Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Army										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	82.449	48.929	43.521	-	43.521	47.014	54.378	54.909	56.254	Continuing	Continuing
H15: *GROUND COMBAT ID TECH*	7.568	7.874	2.069	-	2.069	2.169	4.815	4.691	4.381	Continuing	Continuing
H16: *S3I TECHNOLOGY*	19.298	17.910	19.914	-	19.914	20.768	22.060	22.080	22.682	Continuing	Continuing
SA1: *Sensors and Electronic Initiatives (CA)*	33.246	-	-	-	-	-	-	-	-	Continuing	Continuing
SA2: *BIOTECHNOLOGY APPLIED RESEARCH*	5.585	5.884	5.485	-	5.485	5.895	6.203	6.304	6.413	Continuing	Continuing
TS1: *TACTICAL SPACE RESEARCH*	1.596	1.695	3.725	-	3.725	4.257	4.900	5.364	6.028	Continuing	Continuing
TS2: *ROBOTICS TECHNOLOGY*	15.156	15.566	12.328	-	12.328	13.925	16.400	16.470	16.750	Continuing	Continuing

Note

FY10 funding increase for congressional special interest items.
FY12 funding realigned to higher priority efforts.

A. Mission Description and Budget Item Justification

The focus of this program element (PE) is to investigate research and evaluation of sensors and electronic technologies that enhance survivability, lethality, deployability, and sustainability capabilities. Focus is on research that provides the ability for joint fires to locate, identify, track, and engage targets as necessary with the overall goal of increasing lethality and survivability through the reduction of fratricide (project H15); research on advanced sensors, signal processing and information technologies that provide decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments (project H16); research on biological sensors and biologically derived electronics that exploits breakthroughs in biotechnology basic research in collaboration with the Institute for Collaborative Biotechnology (ICB) a University Affiliated Research Center (UARC) led by the University of California, Santa Barbara in partnership with California Institute of Technology and Massachusetts Institute of Technology and their industry partners (project SA2); research and evaluation of space-based remote sensing, signal, and information processing technology in collaboration with other Department of Defense (DoD) and government agencies to support space force enhancement and space superiority advanced technology integration into Army battlefield operating systems (project TS1); research on advancing perception for autonomous ground mobility, intelligent vehicle control and behaviors, human-robot interaction, robotic manipulation, and unique mobility for unmanned vehicles (project TS2).

Projects SA1 and SA3 fund congressional special interest items.

Work in this program element (PE) complements and is fully coordinated with efforts in PE 0602307A (Advanced Weapons Technology), PE 0602705A (Electronics and Electronic Devices), PE 0602709A (Night Vision Technology), PE 0602782A (Command, Control, Communications Technology), PE 0603772A (Advanced Tactical

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Computer Science and Sensor Technology), PE 0603006A (Command, Control, Communications Advanced Technology), PE 0603710A (Night Vision Advanced Technologies), and PE 0603001A (Warfighter Advanced Technology). and PE 0603008A (Command Electronic Warfare Advanced Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work is performed by the Army Research Laboratory, Adelphi, MD and Aberdeen Proving Ground, MD, the Communications-Electronics Research, Development, and Engineering Center, Ft. Monmouth, NJ, and the US Army Space and Missile Defense Technical Center, Huntsville, AL.

B. Program Change Summary ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	70.272	48.929	50.543	-	50.543
Current President's Budget	82.449	48.929	43.521	-	43.521
Total Adjustments	12.177	-	-7.022	-	-7.022
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	13.350	-			
• SBIR/STTR Transfer	-1.173	-			
• Adjustments to Budget Years	-	-	-7.022	-	-7.022

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
H15: *GROUND COMBAT ID TECH*	7.568	7.874	2.069	-	2.069	2.169	4.815	4.691	4.381	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project researches and investigates emergent combat identification (CID) technologies for Joint, allied, and coalition air-to-ground and ground-to-ground mounted, dismounted, forward observer, and forward air controller missions. Efforts include research on enabling technologies to provide a common battlespace picture for joint coalition situation awareness and fusion efforts to increase the survivability and lethality of coalition forces by fusing battlefield sensor and situational awareness data to identify friend from foe.

