub-system for single/multi-panel optically controlled phased array communications antennas.             <ul style="list-style-type: none"> <li>– Integrated performance models of emerging multicast and multimedia communications technologies and systems with existing CECOM performance models.</li> </ul> </li> </ul>										
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<b>FY 1998 Accomplishments: (Continued)</b>		
<ul style="list-style-type: none"> <li>• 659</li> </ul>	<ul style="list-style-type: none"> <li>- Developed advanced system concepts for future generation dismounted soldier personal communications through analysis of emerging technologies and DARPA SUO Program. Began development of technology transition strategies to Land Warrior System.</li> <li>- Conducted experimentation and assessment of commercial personal communications systems PCS technology in a tactical environment and investigated military back haul capability.</li> </ul>	
<ul style="list-style-type: none"> <li>• 500</li> </ul>	<ul style="list-style-type: none"> <li>- Developed techniques for tactical internet command and control protection with focus on providing network access protection tools.</li> </ul>	
Total	8847	
<b>FY 1999 Planned Program:</b>		
<ul style="list-style-type: none"> <li>• 3557</li> </ul>	<ul style="list-style-type: none"> <li>- Design and document analytic and computer models, selections and detailed specifications of dynamic resource allocation based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multimedia systems using airborne base stations.</li> <li>- Design and document enhanced IP multicasting, IP over ATM multicasting, and ATM multicasting protocols for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers.</li> <li>- Integrate initial intelligent, rule-based modules with COTS network node manager and conduct laboratory prototype testing.</li> <li>- Develop Joint Tactical Radio System (JTRS) compatible prototype OTM antenna, covering 30 to 450 MHz frequency bands.</li> <li>- Conduct a cosite performance test and evaluation of VHF multiplexer.</li> <li>- Conduct system test and concept demo for soldier antenna.</li> <li>- Finalize a technical approach, fabricate and test the mechanical inertial positioner and antenna for the super high frequency (SHF) communications on the move (COTM) Antenna.</li> </ul>	
<ul style="list-style-type: none"> <li>• 3440</li> </ul>	<ul style="list-style-type: none"> <li>- Complete development of the integrated photonic control system for single/multi-panel phased arrays, and integrate/demonstrate on a single panel phased array antenna.</li> <li>- Investigate and develop ultra high frequency RF multiplexer and wideband power amplifier technologies to reduce interference from co-located radios, reduce noise induced bit errors, and improve radio range performance.</li> <li>- Test UHF RF multiplexer.</li> <li>- Integrate laboratory measurements of ATM performance into system performance models. Provide corps-level analysis capabilities and provide virtual communications systems models that support man-in-the-loop evaluations.</li> </ul>	
<ul style="list-style-type: none"> <li>• 2132</li> </ul>	<ul style="list-style-type: none"> <li>-Implement emerging technologies to demonstrate advanced system concepts for future generation dismounted soldier personal communications. Test and evaluate dismounted soldier personal communications technologies in laboratory test and field experiment environments under representative terrain conditions, and analyze vulnerabilities to hostile communication threats.</li> <li>-Implement advanced wireless mobile networking protocols on commercially available, portable computing hosts and radio platforms to demonstrate peer-to-peer and multi-hop packet relay communications networking capabilities.</li> </ul>	
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<p><b>FY 1999 Planned Program: (continued)</b></p> <ul style="list-style-type: none"> <li>- Develop advanced of future generation dismounted soldier personal communications by leveraging DARPA Small Unit Operations Situation Awareness System (SUO SAS) Program. Complete development of technology transition strategies to Land Warrior System.</li> <li>• 3400 - Develop protection techniques for the tactical internet expanding the effort to address intrusion detection and host level protection.</li> <li>• 270 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 12799</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 4894 - Integrate, assess, demonstrate in testbed and document enhanced dynamic resource allocation based mobile routing, protocols, controls and reconfiguration algorithms for advanced mobile wireless mixed multimedia systems using airborne base stations. <ul style="list-style-type: none"> <li>- Integrate, assess, demonstrate in testbed and document enhanced IP multicasting, IP over ATM multicasting and ATM multicasting protocols for IP and ATM based mobile backbone and mobile subscriber networks in support of wireless mobile multimedia subscribers.