Exhibit R-2, PB 2010 Army RDT&E Budget Item Justification								DATE: May 2009		
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 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	61.180	75.299	50.641						Continuing	Continuing
H15: GROUND COMBAT ID TECH	5.798	13.008	7.839						Continuing	Continuing
H16: S3I TECHNOLOGY	18.611	19.450	19.567						Continuing	Continuing
SA1: Sensors and Electronic Initiatives (CA)	22.463	29.304	.000						Continuing	Continuing
SA2: BIOTECHNOLOGY APPLIED RESEARCH	4.361	5.732	5.799						Continuing	Continuing
SA3: COMBAT IDENTIFICATION COMPONENT TECHNOLOGIES (CA)	2.319	.000	.000						Continuing	Continuing
TS1: TACTICAL SPACE RESEARCH	1.605	1.631	1.661						Continuing	Continuing
TS2: ROBOTICS TECHNOLOGY	.000	.000	15.775						Continuing	Continuing
140: HI-POWER MICROWAVE TEC	6.023	6.174	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this program element (PE) is to provide research and evaluation of sensors and electronic technologies that will enhance survivability, lethality, deployability, and sustainability capabilities. Focus is on research that will provide high-power electronic components and technologies for compact, light-weight power and energy storage, power and energy conversion, and conditioning and radio frequency (RF)/microwave directed energy (DE) weapons (Project 140 - moves to PE 0602705A in FY10 and FY11); research that will provide 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 sensor, signal, and information processing technology for advanced reconnaissance, surveillance, and target acquisition (RSTA) (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

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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) is related to and 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 Computer Science and Sensor Technology), PE 0603006A (Command, Control, Communications 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 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	62.910	46.147	40.993	
Current BES/President's Budget	61.180	75.299	50.641	
Total Adjustments	-1.730	29.152	9.648	
Congressional Program Reductions	.000	-.248		
Congressional Rescissions	.000	.000		
Total Congressional Increases	.000	29.400		
Total Reprogrammings	-.524	.000		
SBIR/STTR Transfer	-1.206	.000		

Change Summary Explanation

FY09 increase is due to congressional adds.

FY10 have net increases as funding was transferred from PE 0602618A, project H05 (Robotics Technology), and funding was transferred to PE 0602705, project EM8 (Hi-Power Microwave).

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COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H15: GROUND COMBAT ID TECH	5.798	13.008	7.839						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to research and investigate 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 demonstrate 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 coordinated with PE 0603270A (EW Technology), PE 0602270A (EW Techniques), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), 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.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Multi-Intelligence Data Fusion and Targeting: This effort investigates and develops software technologies for intelligence/battle command enterprise collaboration that enable the enterprise to identify, fuse, trace/track specific human targets in an asymmetric environment. In FY10, will develop data extraction tools to incorporate political military economic social information infrastructure and behavior modeling data into a Distributed Common Ground System - Army (DCGS-A) compliant multi-intelligence correlation service and integrate imagery and video data products for additional fidelity; will develop a video-based tracker service for real-time and forensic viewing and analysis; will functionally map battle command mission tasks with the needed intelligence and geospatial data and collection opportunities.	.000	.000	3.694	
Fusion Based Technologies: This effort develops a knowledge generation capability to provide actionable intelligence enabling timely decision-making by commanders and timely action by Soldiers in the execution of operations.	1.165	.000	.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY08, developed expanded set of representations for different types of enemy tactics to handle more complex scenarios including the prediction of locations of specific types of asymmetric attacks using real data. Related work is also accomplished under PE 0602270A/project 442, PE 0602270/project 906, and PE 0603772A/project 243.				
Combat Identification (CID) for Light Weight Tactical Vehicles: This effort researches the miniaturization of real time NATO interoperable CID technologies for current force light weight tactical vehicles that will have potential for Soldier CID. In FY09, investigate technologies to reduce the size, weight, cost, and power consumption of the processor, transceiver, and antenna components for the NATO interoperable Battlefield Target Identification Device (BTID) system for implementation on High Mobility Multi-Wheeled Vehicles; investigate large capacity field programmable gate arrays to reduce the processor and transceiver sizes; develop and demonstrate novel millimeter wave (mmW) antenna designs that produce a similar shaped antenna pattern within a smaller, lower profile configuration; and investigate approaches for target ID correlation. Related work is also accomplished under PE 0603270A/project K15.	.000	5.068	.000	
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.338	.000	
Combat Identification (CID) Technologies: Focus of this effort is to develop and evaluate potentially cost effective CID approaches that reduce fratricide, increase situational awareness (SA), and increase combat effectiveness of Soldier based and Brigade Combat Team (BCT) CID technologies. In FY08, conducted final technical testing of representative models of Geometric Pairing (GP) and Radio Frequency (RF) tag technologies in a high fidelity lab environment and final technical testing of millimeter wave (mmW) identification (ID) application specific integrated circuits (ASIC) in a high fidelity lab facility; completed regression tests of mmW ID ASICs to validate compliance with NATO Standardization Agreement, (STANAG) 4579; conducted virtual experiments with hardware in the loop for Brigade Combat Team (BCT) ground-to-ground technologies. In FY09, develop an integrated approach for a network enabled architecture to provide CID capability to Soldiers and close air support/strike aircraft; investigate embedding CID waveforms in the Joint Tactical Radio Systems; investigate non cooperative technologies for foe and neutral identification in a battlefield environment; investigate RF tags for air to ground Situational Awareness (SA) applications; develop a consolidated target identification and SA data display. In FY10, will assess technologies for incorporation into a universal/multi-platform CID capability. Candidate technologies include the Soldier Radio Waveform (SRW), Laser/RF Time Difference of Arrival (TDOA), and Geometric Pairing techniques at point of detection/response; will demonstrate CID/SA data display.	1.836	7.602	4.145	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Cueing Sensor: This effort develops low cost infrared sensors that detect rocket propelled grenades, anti-tank guided missiles, and kinetic energy, tank fired and high energy anti-tank rounds and then cues active protection system for Army vehicles. In FY08, optimized focal plane arrays design; enhanced sensor, electronics, and algorithms for on-the-move environment. Related work is also accomplished under PE 0603270A/project K16.	2.797	.000	.000	
Total	5.798	13.008	7.839	