Efforts in this project are complimentary of PE 0603270A (EW Technology), PE 0602270A (EW Techniques), and other Services, allies and coalition partners as necessary.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work is performed by the Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ and Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Combat Identification (CID) Technologies	4.083	4.557	2.069
Description: Focus of this effort is to develop and evaluate potentially cost effective CID approaches that reduce fratricide, using non-traditional sensors to increase situational awareness (SA), and increase combat effectiveness of Soldier based and Brigade Combat Team (BCT) CID technologies. Work being accomplished under PE 0603270A/project K16 complements this effort.			
FY 2010 Accomplishments: Assessed technologies for incorporation into a universal/multi-platform CID capability. Candidate technologies included the Soldier Radio Waveform, laser/RF time difference of arrival, and geometric pairing techniques at point of detection/response; experimented with CID/SA data display.			
FY 2011 Plans: Model fusion algorithms for improved battlespace awareness to include geolocation and target identification algorithms utilizing blue force emitter information to resolve current radar, laser, and ultra-violet/infrared (UV/IR) warning receiver sensor ambiguities;			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
link to Distributed Common Ground System-Army (DCGS-A) Enterprise for initial assessment/user jury to obtain user community feedback and recommendations for algorithm improvements; perform communication and network modeling and simulation. ***FY 2012 Plans:*** Will improve algorithms to deconflict, fuse and correlate warning receiver and blue force emitter data with DCGS-A provided intelligence, surveillance and reconnaissance, based on initial user jury results; will investigate data transport requirements needed to support the generation of an enterprise-wide ground and air common operating picture that provides accurate and timely reporting of high value targets for enterprise-wide as well as organic platform SA for increased CID awareness.			
Title: Multi-Intelligence Data Fusion and Targeting ***Description:*** This effort investigates and develops software technologies for intelligence/battle command (Intel/BC) enterprise collaboration to provide faster and higher quality decision making support for the Commander and his key staff. Specific efforts focus on integrating the intelligence surveillance and reconnaissance planning and execution at the task force/battalion level through troop-level as well as efforts that enable the enterprise to identify, fuse, and trace/track specific human targets in an asymmetric environment. Work being accomplished under PE 0602270A/project 906 compliments this effort. ***FY 2010 Accomplishments:*** Coded, integrated and assessed a multi-intelligence sensor manager and planner into DCGS-A and Tactical Ground Reporting Network (TiGRNet); functionally mapped battle command mission tasks with the needed intelligence and geospatial data and collection opportunities; developed data extraction tools to incorporate political, military, economic and social information infrastructure and behavior modeling data using DCGS-A compliant multi-intelligence correlation service, integrated imagery and video data products for additional fidelity; developed a video-based tracker service for real-time and forensic viewing and analysis. ***FY 2011 Plans:*** Associate Intel requirements, geolocation data needs and collection opportunities with operational mission tasks for Intel and BC communities; mature common architecture and framework to provide a portable software environment, storage and access for Intel and Operations communities. Complementary work is also being accomplished under PE 0602270A/project 906.	3.485	3.317	-
Accomplishments/Planned Programs Subtotals	7.568	7.874	2.069

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

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E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
H16: *S3I TECHNOLOGY*	19.298	17.910	19.914	-	19.914	20.768	22.060	22.080	22.682	Continuing	Continuing

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

The objective of this project is to focus on applied research of advanced sensors, signal processing, and information technologies that will enable the future Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. The ultimate impact and utility of this work will be to greatly increase the lethality, range, and speed of engagement of the Soldier. Emphasis is on solving critical Army-specific battlefield sensing and information management problems such as false targets, complex terrain (including urban applications), movement of sensors on military vehicles, and exploitation of multimodal sensors.

