

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY		PE NUMBER AND TITLE						
<b>2 - Applied Research</b>		<b>0602783A - COMPUTER AND SOFTWARE TECHNOLOGY</b>						
COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total Program Element (PE) Cost	4447	6719	5368	5510	5601	5697	5847	6024
Y10 COMPUTER/INFO SCI TECH	3488	3801	5368	5510	5601	5697	5847	6024
Y11 COMPUTER & INFORMATION SCIENCE APPLIED RES CA	959	2918						

**A. Mission Description and Budget Item Justification:** This program element (PE) funds research and application of information and communications technology to enhance the understanding and speed the decision cycle for mounted and dismounted commanders and leaders operating in the mobile dispersed environment envisioned for the Future Force. Focus is on a spectrum of command and control (C2) solutions for lower echelon teams. This program investigates and matures command, control, communications and computer (C4) technologies to increase Future Force lethality and survivability through improved commanders' decision making and situational awareness and, where feasible, exploits opportunities to enhance Current Force capabilities. The goals of this program element are to develop information processing technologies to automate the delivery of local/global information for decision making (planning, rehearsal, and execution) so that it is synchronized, parallel, real-time, and to devise communication/network technologies that will enable the synchronization of secure data/information from humans to humans, humans to computers, computers to humans, as well as reducing dependence on mouse and keyboard versus other modes of computer interaction. Challenges for this program include developing automated tools to support the discovery of services within an unreliable ever-changing network topology as well as providing methods for end-users to understand the tactical significance of events generated from both local and global tactical sensors. Technologies addressed in this work will enable a spatial and temporal explanation of the situation through graphical and narrative based multi-media reporting for the commander. Work in this PE is related to and fully coordinated with efforts in PE 0602782A(Command, Control, Communications Technology), PE 0603772A(Advanced Tactical Computer Science and Sensor Technology), and PE 0603008A(Command, Control, Communications Advanced Technology). 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 Army Research Laboratory (ARL). Project Y11 contains congressional adds only.

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<u><b>B. Program Change Summary</b></u>	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	4521	3844	3785	3810
Current BES/President's Budget (FY 2008/2009)	4447	6719	5368	5510
Total Adjustments	-74	2875	1583	1700
Congressional Program Reductions		-26		
Congressional Rescissions				
Congressional Increases		2950		
Reprogrammings	-74	-49		
SBIR/STTR Transfer				
Adjustments to Budget Years			1583	1700

In FY08 and FY09 funds increased to explore statistical based tools for design and analysis of complex networks to support development of network-centric operations.

Two FY07 congressional adds totaling \$2828 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

- (\$959) Biologically-Inspired Security Infrastructure
- (\$1869) Commercial O-T-Shelf Military (COTS-M) Scout Robot

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

**February 2007**

<b>BUDGET ACTIVITY</b> <b>2 - Applied Research</b>		<b>PE NUMBER AND TITLE</b> <b>0602783A - COMPUTER AND SOFTWARE TECHNOLOGY</b>					<b>PROJECT</b> <b>Y10</b>		
COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
Y10 COMPUTER/INFO SCI TECH	3488	3801	5368	5510	5601	5697	5847	6024	

**A. Mission Description and Budget Item Justification:** This project funds research and application of information and communications technology to enhance the understanding and accelerate the decision cycle time for mounted and dismounted commanders and leaders operating in the mobile dispersed environment envisioned for the Future Force. Focus is on a spectrum of command and control (C2) solutions for lower echelon teams. Research within this project investigates and matures command, control, communications, and computer (C4) technologies to increase Future Force lethality and survivability through improved commanders' decision-making and situational awareness and, where feasible, exploits opportunities to enhance Current Force capabilities. The goals of this project are to develop information processing technologies to automate the delivery of local/global information for decision making (planning, rehearsal, and execution) so that it is synchronized, parallel, real-time and to devise communication/network technologies that will enable the synchronization of secure data/information from humans to humans, humans to computers, computers to humans, as well as reducing dependence on mouse and keyboard versus other modes of computer interaction. Challenges for this program include developing automated tools to support the discovery of services within an unreliable ever-changing network topology as well as providing methods for end-users to understand the tactical significance of events generated from both local and global tactical sensors. Technologies addressed in this work will enable a spatial and temporal explanation of the situation through graphical and narrative based multi-media reporting for the commander. Work in this project is related to and fully coordinated with efforts in PE 0602782A (Command, Control, Communications Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and PE 0603008A (Command, Control, Communications Advanced Technology). 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 Army Research Laboratory (ARL).

