ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**

	COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	48396	62910	46147	40993	41457	42877	44332
140	HI-POWER MICROWAVE TEC	5355	6114	6194	6267	6315	6455	6600
H15	GROUND COMBAT ID TECH	5131	5934	13051	7915	7976	8153	8337
H16	S3I TECHNOLOGY	16922	18683	19514	19249	19437	20368	21317
SA1	Sensors and Electronic Initiatives (CA)	13800	23743					
SA2	BIOTECHNOLOGY APPLIED RESEARCH	3860	4474	5752	5874	5991	6125	6262
SA3	COMBAT IDENTIFICATION COMPONENT TECHNOLOGIES (CA)	2130	2384					
TS1	TACTICAL SPACE RESEARCH	1198	1578	1636	1688	1738	1776	1816

A. Mission Description and Budget Item Justification: The objective of this program is to research and evaluate technologies that will enhance the capabilities of the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Focus is on providing sensor, signal, and information processing technology for advanced reconnaissance, surveillance, and target acquisition (RSTA); ground-to-ground and air-to-ground combat identification (ID), fire control systems, fuzing, and guidance-integrated fuzing functions in future munitions; significantly improving the survivability, lethality, deployability, and sustainability of future tactical vehicles/platforms by devising 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 funds research, development, and evaluation of RF weapon technology, high energy laser technology, and high power components. Project H15 funds 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 H16 funds studies that will provide the Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. In project SA2, the Army Research Laboratory 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 conducts applied research focused on biological sensors and biological photovoltaic power generation. Work in SA2 will exploit breakthroughs in biotechnology basic research transitioning from the ICB to enable Future Force capabilities in sensors, electronics, and photonics. Projects SA1 and SA3 fund congressional special interest items. Project TS1 funds research, development, 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.

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 Department of Defense Research and Engineering Strategic Plan, the Army Science and Technology Master Plan, the Army Modernization Strategy, and the Army Posture Statement.

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

B. Program Change Summary	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008/2009)	48575	39826	41017
Current BES/President's Budget (FY 2009)	48396	62910	46147
Total Adjustments	-179	23084	5130
Congressional Program Reductions		-3216	
Congressional Rescissions			
Congressional Increases		26300	
Reprogrammings	683		
SBIR/STTR Transfer	-862		
Adjustments to Budget Years			5130

FY09 was increased for applied research for combat identification.

Sixteen FY08 congressional adds totaling $26300 were added to this PE.

($800) S3I Technology
($800) Wearable Video Capture System
($1000) Advanced Detection of Explosives Program
($1000) Electromagnetic Geolocation
($1000) Land and Sea Special Operations (LASSO)
($1000) Single Crystal Chemical Vapor Deposition Diamond Thermal Management Elements for high-energy lasers
($1000) Urban Warfare Knowledge Base
($1600) High Brightness Diode-pumped Fiber Laser (HIBriD-FL)
($1600) Nanophotonic Devices
($1600) Terahertz Spectrometer Technology
($2000) Advanced Bonded Diamond for Optical Applications
($2000) Center for Advanced Microelectronics Manufacturing (CAMM)
($2000) Integrated Multi-Target Remote-Sensing Technology and Its Applications
($2000) Urban Warfare Analysis Center (UWAC)
($4500) One-Step JP-6 Bio Diesel Fuel
($2400) Network Enabled Combat Identification (CID)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**140**

COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
140 HI-POWER MICROWAVE TEC	5355	6114	6194	6267	6315	6455	6600

A. Mission Description and Budget Item Justification: This project funds research and evaluation of traditional and non-traditional Radio Frequency (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/munitions. Realizing DEW capabilities for diverse targets at a variety of lethality levels and operational ranges requires optimizing the DEW system including devising compact, high density power systems meeting stringent weight and volume restrictions. System optimization relies on determining the most effective DEW parameters and system components needed to defeat classes of selected targets; i.e., determining the desired DE effects drives the DEW component and system design, including power. 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/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.

Work on this project is performed by the US Army Research, Development, and Engineering Command's Army Research Laboratory (ARL) in coordination with the Tank and Automotive Research, Development, and Engineering Center; the Armaments Research, Development, and Engineering Center; 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.