Significant areas of research include: low cost sensors designed to be employed in large numbers as unattended ground sensors (UGS) for force protection, hostile fire defeat, homeland defense, counter terrorism operations, and munitions; tagging, tracking, and locating (TTL) of non-traditional targets; fusion of disparate sensors such as acoustic, seismic, electric-field (E-field), magnetic, radar, infrared (IR), forward looking IR (FLIR), laser detection and ranging (LADAR), visible imagers; low cost acoustic, seismic, and magnetic sensors that can passively detect, classify, and track battlefield targets such as personnel, heavy/light vehicles, and helicopters. Other areas of research include sensing technologies to locate gun fire and other hostile threats; enable stand-off characterization of infrastructure, equipment or materials; and allow the detection, tracking, and assessment of humans, especially in urban terrain. Further areas of research are high performance multi-function radio frequency (RF) systems that allow consolidated target acquisition, combat identification (ID), active protection, surveillance, and communications systems; passive and active RF sensors capable of high-resolution imaging to detect targets hidden in foliage, smoke, and fog; ultra wideband radar work enabling buried mine detection and target imaging through dense foliage and greatly enhanced robotic mobility; and Ultra-violet (UV) optoelectronics for battlefield sensors. Additional areas of research are aided/automatic target recognition (ATR) allowing sensors to autonomously locate and identify targets; advanced battlefield sensor and information processing to conduct a dynamic and real time situational assessment to present a common picture of the battlespace focused on low echelon commanders; and advanced information processing methods to provide automatic information technologies that utilize widely dispersed sensor and legacy information sources.

This work complements and is fully coordinated with the Communications and Electronics Research, Development, and Engineering Center (CERDEC), other Research and Development Engineering Centers (RDECs), and the Defense Advanced Research Projects Agency (DARPA).

This work is related to and fully coordinated with efforts funded in PE 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technologies), and PE 0603001A (Warfighter Advanced Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

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Work in this area is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Unattended Ground Sensors (UGS)	4.731	6.042	6.260
Description: Develop technologies for multi-modal low-cost UGS to enhance persistent sensing capabilities with increased probability of target detection and reduced false alarms. Research focus is based on opportunities and feedback from UGS used in Operation Iraqi Freedom, Operation Enduring Freedom, and other theaters. A key focus is on detecting and discrimination between people and animals. ***FY 2010 Accomplishments:*** Along with the United States Marine Corps and others, advanced the concept of UGS for persistent surveillance and developed standard protocols and communications, implemented acoustic wind and flow mitigation techniques on moving and airborne systems; expanded transient classification capabilities; enhanced Micro Electro Mechanical System magnetic sensor sensitivity and detection algorithms; evaluated non-erasable magnetic memory; and implemented E-field sensor system to conduct target detection, material characterization, and subsurface imaging. ***FY 2011 Plans:*** Implementing the concept of UGS for persistent surveillance with increased interoperability with multiple UGS vendors; enhancing acoustic localization accuracy through meteorological correction of solution vectors; exploiting acoustic, seismic, magnetic, and electric fields for locating, reliable target characterization, and classification; and investigating airborne multimodal sensing of targets. ***FY 2012 Plans:*** Will investigate new fusion techniques for enhanced discrimination between vehicles, humans and animals and will develop algorithms for acquiring 360 degree situational awareness from multisensory wide-area persistent surveillance platforms.; will apply acoustic, seismic, magnetic, and E-field to subsurface anomaly detection and characterization; will apply advanced transient event classification algorithms to fielded acoustic systems; and will enhance detection range and localization accuracy of airborne acoustic systems to include an unmanned aerial vehicle (UAV) with both acoustic and E-field sensors.			
Title: Sensor and Data Fusion	4.515	4.722	5.427
Description: Investigate and devise hyper-modal sensor data fusion for detecting and classifying humans, human infrastructure in urban operations, such as personnel, adversarial, vehicles, machinery, RF emissions, chemicals, and computers in hidden and confined spaces such as tunnels, caves, sewers, and buildings. ***FY 2010 Accomplishments:***			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Transitioned sensor fusion research from the US-UK International Technology Alliance to support Coalition Warfare Programs; implemented diverse modality sensor and information fusion for enhanced situational awareness for hostile fire defeat; experimentally validated optical, acoustic, E-field, RF, IR, retroreflection and other threat-detection sensors and fusion algorithms on UGS, man-wearable, vehicles, robotic, as well as other airborne systems; and assessed low-cost implementations of solar blind avalanche detector. ***FY 2011 Plans:*** Implementing novel fusion methodologies, and decentralized and distributed data fusion using heterogeneous sensor systems, platforms, and networks to performing enhanced detection, tracking, and classification of threats; exploiting multi-modal sensing and fusion concepts to characterize underground facilities, materiel and tunnels; developing new policy-based sensor information algorithms for robust communication up to coalition level; and implementing new computationally efficient anomaly detection algorithms for imaging target recognition. ***FY 2012 Plans:*** Will apply advanced fusion algorithms to multimodal sensors and systems; will exploit magnetic and E-field fusion for equipment characterization, power line monitoring, and target localization; will employ acoustic and seismic techniques to augment E-field subsurface imaging; will enhance sensing from airborne platforms with multimodal sensors, cueing and fusion algorithms; and will implement fusion algorithms to discriminate humans versus other targets with high accuracy.			
Title: Tagging Tracking and Locating (TTL) ***Description:*** Conduct applied research to support advances in state-of-the-art clandestine TTL for non-traditional hostile forces and non-cooperative targets. Specific technical details related to this effort are classified. This effort will directly support the Communication-Electronics Research, Development, and Engineering Center's (CERDEC) advanced research in clandestine TTL. ***FY 2010 Accomplishments:*** Conducted research to integrate TTL with UGS; completed an advanced RF integrated circuit for an RF Tag; and completed the design of a 2nd generation IR Tag. ***FY 2011 Plans:*** Design, fabricate, and evaluate TTL experimental devices including UGS integration, RF Tags, and IR Tags for transition to CERDEC. ***FY 2012 Plans:***	0.985	1.028	1.553