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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APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602120A Sensors and Electronic Survivability					PROJECT NUMBER H16	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H16: S3I TECHNOLOGY	18.611	19.450	19.567						Continuing	Continuing

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, etc.

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, minefield replacements, counter terrorism operations, and munitions; tagging, tracking, and locating (TTL) of non-traditional targets; fusion of diverse sensors such as acoustic, seismic, magnetic including the micro electro mechanical system (MEMS) magnetic flux concentrator, 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 and track battlefield targets such as tanks, helicopters, etc., and locate gun fire; improved signal-to-noise ratio (SNR) and noise mitigation devices and algorithms; sensor technologies for the detection, tracking, and assessment of humans, especially in urban terrain; high performance multi-function radio frequency (RF) systems that allow target acquisition, combat identification (ID), active protection, surveillance, and communications systems consolidated into a single system, reducing system cost, and size; 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; aided/automatic target recognition (ATR) allowing sensors to autonomously locate and identify targets; Ultra-violet (UV) opto-electronics for battlefield sensors; 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; advanced information processing methods to provide automatic information technologies that utilize widely dispersed sensor and legacy information sources; sensor and eye protection against laser threats, and algorithms for acoustic sensors mounted on a Soldier's helmet to localize source of gunfire.

The work in this project is 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 Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Sensor and Data Fusion: Investigate and devise hyper-modal sensor data fusion for detecting and classifying human infrastructure in urban operations such as machinery, RF emissions, chemicals, and computers in hidden and confined spaces such as tunnels, caves, sewers, and buildings. In FY08, validated an integrated hyper-modal sensor test-bed tailored for urban operations; devised node-based algorithms for detecting human infrastructure and presence in hidden/confined spaces and established a database of co-registered, hyper-modal relevant signatures and features that are detectable with available sensor technologies. In FY09, investigate the application of sensor fusion algorithms and sensor networks to new Army applications, such as force protection and homeland security applications and investigate feasibility of a solar-blind 280-nanometer (nm) avalanche photodiode for Soldier protection. In FY10, will transition research from the US-UK International Technology Alliance, implement diverse modality sensor and information fusion for enhanced situational awareness for hostile fire defeat; advance the state of the art in optical, acoustic, RF, IR, retroreflection and other threat-detection sensors and fusion algorithms on UGS, man-wearable, vehicles, robots, and other airborne systems. Will pursue low-cost implementations of solar blind avalanche detector.	3.500	2.072	4.547	
Unattended Ground Sensors (UGS): Develop technologies for low-cost UGS to enhance persistent sensing capabilities. Research focus is based on opportunities and feedback from UGS used in Operation Iraqi Freedom and other theaters. A key focus is on detecting people. Investigate fusion algorithms using multi-modal sensing phenomenology including acoustic, seismic, magnetic, electric field (E-field), passive IR, and RF to increase probability of target detection and reduce false alarms. In FY08, prepared 1st generation multi-modal algorithms for fielding in Army UGS systems; evaluated use of hyperspectral technology, including band selection techniques for target detection; created image enhancement algorithm toolbox to enable feasibility studies; optimized and transitioned the high sensitivity magnetic sensor and extend advanced infrasonic algorithms to extract a larger class of transient events. In FY09, evaluate the combination of advanced imaging sensor types for ATR such as polarimetric FLIR with LADAR; extend autonomous acoustic sensing and processing algorithms to new platforms; investigate use of magnetic and E-field sensors on vehicles. In FY10, along with the United States Marine Corps and others, advance the Family of UGS concept to develop standard protocols and communications, implement acoustic wind and flow mitigation techniques on moving and airborne systems;	3.790	4.696	4.795	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