Accomplishments/Planned Program:	FY 2007	FY 2008	FY 2009
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 FY07, matured high temperature SiC power modules for power conversion levels >100 kW. Designed and built an isotope battery based on isotope material figures-of-merit, and SiC-conversion efficiencies. Measured efficiency of novel Stirling engine. In FY08, mature development of high-temperature SiC power modules for operation at power conversion levels >200 kW. Investigate 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. Model Stirling engine characteristics and optimize parameters for battery charging loads determined by CERDEC. Investigate carbon-monoflourides alloys as anodes and continue work on high energy cathodes for Li-Air batteries. In FY09, will develop SiC power modules for operation at high temperature for power conversion levels >350 kW. Will evaluate gallium-nitride (GaN) and diamond materials for use as direct energy converter in extended life batteries for unattended sensor and prognostics and diagnostics.	1354	2282	2232
Research and mature novel solid-state laser concepts, architectures, and design components enabling High Energy Laser (HEL)	1791	2412	2440

technology for Army specific DEW applications. Exploit breakthroughs in laser technology and photonics basic research to meet the stringent weight/volume requirements for Future Force platforms. Applied research will be conducted by ARL in close collaboration with domestic ceramic (and other) material vendors, university researchers, and major laser diode manufacturers. In FY07, investigated and evaluated the efficiency of the ultra-low quantum defect, high power "eye-safe" fiber laser (~1600 nm) with direct diode pumping by long-wavelength (InP) laser diodes (or surrogate narrowband fiber laser); conducted feasibility study of Tellurium Oxide (TeO2) as phase conjugate wavefront-correcting mirror for high power applications. In FY08, evaluate composite ceramic laser materials to increase laser power; evaluate volume Bragg grating based, spectral narrowing of diode pumps for high brightness pumping schemes. Complete feasibility study of TeO2 for high power applications. In FY09, will implement a new approach to the thin disk laser architecture based on edge pumping of a composite doped-undoped gain element.			
Investigate, 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 FY07, investigated integration of threat neutralization breadboard on countermine platforms and conducted lab/field experiment to show effectiveness. Investigated RF effects levels on threat mines of interest to CERDEC. Determined feasibility of RF DE countermine systems by identifying power/energy requirements. Designed and built counter smart mine concept to show proof of principle and transitioned to CERDEC/PM Close Combat Systems. Investigated susceptibility profiles of network components to assess vulnerability of Future Force network. In FY08, measure the RF susceptibility levels of threat sensors/communications of interest to CERDEC. Use data to identify system design requirements for counter electronic system. Build models to help predict the effective range of counter electronic system. Investigate susceptibility profiles of wireless network components. In FY09, will design experimental counter electronic system and will conduct lab and/or field test to evaluate the capability. Will 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. Will identify and acquire critical components of Unmanned Aerial Vehicles and evaluate failure levels. Will transition data and system design to AMRDEC for further evaluation. Will investigate susceptibility profiles for two Future Force systems.	2210	1326	1522
Small Business Innovative Research/Small Business Technology Transfer Programs		94	
Total	5355	6114	6194

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**H15**

COST (In Thousands)		FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H15	GROUND COMBAT ID TECH	5131	5934	13051	7915	7976	8153	8337

