| Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification | | | | | | | | | | | DATE: February 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | | | | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | | | | | | | |
| **COST ($ in Millions)** | **FY 2009 Actual** | **FY 2010 Estimate** | **Base FY 2011 Estimate** | **OCO FY 2011 Estimate** | **Total FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 76.213 | 70.272 | 48.929 | 0.000 | 48.929 | 50.543 | 55.582 | 62.063 | 68.331 | 0 | 480.862 |
| 140: *HI-POWER MICROWAVE TEC* | 6.087 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | Continuing |
| H15: *GROUND COMBAT ID TECH* | 12.669 | 7.798 | 7.874 | 0.000 | 7.874 | 8.015 | 8.670 | 11.816 | 12.954 | Continuing | Continuing |
| H16: *S3I TECHNOLOGY* | 19.388 | 19.465 | 17.910 | 0.000 | 17.910 | 18.990 | 21.935 | 23.357 | 24.781 | Continuing | Continuing |
| SA1: *Sensors and Electronic Initiatives (CA)* | 30.900 | 18.304 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | Continuing |
| SA2: *BIOTECHNOLOGY APPLIED RESEARCH* | 5.584 | 5.769 | 5.884 | 0.000 | 5.884 | 5.985 | 6.295 | 6.703 | 7.306 | Continuing | Continuing |
| TS1: *TACTICAL SPACE RESEARCH* | 1.585 | 1.652 | 1.695 | 0.000 | 1.695 | 1.725 | 2.757 | 3.787 | 4.815 | Continuing | Continuing |
| TS2: *ROBOTICS TECHNOLOGY* | 0.000 | 15.693 | 15.566 | 0.000 | 15.566 | 15.828 | 15.925 | 16.400 | 18.475 | Continuing | Continuing |

**A. Mission Description and Budget Item Justification**

The focus of this program element (PE) is to provide research and evaluation of sensors and electronic technologies that enhance survivability, lethality, deployability, and sustainability capabilities. Focus is on research that provides high-power electronic components and technologies for compact, light-weight power and energy storage, conversion, and conditioning, and radio frequency (RF)/microwave directed energy (DE) weapons (Project 140 - moves to PE 0602705A in FY10 and FY11); 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 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 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

| Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification | DATE: February 2010 |
|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* |

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 2009 | FY 2010 | FY 2011 Base | FY 2011 OCO | FY 2011 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 75.299 | 50.641 | 50.836 | 0.000 | 50.836 |
| Current President's Budget | 76.213 | 70.272 | 48.929 | 0.000 | 48.929 |
| Total Adjustments | 0.914 | 19.631 | -1.907 | 0.000 | -1.907 |
| • Congressional General Reductions | | -0.369 | | | |
| • Congressional Directed Reductions | | | | | |
| • Congressional Rescissions | | 0.000 | | | |
| • Congressional Adds | | 20.000 | | | |
| • Congressional Directed Transfers | | | | | |
| • Reprogrammings | 2.417 | 0.000 | | | |
| • SBIR/STTR Transfer | -1.503 | 0.000 | | | |
| • Adjustments to Budget Years | 0.000 | 0.000 | -1.907 | 0.000 | -1.907 |

**Change Summary Explanation**

FY10 Congressionally directed increases.

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>140: *HI-POWER MICROWAVE TEC* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total 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* | 6.087 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | Continuing |