will expand transient classification capabilities; will enhance MEMS magnetic sensor sensitivity and detection algorithms; will evaluate non-erasable magnetic memory; will implement E-field sensor system to conduct target detection and subsurface imaging.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.063	.000	
Tagging Tracking and Locating (TTL): Conduct applied research to support advances in state-of-the-art clandestine TTL for non-traditional hostile force and non-cooperative targets. Specific technical objectives, products, and deliverables related to this effort are classified. This effort will directly support Communication-Electronics Research, Development, and Engineering Center's (CERDECs) advanced research in clandestine TTL. In FY09, research extremely wide ranging technologies that are applicable to clandestine TTL. In FY10, will identify technologies that have potential to achieve the goals of clandestine TTL and conduct research to mature these areas.	.000	1.397	.992	
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. In FY08, defined robotic asset control technologies and investigated bio-inspired asset behavior algorithm as software components within a stimulation environment. In FY09, conduct lab experiments in order to establish a baseline for evaluating the effectiveness of bio-inspired asset management for providing persistent surveillance for detecting and monitoring activity within a limited activity dynamic urban scene. From this baseline, devise and develop algorithms to scale to more complex scenes. In FY10, conduct 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).	2.165	2.604	2.500	
Sensor Protection: Research, develop, and validate electro-optical techniques and components to protect sensors and eyes from threat laser sources on the battlefield; target redesign of optical devices and explore new nonlinear optical materials for protection. In FY08, investigated large-area fast electro-optic shutter devices and evaluated nonlinear optical tandem limiters. In FY09, develop and evaluate demonstrator protection devices across the visible spectrum.	3.078	2.652	.000	
Ultra Wideband Radar:	3.739	3.680	3.333	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Develop technical underpinnings of ultra wideband (UWB) radar for several key Army concealed target detection technology requirements including landmine detection, through-the-wall sensing, and obstacle detection. Validate advanced computational electromagnetic algorithms and estimate performance of proposed radar systems as well as predict target signatures. Characterize target and clutter scattering behavior in support of advanced image formation and detection algorithm development. Transfer predictions and algorithms to landmine detection, through-the-wall sensing, and robotic perception programs. In FY08, collected and transitioned radar data for a collaborative sensor-fusion Improvised Explosive Device (IED)-detection field test. In FY09, devise radar concepts and supporting algorithms to enable Army ground vehicles to survey the forward looking hemisphere for concealed targets including hidden personnel and large arms caches in buildings and various mine deployments. In FY10, will implement effective target/clutter discrimination algorithms using advanced signal processing techniques including change detection. Devise rough-ground models to compute radar backscatter over UHF and L-band and compare to radar forward-looking measurements over road surfaces. Devise realistic CAD models for rooms of high complexity, including plumbing, heating ventilation, air-conditioning (HVAC) systems, wiring, etc.; compute radar images over typical sensing-through-the-wall (STTW) frequency band and compare the exact solution with approximate solver (Xpatch) to quantify approximations.				
Multi Function Radio Frequency System (MFRFS): 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/track, active protection, and munitions-command guidance. Develop Aluminum-Gallium-Nitride based semiconductor UV optoelectronics for communications and for photoluminescent detection of biological threats. In FY08, evaluated communication functionality with MFRFS demonstration array; investigated methods for increasing communication rates achievable with MFRFS hardware and explored integrated receiver/exciter design and developed methods for increasing frequency flexibility. Investigated UV laser development in the 280 nm to 340 nm range. In FY09, evaluate methods for detecting stationary dismounts using biometric signatures and develop waveforms and algorithms for implementing these techniques in MFRFS and high-power 280-nm light-emitting-diode (LED) sources.	2.339	2.286	3.400	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will develop algorithms to extract RF biometric signatures for CERDEC All-terrain Radar for Tactical Exploitation of moving target indicator (MTI) and Imaging Surveillance (ARTEMIS) - Program and explore sub-mmW phenomenology for application to human-borne IED detection. Pursue high-efficiency 280-nm LED sources.				
Total	18.611	19.450	19.567	