</li> <li>- Design advanced intelligent modules that inter-operate with fielded network node managers and conduct field testing.</li> <li>-Further develop the Body Borne antenna concept/technologies.</li> <li>-Develop an EHF OTM SATCOM self-steering positioner/tracker.</li> <li>-Demonstrate capability of JTRS compatible OTM antenna, and begin development of expanded bandwidth OTM antenna (2 GHz).</li> <li>-Demonstrate performance increments possible using structure tuned antenna technology.</li> </ul> </li> <li>• 1791 -Transition virtual simulations and performance transition models to Common Modeling Environment (CME) to facilitate model enhancements for Force XXI systems.</li> <li>• 5208 -Develop protection techniques for the tactical internet with emphasis on malicious code detection and eradication. <ul style="list-style-type: none"> <li>-Continue advanced development of future generation dismounted soldier personal communications and acquire advanced development prototypes for engineering analysis and system test and evaluation under DARPA SUO SAS Program. Complete development of technology transition strategies to JTRS ground forces domain (Handheld and Dismounted Warrior configurations).</li> <li>-Test and evaluate advanced wireless mobile networking protocols for dismounted soldier personal communications using laboratory test and field experiment environments. Implement networking protocols in computer modeling and simulation environment for evaluation of system scalability and performance issues.</li> <li>-Analyze and evaluate design and engineering approaches for reducing power, weight and size requirements while improving performance of future generation dismounted soldier personal communications.</li> <li>-Assess, characterize, mature and integrate DARPA Global Mobile (GloMo) Geo routing algorithms and Meta channel technology.</li> </ul> </li> </ul> <p>Total 11893</p>		
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<p><b>FY 2001 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 5439 -Conduct and document detailed technical assessment of baseline dynamic addressing algorithms and protocols, and dynamic network constitution and reconstitution algorithms and protocols for tactical survivable dynamic mixed networks (ATM, IP, narrow integrated services digital network (N-ISDN)) environment. -Design a distributed network management architecture, which utilizes intelligent ‘super agents’ for semi-automated end-to-end network management. -Test and evaluate expanded bandwidth JTRS compatible OTM antenna. -Demonstrate prototype soldier antenna.</li> <li>• 1975 -Complete transition to CME and demonstrate next-generation simulation aids for initialization, management and data reduction. -Complete development and demonstrate EHF positioner/tracker.</li> <li>• 5099 -Develop protection techniques for the tactical internet with focus on security management. -Test and evaluate DARPA SUO SAS advanced development prototypes in laboratory test and computer modeling and simulation environments. Demonstrate future generation dismounted soldier communications advanced system concepts in field experiment. -Evaluate engineering approaches for implementing second and third generation PCS air interface standards in DARPA SUO SAS advanced development prototypes. -Continue engineering analysis of future generation dismounted soldier communications and mobile computing system advanced development prototypes to reduce power, weight and size requirements while improving performance of dismounted soldier personal communications. -Finalize integration of DARPA GloMo Geo routing algorithms into a 6.3 ATD program.</li> </ul> <p>Total      12513</p>		
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BUDGET ACTIVITY <b>2 - Applied Research</b>				PE NUMBER AND TITLE <b>0602782A Command, Control, Communications Technology</b>				PROJECT <b>A779</b>		
COST (In Thousands)	FY1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A779 Command/Control (C2) and Platform Electronics Technology	7350	6779	7720	8497	8877	9473	9980	10581	Continuing	Continuing