A. Mission Description and Budget Item Justification: This project funds research and investigation of 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 for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Efforts include research on enabling technologies to demonstrate a common battlespace picture for joint coalition situation awareness, reduction of weight and cost of previously developed CID systems, and evaluation of multiband radio frequency (RF) tags as a CID enabler. This project also funds research on embedded radio algorithm developments as well as Soldier RF Tag hardware for multiband and aerial platform interoperability. Efforts associated with this project increase the survivability and lethality of Coalition Forces by providing fusion of battlefield sensor and situational awareness data to identify friend from foe, thereby, reducing fratricide incidents across the battlefield. Additionally, this project funds investigations of cost-effective sensors for use in threat warning systems for enhanced battlefield situation awareness and target cueing for Army ground combat vehicles. Coordination will be accomplished with other services, allies, and coalition partners. Efforts in this program element (PE) are coordinated with PE 0603270A (EW Technology), PE 0602270A (EW Techniques), and PE 0603772A (Advanced Tactical Computer Science and Sensor 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 Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2007	FY 2008	FY 2009
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 FY07, designed Geometric Pairing (GP) and RF Tag hardware for the ground Soldier to demonstrate dismounted integration concepts and technical performance characteristics; conducted first technical evaluation of GP situation awareness and RF Tag concepts. In FY08, conduct final technical testing of representative models of GP and RF Tag technologies in a high fidelity lab environment and final technical testing of millimeter wave (mmW) ID application specific integrated circuits (ASIC) in a high fidelity lab facility; complete regression tests of mmW ID ASICs to validate compliance with STANAG (NATO Standardization Agreement) 4579; conduct virtual experiments with hardware in the loop for BCT ground-to-ground technologies. In FY09, will develop an integrated approach for a network enabled architecture that will provide CID capability to Soldiers and Close Air Support/Strike Aircraft; will investigate embedding CID waveforms in the Joint Tactical Radio Systems; will investigate non cooperative technologies for foe and neutral identification in a battlefield environment; will investigate RF Tags for Air to Ground SA applications; will develop a consolidated target identification and SA data display. Related work is also accomplished under PE 0603270A, Project K16.	1612	1835	7831
Fusion Based Technologies: This effort develops an advanced knowledge generation capability to provide actionable intelligence enabling timely decision-making by commanders and timely action by Soldiers in the execution of operations. In FY07, demonstrated capabilities in identification and tracking of force aggregates in information noisy scenarios with realistic terrain characteristics and demonstrated initial capabilities for inferring enemy objectives/intent in conventional and asymmetric scenarios. In FY08, develop	672	1153	

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.			
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 cue active protection system for Army vehicles. In FY07, developed cueing sensor algorithms and processing; performed live-fire test of prototype sensors and systems. In FY08, optimize focal plane arrays design; enhance sensor, electronics, and algorithms for on-the-move environment. Related work is also accomplished under PE 0602270A, Project 442; PE 0603270A, Project K15; and PE 0603772A, Project 243.	2847	2807	
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, will 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; will investigate large capacity field programmable gate arrays to reduce the processor and transceiver sizes; will develop and demonstrate novel mmW antenna designs that will produce a similar shaped antenna pattern within a smaller, lower profile configuration; and will investigate approaches for target ID correlation. Work related to this effort is also being accomplished under PE 0603270A, Project K15.			5220
Small Business Innovative Research/Small Business Technology Transfer Programs		139	
Total	5131	5934	13051

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**H16**

COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H16 S3I TECHNOLOGY	16922	18683	19514	19249	19437	20368	21317

A. Mission Description and Budget Item Justification: The objective of this project is to provide the future Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. This project is focused on applied research of advanced sensors, signal processing, and information technologies to enable these capabilities for the Future Force and other emerging thrusts. The ultimate impact and utility of this work will be to protect Soldiers and to greatly increase their lethality, range, and speed of engagement. 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. Cost reduction is a key focus. Significant areas of research include: low cost sensors designed to be employed in large numbers as unattended ground sensors (UGS) for force protection, 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, etc.; low cost acoustic, seismic, and magnetic sensors that can passively detect and track battlefield targets such as tanks, helicopters, etc., and locate gun fire; sensor technologies for the detection and tracking 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; Opto-Electronic (OE) interconnects and processors are being built to greatly speed the movement of information within and between electronic digital processing units to facilitate smart sensors, adaptive sensors, and sensor fusion; 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.

Work is coordinated with Army organizations, particularly the Night Vision Electronic Sensors Directorate, 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 program element (PE) 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technologies), and PE 0603001A (Warfighter Advanced Technology).

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

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.

Accomplishments/Planned Program:	FY 2007	FY 2008	FY 2009
Develop technologies for low-cost UGS to enhance persistent Army sensing capabilities. Research focus is based on opportunities and feedback from UGS used in Operation Iraqi Freedom. A key focus is on detecting people. Investigate fusion algorithms using multi-	3630	3779	4696