<b><u>Accomplishments/Planned Program:</u></b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Enhance information processing techniques through the interactive and automated fusion of distributed local and global information sources in order to inform and protect the force from imminent threats. User directed fusion techniques that combined with the Communications-Electronics Research, Development, and Engineering Center's (CERDEC) techniques will enable semi-automated fusion techniques to improve the completeness and timeliness of decision-making in C2 operations. The integrated technology will be matured for Distributed Common Ground Station-Army (DCGS-A) and Future Force assessment. In FY06, investigated Resource Description Framework (RDF) and Ontology Web Language (OWL) for marking up current Command and Control Information Exchange Data Model and future data-stores to include discovering content through published meta-data. In FY07, mine marked-up RDF and OWL based data-stores for events/associations across disparate data sources. In FY08, will implement ontology to formalize the representation, attributes, and transforms necessary to track a soft target using various data sources. Will integrate soft target tracking algorithms as small, self-contained fusion services that support the Intelligence Analyst in interpreting battlefield events. In FY09, will transition fusion services to CERDEC for integration into DCGS-A.	1012	1100	1083	1090
Conduct applied research on tactical information protection technologies for agent-based vulnerability assessment over wireless bandwidth constrained links and security infrastructures for sensor networks. The Future Force will operate in a complex wireless environment where survivability must be maintained in spite of inherent vulnerabilities of standardized protocols and commercial technologies. In FY06, validated advanced network assurance techniques using 20 network nodes in a tactically representative	965	961	1033	1040

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<b>2 - Applied Research</b>	<b>0602783A - COMPUTER AND SOFTWARE TECHNOLOGY</b>			<b>Y10</b>
environment. In FY07, implement and evaluate cooperative algorithms for detecting sophisticated attacks involving multiple colluding nodes against Mobile Ad Hoc Network (MANET) routing protocols. Evaluate clustering algorithms for creating and maintaining a dynamic hierarchy of cooperative intrusion detection components in MANETs. Implement a prototype network protocol that increases current efficiency of media-access control. In FY08, will investigate and evaluate an integrated distributed wireless intrusion detection system (IDS) capable of detecting multiple classes of intrusions from multiple simultaneous intruders. Enhance network protocol to provide a more efficient healing process. In FY09, will evaluate the scalability of the distributed wireless IDS system in large networks and determine the expected bounds of performance (e.g. overhead, missed detection probability, and false alarm probability).				
Investigate techniques to enable automated integration of global and local information, allowing tactical assets to cooperatively share sensed events within a wireless distributed fusion environment in order to inform the force of relevant events. In FY06, investigated the correlation and tracking agents that provide end-user directed mining of spatially/temporally linked objects. In FY07, using a Distributed Interactive Semi Automated Forces (DISAF) simulation, evaluate the ability of the distributed agent infrastructure to provide a tactically relevant picture of the local operational environment through a series of time sequenced events. In FY08, using social networking concepts will develop soft target tracking algorithms that can be used to identify relevant changes in the tactical environment. In FY09, will integrate cross-security-level information exchange algorithms to insure tactically relevant information is presented to the user in a minimally intrusive manner.	1007	1146	1128	1135
Conduct research into techniques for developing the underlying computational multilingual software framework to enable commanders and troops to bridge language barriers in order to anticipate adversaries and collaborate with allies. In FY06, defined the underlying framework for document exploitation, indexing, and search across archived translated documents. Evaluated current state-of-the-art in two-way speech-to-speech translation technologies to include microphones that can operate in noisy environments. In FY07, enhance the underlying framework to include the ability to extract the metrics required for evaluation of text based machine translation engines. Develop the underlying software framework to integrate the best microphone and two-way speech technologies. In FY08, will implement optical character recognition (OCR), machine translation and name extraction via web services in Deployable Harmony DOCEX System (DHDS) and DCGS-A test beds. In FY09 will evaluate use of prototype document image processing tools operating through web service on noisy and handwritten foreign language documents.	504	549	541	545
Statistical based methods for studying networks supports theory development in network science. It will provide a basis to validate or invalidate theoretical results, point gaps between theory prediction, and field performance, provide experimental verification of mobility, channel, topology models, and of convergence of adaptive protocols, guide development of the theoretical effort by providing a basis for refining models and assumptions. All of this leads to the right levels of robust abstraction to understand network behavior. This will result in a tight coupling between theoretical developments, simulation, emulation, and over-the-air testing in lab and field environments. The long-term goal is to develop a real-time adaptive statistical analysis system that is coupled to a monitoring system that can infer/learn global network behavior and to a control system that controls local behavior so as to predictively improve performance, while ensuring the stability of the overall system. In FY08, will acquire software and hardware, including network monitoring tools, and setup emulation and in-the lab/field experiments to gather network performance data, based on algorithms developed in this PE/Project. In FY09, will refine and expand the scope of the effort (size of the network, complexity of the deployed algorithms and protocols, heterogeneity of the nodes, harshness of the RF channel conditions and sophistication of the adaptation). Theoretical work will be validated against the acquired data.			1583	1700
Small Business Innovative Research/Small Business Technology Transfer Programs		45		
<b>Total</b>	<b>3488</b>	<b>3801</b>	<b>5368</b>	<b>5510</b>