**A. Mission Description and Budget Item Justification**

IN FY10, THIS EFFORT WAS MOVED TO PE 0602705A/PROJECT EM8.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 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 2.232 | 0.000 | 0.000 | 0.000 | 0.000 |
| 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 FY09, developed Silicon Carbide (SiC) power modules that operate at high temperature for power conversion levels >350 kW. Evaluated gallium nitride (GaN) and diamond materials for use as direct energy converter in extended life batteries for unattended sensor and prognostics and diagnostics applications. | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>140: *HI-POWER MICROWAVE TEC* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2<br><br>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. Conduct applied research in close collaboration with domestic ceramic (and other) material vendors, university researchers, and major laser diode manufacturers. In FY09, validated a new approach to developing highly power-scalable, eye-safe, fiber laser based on significant minimization of heat deposition into Erbium (Er) - doped fiber amplifier. This new approach significantly increased laser performance.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base | 2.434 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>140: *HI-POWER MICROWAVE TEC* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #3<br>Directed Energy: Research and evaluate technologies related to DEW technology, electronic warfare (EW) survivability/lethality, and associated high power components to enhance survivability/lethality of Army platforms. In FY09, designed a counter electronic system and conducted lab test to evaluate the capability. Investigated feasibility of using RF DE to electronically attack air threats of interest to the Air Defense Artillery Center and AMRDEC for Enhanced Area Air Defense. Identified and acquired critical components of Unmanned Aerial Vehicles and evaluated failure levels. Transitioned data and system design to AMRDEC for further evaluation. Investigated EW interoperability issues between EW devices and communication systems.<br>*FY 2009 Accomplishments:*<br>FY 2009<br>*FY 2010 Plans:*<br>FY 2010<br>*Base FY 2011 Plans:*<br>FY 2011 Base<br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 1.421 | 0.000 | 0.000 | 0.000 | 0.000 |
| Program #4<br>Small Business Innovative Research/Small Business Technology Transfer Programs | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>140: *HI-POWER MICROWAVE TEC* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Accomplishments/Planned Programs Subtotals | 6.087 | 0.000 | 0.000 | 0.000 | 0.000 |

**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 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H15: *GROUND COMBAT ID TECH* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total 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* | 12.669 | 7.798 | 7.874 | 0.000 | 7.874 | 8.015 | 8.670 | 11.816 | 12.954 | Continuing | Continuing |

**A. Mission Description and Budget Item Justification**

Efforts in this project 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 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 Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 7.602 | 4.124 | 4.557 | 0.000 | 4.557 |
| Combat Identification (CID) Technologies: 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. In FY09, developed an integrated approach for a network enabled architecture to provide CID capability to Soldiers and close air support/strike aircraft; investigated embedding CID waveforms in the Joint Tactical Radio Systems; investigated non-cooperative technologies for foe and neutral identification in a battlefield environment; investigated radio frequency (RF) tags for air to ground Situational Awareness (SA) applications; developed a consolidated target identification and SA data display. In FY10, 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; demonstrate CID/SA data display. In FY11, will model fusion algorithms for improved battlespace awareness to include geolocation and target identification algorithms utilizing blue force emitter information to resolve current radar warning receiver sensor ambiguities; will link to Distributed Common Ground System-Army | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H15: *GROUND COMBAT ID TECH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| (DCGS)-A Enterprise for initial evaluation/User Jury to obtain user community feedback and recommendations for algorithm improvements; will perform communication and network modeling and simulation. Related work is also accomplished under PE 0603270A/project K16.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2<br><br>Multi-Intelligence Data Fusion and Targeting: 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 (ISR) planning and execution at the task force/battalion level through troop-level as well as efforts that enable the enterprise to identify, fuse, trace/track specific human targets in an asymmetric environment. In FY10, develop, integrate and demonstrate a multi-Intelligence sensor manager and planner into Distributed Common Ground System-Army (DCGS)-A and Tactical Ground Reporting Network (TiGRNet); functionally map battle command mission tasks with the needed intelligence and geospatial data and collection opportunities; develop data extraction tools to incorporate political military economic social information infrastructure and behavior modeling data DCGS-A compliant multi-intelligence correlation service and integrate imagery and video data products for additional fidelity; develop a video-based tracker service | 0.000 | 3.485 | 3.317 | 0.000 | 3.317 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H15: *GROUND COMBAT ID TECH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| for real-time and forensic viewing and analysis. In FY11, will associate Intel requirements, Geolocation data needs and collection opportunities with operational mission tasks for Intel and BC communities; will mature common architecture and framework to provide a portable software environment, storage and access for Intel and Operations communities. Related work is also being accomplished under PE 0602270A/project 906.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #3<br><br>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, investigated 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; investigated large capacity field programmable gate arrays to reduce the processor and transceiver sizes; developed and demonstrated novel millimeter wave (mmW) antenna designs to achieve required antenna pattern with a smaller, lower profile configuration; and investigated approaches for target ID correlation. Related work is also accomplished under PE 0603270A/project K15. | 5.067 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H15: *GROUND COMBAT ID TECH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #4<br>Small Business Innovative Research/Small Business Technology Transfer Programs<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 0.189 | 0.000 | 0.000 | 0.000 |
| Accomplishments/Planned Programs Subtotals | 12.669 | 7.798 | 7.874 | 0.000 | 7.874 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H15: *GROUND COMBAT ID TECH* |

**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 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | FY 2014 Estimate | FY 2015 Estimate | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H16: *S3I TECHNOLOGY* | 19.388 | 19.465 | 17.910 | 0.000 | 17.910 | 18.990 | 21.935 | 23.357 | 24.781 | 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, counter terrorism operations, and munitions; tagging, tracking, and locating (TTL) of non-traditional targets; fusion of diverse sensors such as acoustic, seismic, 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 and track battlefield targets such as personnel, heavy/light vehicles, 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.Work in this area is performed by the Army Research Laboratory (ARL), Adelphi, MD.