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 FY07, devised and matured algorithms for low cost persistent sensing and change detection. Designed biomimetic acoustic sensing systems for a helmet mounting; evaluated low cost, high sensitivity magnetic sensor, and evaluated E-field sensor suitability for low cost UGS. Designed and evaluated fusion algorithms for multi-band IR sensor target detection; integrated advanced multi-target tracking techniques for imagery to enhance force protection and adapted ATR methods for multimodal fusion. In FY08, prepare 1st generation multi-modal algorithms for fielding in Army UGS systems; evaluate use of hyperspectral technology, including band selection techniques for target detection; create image enhancement algorithm toolbox to enable feasibility studies; optimize and transition the high sensitivity magnetic sensor and extend advanced infrasonic algorithms to extract a larger class of transient events. In FY09, will evaluate the combination of advanced imaging sensor types for ATR such as polarimetric FLIR with LADAR; will extend autonomous acoustic sensing and processing algorithms to new platforms; will investigate use of magnetic and E-field sensors on vehicles.			
Investigate and mature 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 FY07, designed detection algorithms and began sensor fusion algorithm maturation for imagery. Evaluated a correlation matrix to establish relationships between sensor detection capabilities and relevant target signatures. Collected additional multimodal data. In FY08, experimentally validate an integrated hyper-modal sensor test-bed tailored for urban operations; devise node-based algorithms for detecting human infrastructure and presence in hidden/confined spaces and establish a database of co-registered, hyper-modal relevant signatures and features that are detectable with available sensor technologies. In FY09, will investigate the application of sensor fusion algorithms and sensor networks to new Army applications, such as force protection and homeland security applications.	3610	3500	2072
Conduct applied research to support advances in state-of-the-art clandestine Tagging, Tracking, and Locating (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 advanced research in clandestine TTL. In FY09, will research extremely wide ranging technologies that are applicable to clandestine TTL. Will identify technologies that have potential to achieve the goals of clandestine TTL and conduct research to mature these areas.			1397
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 FY07, designed and evaluated multi-element magneto-optical switches and characterized response time. In FY08, investigate large-area fast electro-optic shutter devices and evaluate nonlinear optical tandem limiters. In FY09, will develop and evaluate demonstrator protection devices across the visible spectrum.	2578	3078	2652
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 FY07, matured advanced through-the-wall imaging capabilities consistent with a randomized, distributed array implementation concept. In FY08, examine techniques to combine radar data with other advanced perception sensors to improve obstacle detection on autonomous navigation systems. In FY09, will 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.	3051	3739	3807

Develop Multi Function Radio Frequency System (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 Ultra-Violet (UV) optoelectronics for covert line-of-sight and non-line-of-sight communications and for photoluminescent detection of biological threats. In FY07, established MFRFS radar model for use in analyzing the radar limitations in adverse environments and evaluated RF imaging and collision avoidance radar for robotic perception. Explored high-brightness active regions for light emitting diodes and lasers operating at wavelengths below 300 nm for UV covert communications and bio-agent detection. In FY08, evaluate communication functionality with MFRFS demonstration array ; investigate methods for increasing communication rates achievable with MFRFS hardware and explore integrated receiver/exciter design and develop methods for increasing frequency flexibility. Investigate UV laser development in the 280 nm to 340 nm range. In FY09, will evaluate methods for detecting stationary dismounts using biometric signatures and develop waveforms and algorithms for implementing these techniques in MFRFS. Will investigate feasibility of a solar-blind 280 nm avalanche photodiode.	1553	2339	2286
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 FY07, explored robotic asset management and control technologies in order to enable semi-autonomous assets with the ability to provide persistent surveillance. In FY08, define robotic asset control technologies and investigate bio-inspired asset behavior algorithm as software components within a stimulation environment. In FY09, will conduct lab experiments in order 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, will devise and develop algorithms to scale to more complex scenes.	2500	2165	2604
Small Business Innovative Research/Small Business Technology Transfer Programs		83	
Total	16922	18683	19514

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**SA2**

COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
SA2 BIOTECHNOLOGY APPLIED RESEARCH	3860	4474	5752	5874	5991	6125	6262

A. Mission Description and Budget Item Justification: The objective of this project is to transition biotechnology research from the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center (UARC). 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). The ICB is focused on advancing the survivability of both the Soldier and weapons systems through fundamental breakthroughs in the area of biotechnology. This project will conduct applied research that transitions breakthroughs in biotechnology basic research from the ICB to enable revolutionary Future Force 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. This applied research effort will ensure that the basic science developed at the ICB is directed towards and transitioned to Army devices and systems. The in-house research program (~20%) will link the ICB research to Army requirements and enhance the transition of this technology into the Army. Most of the 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 Army seeks to provide the interdisciplinary fundamental knowledge and technical capabilities to manipulate biological systems and components, and to exploit biologically derived products and processes for both the Soldier and engineered systems and platforms. The process of transformation requires revolutionary advances in performance of Army weapons systems, including improvements in engineered systems impacting Soldier survivability.