<p><b>Mission Description and Justification:</b> The objective of this project is the exploration of new concepts and techniques in command/control and platform electronics integration to achieve new and enhanced military functional capabilities. Emphasis is on mission planning, rehearsal, execution and monitoring, precision navigation and landing, command and control, and integration with the evolving digital battlefield. New enabling technologies which support the current thrusts are also explored, such as advanced controls and displays, voice interactive technology, 3D visualization, decision aids and tactical planning aids, data transfer, distributed data bases, advanced open system architectures, visionics technology and integration concepts which contribute to digitization of the battlefield and provide command and control on the move. 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: Battlespace Command and Control (BC2) ATD, Logistics Command and Control (Log C2) ATD, Rapid Terrain Visualization ACTD, Battlefield Awareness and Data Dissemination ACTD, Joint Countermine ACTD, Navigation Warfare ACTD, Consistent Battlespace Understanding DTO; Forecasting, Planning, and Resource Allocation DTO; and Integrated Force Management DTO.</p> <p><b>FY 1998 Accomplishments:</b></p> <ul style="list-style-type: none"> <li>• 3475 – Demonstrated real-time platform positioning accurate to 1-3 meters to enhance situation awareness in all environments (electronic counter measures (ECM) and nap of earth) with registration to digital terrain modeling. <ul style="list-style-type: none"> <li>– Conducted flight test of the multi-sensor differential global positioning system (GPS) precision approach/landing. Assembled a precision approach database with raw sensor data that will support the development of new techniques, algorithms and Kalman filters for multiple Army airborne platforms.</li> <li>– Evaluated concepts for employing GPS pseudolites (ground based devices transmitting GPS-like signals) to reduce GPS signal acquisition times under a hostile ECM environment.</li> </ul> </li> <li>• 3375 – Demonstrated a battlespace planning and visualization system that integrates emerging technologies with existing DoD systems to enhance battlespace awareness and facilitate tactical assessment, forecasting, information visualization, course of action analysis and other critical C2 functions. Ported planning functionality from high-end workstation environment to personal computer environment. Started development of a collaboration infrastructure to support real-time planning across dissimilar platforms.</li> <li>• 250 – Enhanced performance models to reflect the evolving tactical internet in support of near-term security architecture analysis and modeling and simulation/stimulation (MSS) specification requirements.</li> <li>• 250 – Developed a situation awareness model based on field data captured during the Task Force XXI AWE.</li> </ul> <p>Total 7350</p>										
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<p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1188 – Develop models and simulate battlespace tactical navigation (BTN) system architecture concepts that provide robust and precise platform positioning. GPS pseudolites, anti-jam GPS, video/imagery registration and small, low cost self-contained sensor technologies will be researched and evaluated. The system concept will be scalable in that it will support multiple platform types at all echelons. – Develop prototype designs for the evaluation of BTN concepts.</li> <li>• 4235 – Develop and demonstrate battle planning and visualization technology that integrates multiple existing DoD systems with emerging planning and user interface technologies to enhance all-echelon battlespace awareness down to the individual soldier. This battle planning and visualization technology will provide real-time/ near real-time hyperlinks to multiple battlefield information sources and innovatively display and interact with commanders and staff to accelerate and improve the commander’s nine-step planning process. Complete and transition the collaboration infrastructure to the BC2 ATD. – Test and evaluate forecasting, continuous planning/scheduling, interactive 3-D exploration of the battlespace, speech/natural language interaction and other advanced capabilities in battlelab/field experiments.</li> <li>• 750 – Specify and develop a MSS environment to support man-in-the-loop evaluation and warfighter training for advanced command and control protect and attack (C2 P/A) capabilities. Evaluate the effects of C2 attack on tactical internet operations.</li> <li>• 500 – Develop an information model that describes Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) processes and man-machine interactions for division-level simulations.</li> <li>• 106 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 6779</p> <p><b>FY 2000 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 1075 – Evaluate GPS enhancement technologies (e.g., advanced filters, low power clocks, advanced antennas) and prepare a plan for the demonstration of these technologies in air and ground platforms. Conclude simulation of navigation system/database registration error minimization.</li> <li>• 4983 – Investigate and develop data visualization, forecasting optimization routines and automatic alerts for insertion into the Logistics command and control (C2) advanced technology demonstration (ATD).</li> <li>• 698 – Integrate a C2 attack simulator with core distributed interactive simulation (DIS) facilities (CDFs). Conduct a distributed simulation using live troops and multiple sites to support development and training for integrated C2 P/A capabilities.</li> <li>• 499 – Enhance the C4ISR processes model to include corps-level requirements and joint/allied interfaces.</li> <li>• 465 – Develop an experimentation plan and testbed environment to evaluate future C2 needs of tactical commanders from battalion through platoon.</li> </ul> <p>Total 7720</p>		