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Will optimize and transition TTL technologies to CERDEC and implement improvements to RF and IR Tags.			
Title: Ultra Wideband Radar ***Description:*** Develop technical underpinnings of ultra wideband (UWB) radar for several key Army concealed target detection technology requirements including landmine detection, sensing through-the-wall (STTW), and obstacle detection. Validate advanced computational electromagnetic algorithms and estimate performance of proposed radar systems as well as predict target signatures. ***FY 2010 Accomplishments:*** Implemented effective target/clutter discrimination algorithms using advanced signal processing techniques including change detection; devised rough-ground models to compute radar backscatter over UHF and L-band and compare to radar forward-looking measurements over road surfaces; devised realistic computer-aided-design models for rooms of high complexity, including plumbing, heating ventilation, air-conditioning systems, and wiring; as well as computed radar images over typical STTW frequency band and compared the exact solution with approximate solver (Xpatch) to quantify approximations. ***FY 2011 Plans:*** Investigate advanced Improvised Explosive Device (IED)-discrimination algorithms and technologies that exploit physics-based features to reduce false alarms in low-artifact radar imagery. ***FY 2012 Plans:*** Will collect data with improved forward-looking UWB radar testbed to assess IED detection performance gains relating to the following areas: increased antenna height above ground, new antenna/balun design with enhanced low frequency content for better ground penetration, and polarimetric effects; and will investigate techniques to utilize information embedded in low frequency radar data to develop an effective combination of interior building maps, moving target indication algorithms and RF Measurement & Signatures Intelligence technology.	3.310	2.271	2.945
Title: Multi Function Radio Frequency System (MFRFS) and Wide Bandgap Optoelectronics ***Description:*** Develop MFRFS for use on small ground and air vehicles and future Soldier technologies. Develop understanding of phenomenology for an integrated RF sensor that performs radio, radar, and control functions to allow communications, combat ID, target acquisition/tracking, active protection, and munitions-command guidance. Develop Aluminum-Gallium-Nitride based semiconductor UV optoelectronics for communications, water/air/surface purification, and photoluminescent detection of biological threats. ***FY 2010 Accomplishments:***	3.365	1.236	1.138