Work in this project is performed by ARL in coordination with ECBC, NSRDEC, and other Army laboratories.

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.

Accomplishments/Planned Program:	FY 2007	FY 2008	FY 2009
Institute for Collaborative Biotechnologies: In FY07, identified biologically-based and inspired sensors and materials to design and fabricate "sense and respond" system components, investigated biologically-inspired control, and networking capability for these systems; evaluated the biological sensors in a relevant environment and transitioned to ECBC and/or NSRDEC. Began fabrication of microbial fuel cells and optimize power output for low power sensor applications. Established baseline methodologies for comparisons of novel molecular recognition elements (MREs) devised using rapid micro-fluidic screening and currently used antibodies. In FY08, design biologically-based and inspired sensors and materials for "sense and respond" systems components and determine the feasibility of	3860	4359	5752

biologically inspired control and network systems for these devices, investigate high-throughput screening of microbe, and fuel candidates for microbial fuel cells, waste reclamation, and bioremediation. Optimize and perform side-by-side comparison evaluation of novel MREs and standard antibody using baseline methodologies. In FY09, will 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 nano-fibers. Will 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 and scale-up protein system for conversion of methane to methanol for fuels to reduce logistics burden. Optimize bio-inspired control system for collection of data 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.			
Small Business Innovative Research/Small Business Technology Transfer Programs		115	
Total	3860	4474	5752

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2008

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**TS1**

COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
TS1 TACTICAL SPACE RESEARCH	1198	1578	1636	1688	1738	1776	1816

A. Mission Description and Budget Item Justification: The objective of this project is to design, develop, and evaluate space-based technologies that provide the ground commander with the ability to identify and exploit opportunities early as well as to enhance planning for and conducting operations. Critical Army Required Capabilities identified in the Army Space Master Plan include the need for increased situational awareness; the ability to network, communicate, and share information, and the ability to control, direct, and download information from space and high altitude assets within the theater. Focus of this project is on space and high altitude based sensors, signal, and information processing technology; advanced intelligence, surveillance, and reconnaissance (ISR) capabilities; battle command, control, and communications; target acquisition; position/navigation; threat warning; and space superiority technologies with the potential to provide ground forces relevant and timely information to influence operations. 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. This includes applied research in technologies that provide the theater forces with persistent intelligence, surveillance, and reconnaissance and dedicated communications payloads that can be integrated into high altitude long loiter and tactically responsive space platforms. Validated and executable technologies emerging from this project will 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 Space and Missile Defense Technical Center in Huntsville, AL. This project is designated as a DoD Space Program.

Accomplishments/Planned Program:	FY 2007	FY 2008	FY 2009
In FY07, in cooperation with the Naval Research Laboratory (NRL) designed and analyzed very small (~20 pounds) sensor and communication payload technologies, including on-orbit reprogrammable software radios, optical sensor with direct downlink, multiple phenomena using a common aperture, and multi-spectral surveillance Electro-Optical / Infra Red (EO / IR), for Army assured communications and persistent Intelligence, Surveillance, and Reconnaissance (ISR) applications; supported the Operationally Responsive Space (ORS) Office in evaluating the technical maturity of responsive space payloads, including kinetic event detection, small Synthetic Aperture Radar (SAR) packages, Communications / Intelligence mapping, and Communications On-The-Move. In FY08, select best very small sensor and communications payload technology candidates for breadboard development; identify ORS payload technologies suitable for Army applications and build breadboards for further assessment. In FY09, will verify sensor and communications very small payload breadboard performance in a laboratory environment and identify candidates for further maturation; will assess performance of ORS payload technologies in a laboratory simulated high-altitude environment to assess viability for further development and maturation in a space environment.	1198	1534	1636
Small Business Innovative Research / Small Business Technology Transfer Programs		44	
Total	1198	1578	1636