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<p><b>FY 2001 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 2050 – Develop and demonstrate a real-time prototype of the navigation sensor/database error registration minimization algorithm.</li> <li>• 1294 – Evaluate improved C2 P/A capabilities against each other in a virtual environment to support development and training for C2 P/A capabilities. Integrate brigade and above communications models (e.g., that for mobile subscriber equipment (MSE)).</li> <li>• 500 – Develop High Level Architecture/Army Battle Command System interfaces as part of a common modeling environment (CME) supporting live/virtual/constructive simulations for all modeling and simulation (M&amp;S) domains.</li> <li>• 1800 – Conduct laboratory and field experiments with candidate collaborative planning, tactical display, and man-machine interface concepts, built within a portable testbed. Concepts will show proof-of-principle improvement in battlespace situation awareness and decision-making processes for commanders from battalion to squad levels. Concepts will be evaluated toward feasible solutions for smaller, lighter, energy efficient, and software reprogrammable applications.</li> <li>• 2853 – Develop technology concepts and enablers for next generation command posts and tactical operations centers and the logistics C2 ATD: integrated voice/natural language/collaboration capability to provide C2 on-the-move, course of action tools to support logistics planning and reconstitution, and tools to aid course of action development and analysis in a hasty environment.</li> </ul> <p>Total 8497</p>		
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BUDGET ACTIVITY <b>2 - Applied Research</b>				PE NUMBER AND TITLE <b>0602782A Command, Control, Communications Technology</b>					PROJECT <b>J06</b>	
COST <i>(In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
J06 Multimedia Tactical Adapter	0	2781	0	0	0	0	0	0	0	2781
<p><b><u>Mission Description and Justification:</u></b> The objective of this one year Congressional special interest project is to investigate methods that provide a seamless interface from standards/commercial based communications products to the Warfighters Information Network (WIN). The Multimedia Tactical Adapter program will develop an operational prototype to address the interoperability of voice, data and video over a single military communications infrastructure. It will provide the soldier with state of the art technology while adapting commercial technology for use in the tactical environment. The Multimedia Tactical Adapter program will develop a means to provide the required technology to implement a more reliable, efficient, and cost effective multimedia communications system. A Multimedia Inter-Working Functions (IWF) will be developed to provide gateway and gatekeeper functions for various standards based (H.320 and H323) interoperability technologies. Methods to control available bandwidth usage for these technologies will be investigated as well as defining and implementing a scheme to allow for preemption and prioritization of the users multimedia communications. This effort will give the warfighter an enhanced capability that will save setup time, prioritize usage, and conserve precious tactical bandwidth based upon network traffic.</p> <p><b>FY 1998 Accomplishments:</b> Program not funded in FY 1998</p> <p><b>FY 1999 Planned Program:</b></p> <ul style="list-style-type: none"> <li>• 800 -Complete investigation of approaches to integrate and control various standards based video teleconferencing techniques into tactical communications networks.</li> <li>• 1908 -Complete design and development of the appropriate hardware and software required prototypes to interface and control Multimedia Communications on tactical Networks. -Perform test and evaluation of the completed system.</li> <li>• 73 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs</li> </ul> <p>Total 2781</p> <p><b>FY 2000 Planned Program:</b> Program not funded in FY 2000</p> <p><b>FY 2001 Planned Program:</b> Program not funded in FY 2001</p>										
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