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Developed algorithms to extract RF biometric signatures for CERDEC All-terrain Radar for Tactical Exploitation of Moving target indicator and Imaging Surveillance; programmed and explored sub-millimeter Wave (mmW) phenomenology for application to human-borne IED detection; and pursued high-efficiency 280-nm light-emitting-diode (LED) sources. ***FY 2011 Plans:*** Apply RF biometric algorithms to an unattended compact radar for perimeter watching as part of a larger Unmanned Ground System network and establish baseline designs of a sub-mmW imager for human-borne IED detection. Extend UV source and detector research to 250-nm. ***FY 2012 Plans:*** Will develop new methods of moving target classification based on micro-doppler analysis; will explore the phenomenology and image processing associated with sub-mmW imaging of human borne IEDs and validate new sub-mmW / terahertz device technology; and will continue and extend research on 230-275-nm optical sources including LEDs, lasers, and detectors.			
Title: Information Fusion ***Description:*** Improve the lower echelon commander's (i.e. platoon) situational understanding in complex/urban terrain by developing infrastructure and validating algorithms, filters and agent technologies to reduce cognitive load by fusing information. ***FY 2010 Accomplishments:*** Conducted experiments to assess the effectiveness of collaborative bio-inspired surveillance algorithms using fixed and mobile assets operating in Military relevant environments (e.g., Command, Control, Communications, Computers and Information, Surveillance and Reconnaissance On the Move). ***FY 2011 Plans:*** Investigate the transition of Network Science and the Micro Autonomous Systems and Technology Collaborative Technology Alliance technologies and assess their potential impact on persistent surveillance for situational awareness. ***FY 2012 Plans:*** Develop algorithms and enhance applications directed to persistent surveillance, sensor management, and asset-to-asset taskings to minimize the cognitive workload of a lower echelon commander.	2.392	2.611	2.591
Accomplishments/Planned Programs Subtotals	19.298	17.910	19.914

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C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
SA1: *Sensors and Electronic Initiatives (CA)*	33.246	-	-	-	-	-	-	-	-	Continuing	Continuing

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Sensors and Electronic Initiatives.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Advanced Detection of Explosives Program ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated an innovative remote sensor monitoring technology for advanced stand-off detection of explosives.	1.591	-	-
Title: Next Generation Wearable Video Capture System ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated wearable video capturing technology for soldier applications.	0.796	-	-
Title: Advanced UV Light Diode Sensor Development ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated options to improve wall plug efficiency in deep ultraviolet light sources.	0.796	-	-
Title: Diamond Lens Elements for High-Powered Lasers ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:***	0.795	-	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Investigated technologies in 25 millimeter single crystal diamond substrates for the purpose of creating heat spreader and optical elements for high powered lasers.			
Title: Surveillance Augmentation Vehicle ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated technologies for human target detection, recognition, and location in a 4 km diameter circle to improve situational awareness.	1.194	-	-
Title: Terahertz Sensing and Imaging Technology ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated portable Terahertz (electromagnetic (EM) wave frequency equal to one trillion hertz) sensing and imaging technology that has the potential to detect hidden or concealed objects.	1.592	-	-
Title: Electronic Keel ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated technologies intended to improve computing power in ground vehicles.	1.592	-	-
Title: Advanced Bonded Diamond for Optical Applications ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated use of a chemical vapor deposition diamond heat spreader as a heat management component in solid state laser systems.	1.990	-	-
Title: Advanced Communications for Mobile Networks ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:***	3.183	-	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Investigated technologies for small units with advanced mobile communications equipment.			
Title: Advanced Tactical Laser Flashlight ***Description:*** This is a Congressional Special Interest Item ***FY 2010 Accomplishments:*** Investigated technologies for an Advanced Tactical Laser Flashlight Devices (ATLFD) to address the potential Army needs.	0.796	-	-
Title: Compact Biothreat Rapid Analysis Concept ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** This effort investigated technology concepts for biothreat detection.	4.775	-	-
Title: Command, Control, Communications Technology ***Description:*** This is a Congressional Interest Item ***FY 2010 Accomplishments:*** This Congressional Interest Item developed an application framework for edge-developed (configurable in the field) applications based on open software protocols and standards to improve component and service reuse, flexibility and platform portability.	1.592	-	-
Title: Nanoelectronic Memory, Sensor and Energy Devices ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** Investigated nanosensor technology with potential applications for detecting explosives, chemicals and motion.	6.267	-	-
Title: Distributed, Networked, Unmanned Ground Systems for Enhanced Reconnaissance, Surveillance, and Target Acquisition (RSTA) ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** Investigated technology approaches to increasing sensor coverage area on the battlefield while keeping within the current bandwidth limitations of tactical information networks.	3.183	-	-
Title: Nanophotonic Biosensor Detection of Bioagents and Pathogens	1.512	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army		DATE: February 2011
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** This effort investigated nanophotonic biosensors to facilitate direct, rapid, and extremely sensitive detection of bioagents and pathogens using surface enhanced Raman spectroscopy.			
Title: Force Protection Radar for Forward Operating Bases ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** Investigated a portable, rugged radar system for the Army to identify perimeter threats despite obscured weather conditions or dense foliage at combat bases.	1.592	-	-
Accomplishments/Planned Programs Subtotals	33.246	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*	PROJECT SA2: *BIOTECHNOLOGY APPLIED RESEARCH*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
SA2: *BIOTECHNOLOGY APPLIED RESEARCH*	5.585	5.884	5.485	-	5.485	5.895	6.203	6.304	6.413	Continuing	Continuing