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 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
SA1: Sensors and Electronic Initiatives (CA)	22.463	29.304	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Sensors and Electronic Initiatives.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Urban Warfare Knowledge Base	.967	.000	.000	
Nanotechnologies Initiative	1.400	.000	.000	
Advanced Detection of Explosives Program	.966	2.325	.000	
Urban Warfare Analysis Center (UWAC)	1.933	.000	.000	
Center for Advanced Microelectronics Manufacturing (CAMM)	1.932	.000	.000	
High Brightness Diode-pumped Fiber Laser (HiBriD-FL)	1.545	.000	.000	
Single Crystal Chemical Vapor Deposition Diamond Thermal Management Elements for High-Energy Lasers	.965	.000	.000	
Wearable Video Capture System	.773	.775	.000	
Advanced Bonded Diamond for Optical Applications	1.932	.000	.000	
Electromagnetic Geolocation	.967	.000	.000	
Integrated Multi-Target Remote-Sensing Technology and Its Applications	1.933	.000	.000	
Land and Sea Special Operations (LASSO)	.966	.000	.000	
Terahertz Spectrometer Technology	1.545	.775	.000	
S31 Technology	.774	.000	.000	
Boston University Photonics Center	3.865	.000	.000	
Nanophotonic Devices (pending transfer to 622782)	.000	1.550	.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Command, Control, Communications and Computer Module (pending transfer to 622782)	.000	1.163	.000	
Semi-Autonomous or Unattended PsychOp and Recon Tool (SUPORT)	.000	2.326	.000	
Self-Deploying Autonomous Sensor Platforms for Situational Awareness	.000	3.875	.000	
Adaptive Infrastructure for SOF Experimentation	.000	2.326	.000	
Wearable Gyro-Compensated Personnel Tracking During GPS Interference	.000	.775	.000	
Lookout Small Scale Radar Program	.000	1.937	.000	
Intelligent Fault Protected Laser Diodes	.000	.775	.000	
Large Aluminum Nitride Crystals for Effective Deep Ultraviolet Sources	.000	.775	.000	
Advanced Magnetic Nanosensors for Defense Applications	.000	4.650	.000	
Advanced UV Light Diode Sensor Development	.000	1.550	.000	
Hydrogen Batteries for the Warfighter	.000	2.906	.000	
SBIR/STTR	.000	.821	.000	
Total	22.463	29.304	.000	