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

The objective of this project is to transition biotechnology research from PE 0601104/H05, Institute for Collaborative Biotechnologies (ICB). The ICB is led by the University of California, Santa Barbara (Santa Barbara, CA) in partnership with the California Institute of Technology (Pasadena, CA) and the Massachusetts Institute of Technology (Cambridge, MA). Applied research will be conducted that transitions breakthroughs in biotechnology basic research from the ICB to enable capabilities in sensors, electronics, photonics, and network science. Areas of applied research include bio-array sensors, biological, and bio-inspired power generation and storage, biomimetics, proteomics, genomics, network science, DNA research and development, control of protein, and gene expression. Efforts include designing and performing multi-scale dynamic and predictive modeling to understand biologically-inspired "sense and respond" systems: integrated system of sensor, information processing, and response mechanism and their components. The Army Research Laboratory and other Army organizations, including the Natick Soldier Research, Development, and Engineering Center, and Edgewood Chemical Biological Center, in collaboration with the ICB industry partners, will conduct applied research focused on biological sensors, biological, and bio-inspired materials, and biological and bio-inspired power generation and storage. The in-house research program (~20%) will link the ICB research to Army requirements and enhance the transition of this technology into the Army. The remaining funding (~80%) is focused on competitively awarded joint projects led by an ICB Industrial partner in collaboration with an Army laboratory and an ICB faculty member to transition ICB research into the Army and industry. The projects are programmed for three years each and are reviewed annually. Projects are intended to cover the entire breadth of the ICB program.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work is performed by the Army Research Laboratory, Adelphi, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Institute for Collaborative Biotechnologies (ICB)	5.585	5.884	5.485
Description: Transition biotechnology research from PE 0601104/H05, Institute for Collaborative Biotechnologies (ICB) to enable capabilities in sensors, electronics, photonics, and network science.			
FY 2010 Accomplishments:			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Fabricated and evaluated uncooled thermal detector materials; evaluated algorithms for optimized collection of data from sensor networks; characterized reversible adhesive pads based on gecko-inspired design; designed and fabricated open-channel micro-fluidic devices for use in surface-enhanced Raman spectroscopy for explosives detection in the vapor phase; incorporated bio-inspired flocking and search algorithms into the GeoTrack system, and began the design of adaptive algorithms based on neural processing to control data display on Army vehicle systems. ***FY 2011 Plans:*** Fabricate and evaluate arrays of bio-inspired material-based thermal imagers; implement bio-inspired algorithms for optimized collection of data from sensor networks; implement gecko-mimicking reversible adhesives in robotic applications; experimentally validate surface-enhanced Raman spectroscopic detection of explosives in open-channel micro-fluidic devices; and implement bio-inspired flocking and search algorithms for unmanned vehicles in GeoTrack system. ***FY 2012 Plans:*** Will design/build hardware/software required to image single cells in 3D and collect initial 3D images; will apply the lessons learned in microbial fuel cells to implement enhanced fermentation, environmental monitoring, and investigate waste water treatment; will complete characterization and investigation of bacterial nanowires fabricated artificially from the naturally occurring proteins; and will complete and validate algorithms for control of data displayed on crew stations based on neural processing, and begin two new start projects selected in FY11.			
Accomplishments/Planned Programs Subtotals	5.585	5.884	5.485

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*	PROJECT TS1: *TACTICAL SPACE RESEARCH*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
TS1: *TACTICAL SPACE RESEARCH*	1.596	1.695	3.725	-	3.725	4.257	4.900	5.364	6.028	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project researches and investigates technologies with the potential for space-based, high altitude, and cyberspace applications. Applied research efforts include the design and development of sensors and electronic components, communications, signal and information processing, target acquisition, position/navigation, and threat warning within space and high altitude environments as well as the design and development of technologies and analytical tools for cyber risk assessment and mitigation in acquisition systems. The applied research and technology evaluations conducted under this Project leverage other DoD space science and technology applications to support space force enhancement and cooperative satellite payload development. Successful technologies emerging from this project transition for maturation and demonstration under the Space Applications Technology in program element 0603006A.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the US Army Space and Missile Defense Command (SMDC) in Huntsville, AL.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Tactical Space Research	1.596	1.695	2.725
Description: This effort designs, develops, and evaluates space-based technologies and components that lead to smaller, lighter, and more responsive payloads. These technologies allow for the rapid integration and development of tactical payloads in support of responsive space and high altitude environments.			
FY 2010 Accomplishments: Investigated multiple nano-satellite architectures and integration of multi-spectral and hyper-spectral bands for imaging sensors operating in high altitude and space environments; investigated use of multiple waveforms on single tactical radio relay payloads operating in high altitude and space environments; continued to conduct the Joint Space Experiment (JSE) for measurement of ground illumination.			
FY 2011 Plans: Develop component technologies for high altitude payloads and small satellites, such as sensor subsystems, data links/ cross links, propulsion, power, energy, guidance, navigation, and flight control; investigate protection technologies for uplinks,			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*	PROJECT TS1: *TACTICAL SPACE RESEARCH*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
downlinks, and cross-links of space and high altitude assets; investigate and design a Space Analysis Laboratory for component development, testing, and system integration for ground testing and evaluation in support of space and high altitude applications. ***FY 2012 Plans:*** Will continue development of advanced power technologies for use in space and high altitude payload efforts; will investigate and identify previously developed space sensor and power component technologies to implement in high altitude payloads; will begin tool development to support evaluations of cyber attack risks and remediation approaches for acquisition efforts, to include space and high altitude payloads and systems.			
Title: Space and Analysis Lab ***Description:*** This effort supports the design and analytic evaluations of space, high altitude, and cyberspace technologies. ***FY 2012 Plans:*** Will implement the design of the Space Analysis Lab to stand up an in-house capability to support component development and system integration for ground demonstrations and evaluation of space, high altitude, and cyberspace technology applications.	-	-	1.000
Accomplishments/Planned Programs Subtotals	1.596	1.695	3.725

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army			DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*	PROJECT TS2: *ROBOTICS TECHNOLOGY*	

COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
TS2: *ROBOTICS TECHNOLOGY*	15.156	15.566	12.328	-	12.328	13.925	16.400	16.470	16.750	Continuing	Continuing

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

The objective of this project is to investigate autonomous mobility technology that will enable near autonomous unmanned ground vehicles (UGVs). Technical efforts are focused on advancing perception for autonomous ground mobility, intelligent vehicle control and behaviors, human-robot interaction, robotic manipulation, and unique mobility for unmanned vehicles. The project also evaluates the basis for the Robotics Collaborative Technology Alliance (CTA), a tri-Service research consortium joining researchers from the Department of Defense (DoD), other Government agencies, industry and academia in a concerted, collaborative effort to advance key enabling robotic technologies.

The applied research conducted in this program will be transitioned to technology development, demonstration, and materiel acquisition programs being conducted by the Office of the Secretary of Defense Joint Ground Robotics Enterprise and each of the Services. Research supports collaborative efforts with Defense Advanced Research Projects Agency (DARPA).