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 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
SA2: BIOTECHNOLOGY APPLIED RESEARCH	4.361	5.732	5.799						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to provide funding for 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 (ARL) and other Army laboratories, including the Natick Soldier Research, Development, and Engineering Center (NSRDEC) and Edgewood Chemical Biological Center (ECBC), 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 Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ICB: In FY08, designed biologically-based and inspired sensors and materials for "sense and respond" systems components and determined the feasibility of biologically inspired control and network systems for these devices, investigated high-throughput screening of microbe, and fuel candidates for microbial fuel cells, waste reclamation, and bioremediation. Optimized and performed side-by-side comparison evaluation of novel molecular recognition elements (MREs) and standard antibody using baseline methodologies. In FY09, optimize the design of biologically-based and inspired sensors and materials and investigate incorporation of biologically-inspired control systems and networks, investigate bioelectronic properties of biologically-derived conductive	4.361	5.583	5.799	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
nano-fibers. Establish supporting infrastructure to select MREs using novel micro-fluidic system. Design and fabricate novel materials for uncooled thermal imagers to reduce cost and power consumption. Optimize protein system for conversion of methane to methanol for fuels to reduce logistics burden. Optimize bio-inspired control system for data collection from networks to optimize information flow to users. Fabricate reversible adhesive pads based on gecko-inspired design and design integration with small robots for covert robotic surveillance. Transition MRE selection devices to ECBC and NSRDEC. In FY10, will fabricate and evaluate uncooled thermal detector materials, investigate scale-up of proteins for methane to methanol conversion, evaluate algorithms for optimized collection of data from sensor networks, and characterize reversible adhesive pads based on gecko-inspired design.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.149	.000	
Total	4.361	5.732	5.799	

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, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602120A Sensors and Electronic Survivability					PROJECT NUMBER SA3	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
SA3: COMBAT IDENTIFICATION COMPONENT TECHNOLOGIES (CA)	2.319	.000	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Combat Identification Component Technologies.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Network Enabled Combat Identification	2.319	.000	.000	
Total	2.319	.000	.000	

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, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602120A Sensors and Electronic Survivability					PROJECT NUMBER TS1	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
TS1: TACTICAL SPACE RESEARCH	1.605	1.631	1.661						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project researches and investigates technologies with the potential for space-based and high altitude applications. Applied research efforts include sensors and components, communications, signals and information processing, target acquisition, position/navigation, and threat warning within space and high altitude environments. The applied research and technology evaluation conducted under this effort leverages other DoD space science and technology applications to support space force enhancement 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. This project is designated as a DoD Space Program.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research / Small Business Technology Transfer Programs	.000	.046	.000	
Tactical Space Research: This effort designs, develops, and evaluates space-based technologies and components that lead to smaller, lighter, and more responsive payloads with plug and play standardization. These technologies allow for the rapid integration and development of tactical satellites in support of responsive space and high altitude. In FY08, completed concepts and began design of an Electro Optical/Infrared (EO/IR) imaging space sensor nano-satellite payload; investigated a small on-station digitally reprogrammable radio to provide non-line-of-sight communications from a high-altitude and/or space environment; designed an initial architecture to migrate an existing EO/IR moving target indicator (MTI) sensor to operate in a high altitude environment. In FY09, continue investigation of a small on-station digitally reprogrammable radio for insertion into a tactical radio relay payload for high altitude and/or space environments; begin design of on-board processor and communication links and mature existing software for an EO/IR MTI sensor payload to operate in a high altitude environment; conduct a Joint Space Experiment (JSE) with the US Air Force to measure illumination of the ground. In FY10, will investigate multi-nano-satellite architectures and integration of multiple spectral and hyper-spectral bands for imaging sensors operating in high altitude and space environments; will investigate use of multiple waveforms on	1.605	1.585	1.661	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
single tactical radio relay payloads operating in high altitude and space environments; will continue to conduct the JSE for measurement of ground illumination.				
Total	1.605	1.631	1.661	

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, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602120A Sensors and Electronic Survivability					PROJECT NUMBER TS2	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
TS2: ROBOTICS TECHNOLOGY	.000	.000	15.775						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to provide 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 provides the basis for the Collaborative Technology Alliance (CTA) in robotics, 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. Research within the CTA is conducted at the Army Research Laboratory, other DoD laboratories and research centers, National Institute of Standards and Technology, National Aeronautics and Space Administration, and Department of Energy research laboratories, as well as industry and academic institutions.

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), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Robotics CTA: Execute CTA 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	.000	.000	6.880	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
environments and 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. In FY10 will increase focus upon improved understanding of urban scenes and activities to promote enhanced autonomous situational awareness for safe, effective operations and survivability, to enhance techniques for planning and execution of missions in uncertain and dynamic environments, and to examine concepts for dexterous manipulation.				
Perception and Control: 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 Advanced Technology) project 515 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. In FY10, will investigate perception and control algorithms for safe operations in dynamic urban environments.	.000	.000	5.019	
Autonomous Robotics Integration: Integrate technology on unmanned ground vehicle test beds and conduct extensive field testing 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 testing 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. In FY10, will evaluate ability to safely operate in mixed, dynamic, urban-like environments.	.000	.000	3.876	
Total	.000	.000	15.775	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
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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.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602120A Sensors and Electronic Survivability					PROJECT NUMBER 140	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
140: HI-POWER MICROWAVE TEC	6.023	6.174	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to research and evaluate high-power electronic components and technologies. These technologies have application in compact, light-weight power and energy storage, power and energy conversion, and conditioning, radio frequency (RF)/microwave directed energy (DE) weapons, and traditional and non-traditional RF and laser electronic attack. This includes traditional jammers, RF Directed Energy Weapon (DEW) technology as well as the high power components that will significantly enhance the survivability and lethality of Army platforms and related systems. The DEW effort studies both RF microwave and laser system capabilities and effects against various threats such as off- and on-route mines and electronically guided and fuzed missiles and munitions. Required power system components include power generation and storage, high-temperature/high power devices, power converters, and power conditioning. The ongoing DE effects and power component work is coordinated with and, as appropriate, leveraged by DEW and power and energy programs in the Air Force, Navy, High Energy Laser Joint Technology Office, Defense Threat Reduction Agency, national labs, university consortia, and relevant industry and foreign partners.

The work in this project is coordinated with the Tank and Automotive Research, Development, and Engineering Center (TARDEC); the Armaments Research, Development, and Engineering Center (ARDEC); the Aviation and Missile Research, Development, and Engineering Center (AMRDEC); and the Communications and Electronics Research, Development, and Engineering Center (CERDEC).

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 on this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
High Energy Laser: Research novel solid-state laser concepts, architectures, and design components enabling High Energy Laser (HEL) technology for Army specific DEW applications. Exploit breakthroughs in laser technology and photonics basic research. Applied research will be conducted in close collaboration with domestic ceramic (and other) material vendors, university researchers, and major laser diode manufacturers.	2.412	2.434	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 2 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602120A Sensors and Electronic Survivability		PROJECT NUMBER 140		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY08, evaluated composite ceramic laser materials to increase laser power; evaluated volume Bragg grating based spectral narrowing of diode pumps for high brightness pumping schemes. Completed feasibility study of Tellurium Oxide (TeO2) for high power applications. In FY09, validate a new approach to highly power-scalable, eye-safe, fiber laser based on significant minimization of heat deposition into Erbium (Er) - doped fiber amplifier. This new approach will significantly increase the performance of the laser.					
Research and evaluate technologies related to DEW technology, electronic warfare (EW) survivability/lethality, and supporting high power components to enhance the survivability/lethality of Army platforms. In FY08, measured the RF susceptibility levels of threat sensors/communications of interest to CERDEC. Used data to identify system design requirements for counter electronic system. Built models to help predict the effective range of counter electronic system. Investigated susceptibility profiles of wireless network components. In FY09, design counter electronic system and conduct lab and/or field test to evaluate the capability. Investigate feasibility of using RF DE to electronically attack air threats of interest to Air Defense Artillery Center and AMRDEC for Enhanced Area Air Defense. Identify and acquire critical components of Unmanned Aerial Vehicles and evaluate failure levels. Transition data and system design to AMRDEC for further evaluation. Investigate EW interoperability issues between EW devices and communication systems.		1.329	1.422	.000	
High Power Devices: Research and evaluate materials and component structures that provide the higher energy density required by next generation Army systems such as electromagnetic armor, hybrid-vehicle propulsion electronics, directed energy sources, pulse power for future force systems, small unattended ground sensors, and Soldier systems. In FY08, advanced development of high-temperature Silicon Carbide (SiC) power modules for operation at power conversion levels >200 kW; determined that additional power is required to meet vehicle requirements. Investigated use of gallium-nitride (GaN) and diamond materials for use as direct energy converter in extended life batteries for unattended sensor and prognostics and diagnostics. Modeled Stirling engine characteristics and optimized parameters for battery charging loads determined by CERDEC. Investigated carbon-monoflourides alloys as anodes and continued work on high energy cathodes for lithium ion air batteries. In FY09, develop SiC power modules for operation at high temperature for power conversion levels >350 kW. Evaluate GaN and diamond materials for use as direct energy converter in extended life batteries for unattended sensor and prognostics and diagnostics.		2.282	2.232	.000	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.086	.000	
Total	6.023	6.174	.000	

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.