Robotics Technology was previously funded in PE 0602618A, project H03 and was transferred to PE 0602120, project TS2 starting in FY10 to more accurately align the research.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) at the Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Robotics CTA	6.554	6.895	7.260
Description: Conduct research to evaluate capabilities for advanced perception, intelligent control and tactical behavior, human-robot interaction, robotic manipulation, and unique mobility for unmanned systems to conduct multiple military missions for a full range of robots from man-portable to larger systems. Research focuses on new sensor and sensor processing algorithms for rapid detection and classification of objects in the environment enabling safe high-speed mobility and intelligent tactical behavior by future unmanned systems; implementing adaptive control strategies that will enable unmanned systems to display intelligent tactical behavior, formulation of control strategies that will facilitate use of unmanned systems in populated environments and			

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*	PROJECT TS2: *ROBOTICS TECHNOLOGY*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
minimize the cognitive workload on Soldier operators, enable more dexterous manipulation of objects, and explore unique modes of mobility enabled by removing Soldiers from the vehicle. CTA research will be integrated into test beds to assess technology maturity. ***FY 2010 Accomplishments:*** Evaluated ways to improve understanding of urban scenes and activities to promote enhanced autonomous situational awareness for safe, effective operations and survivability, to enhance techniques to plan and execute missions in uncertain and dynamic environments, as well as to examine concepts for dexterous manipulation. ***FY 2011 Plans:*** Extend research to examine robot understanding of cues and activity permitting more 'human-like' control of unmanned systems; will research methods for improving perception in increasingly cluttered environments from both a static and dynamic perspective, and increase application of learning techniques to improve flexibility in unknown environments. ***FY 2012 Plans:*** Will develop lower cost sensory capability for smaller unmanned systems; will examine issues of trust in automation and develop a common "mental" picture between soldier and unmanned system; and will examine mid- and long- range scene recognition to facilitate tactical behavior in unmanned systems.			
Title: Perception and Intelligent Control ***Description:*** Develop perception and intelligent control technologies required to meet objective capabilities for future unmanned vehicles of multiple size scales and to transition this technology to advanced development programs being conducted under PE 0603005A (Combat Vehicle and Automotive Advanced Technology) project 515 (Robotic Ground Systems) for integration into test bed systems. Leverage DARPA sponsored research for control of collaborating agents to enable mixed teams (manned/ unmanned) to conduct military missions. ***FY 2010 Accomplishments:*** Evaluated perception and control algorithms for safe operations in dynamic urban environments. ***FY 2011 Plans:*** Investigate tactical behavior appropriate to military missions in 'urban-like' environments. ***FY 2012 Plans:*** Will focus upon improved shared understanding of tactical environment between soldier and unmanned systems.	4.853	4.828	3.824
Title: Autonomous Robotics Integration	3.749	3.843	1.244

Exhibit R-2A, RDT&E Project Justification: PB 2012 Army		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602120A: *Sensors and Electronic Survivability*	PROJECT TS2: *ROBOTICS TECHNOLOGY*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: Integrate technology on unmanned ground vehicle test beds and conduct extensive field evaluation and technology characterization to establish improved capability for near autonomous UGVs. Leverage algorithms being conducted under DARPA sponsored research, e.g., Learning Applied to Ground Robotics (LAGR). Conduct regular, periodic evaluation at Ft. Indiantown Gap, PA, and other military facilities that will stress the technology in complex environments to further focus CTA sponsored research, assess performance, and provide the opportunity for US Army Training and Doctrine Command to engage in the early development of the tactics, techniques, and procedures required for successful utilization of unmanned systems in future conflicts. ***FY 2010 Accomplishments:*** Evaluated ability to safely operate in mixed, dynamic, urban-like environments. ***FY 2011 Plans:*** Evaluate the ability of unmanned systems to maneuver intelligently and autonomously in urban-like environments. ***FY 2012 Plans:*** Will conduct initial assessments to establish baseline capability for unmanned systems to understand terrain and behaviors.			
Accomplishments/Planned Programs Subtotals	15.156	15.566	12.328

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.