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 4.696 | 4.762 | 6.042 | 0.000 | 6.042 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| 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 FY09, evaluated the combination of advanced imaging sensor types for ATR such as polarimetric FLIR with LADAR; extended autonomous acoustic sensing and processing algorithms to new platforms; investigated 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; expand transient classification capabilities; enhance MEMS magnetic sensor sensitivity and detection algorithms; evaluate non-erasable magnetic memory; implement E-field sensor system to conduct target detection and subsurface imaging. In FY11, will implement family of UGS concepts with multiple UGS vendors; will enhance acoustic localization accuracy through meteorological correction of solution vectors; will exploit acoustic, seismic, magnetic, and electric fields for locating, reliable target characterization, and classification; and will implement airborne multimodal sensing of targets.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2 | 2.072 | 4.515 | 4.722 | 0.000 | 4.722 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total 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 personnel, vehicles, machinery, RF emissions, chemicals, and computers in hidden and confined spaces such as tunnels, caves, sewers, and buildings. In FY09, investigated the application of sensor fusion algorithms and sensor networks to new Army applications, such as force protection and hostile fire defeat (sniper detection/defeat), and homeland security applications, and investigate feasibility of a solar-blind 280-nanometer (nm) avalanche photodiode for Soldier protection. In FY10, transition sensor fusion research from the US-UK International Technology Alliance to support Coalition Warfare Programs; implement diverse modality sensor and information fusion for enhanced situational awareness for hostile fire defeat; experimentally validate optical, acoustic, E-field, RF, IR, retroreflection and other threat-detection sensors and fusion algorithms on UGS, man-wearable, vehicles, robotic, and other airborne systems. Assess low-cost implementations of solar blind avalanche detector. In FY11, will implement novel fusion methodologies, and decentralized and distributed data fusion using heterogeneous sensor systems, platforms, and networks to perform enhanced detection, tracking, and classification of threats, exploit multi-modal sensing and fusion concepts to characterize underground facilities, materiel and tunnels, and develop new policy-based sensor information algorithms for robust communication up to coalition level. Will implement new computationally efficient anomaly detection algorithms for imaging target recognition.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #3 | 1.397 | 0.985 | 1.028 | 0.000 | 1.028 |
| Tagging Tracking and Locating (TTL):Conduct applied research to support advances in state-of-the-art clandestine TTL for non-traditional hostile forces 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 (CERDEC) advanced research in clandestine TTL. In FY09, researched extremely wide ranging technologies that are applicable to clandestine TTL. In FY10, identify technologies that have the potential to achieve the goals of clandestine TTL and conduct research to mature these areas. In FY11, will design, fabricate, and evaluate TTL devices for transition to CERDEC.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #4 | 2.652 | 0.000 | 0.000 | 0.000 | 0.000 |
| Sensor Protection:Research, develop, and validate electro-optical techniques and components to protect sensors and eyes from threat laser sources on the battlefield; explore redesign of optical devices and new nonlinear optical materials for enhanced protection. In FY09, developed and evaluated demonstrator protection devices across the visible spectrum. | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #5<br>Ultra Wideband Radar: 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. Characterize target and clutter scattering behavior in support of advanced image formation and detection algorithm development. Transfer predictions and algorithms to landmine detection, STTW, and robotic perception programs. In FY09, devised 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, 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 computer-aided-design (CAD) models for rooms of high complexity, including plumbing, heating ventilation, air-conditioning (HVAC) systems, wiring, etc.; compute radar images over typical STTW frequency band and compare the exact solution with approximate solver (Xpatch) to quantify approximations. In FY11, will | 3.680 | 3.310 | 2.271 | 0.000 | 2.271 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| investigate advanced Improvised Explosive Device (IED)-discrimination algorithms that exploit physics-based features to reduce false alarms in low-artifact radar imagery.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #6<br><br>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/tracking, active protection, and munitions-command guidance. Develop Aluminum-Gallium-Nitride based semiconductor UV optoelectronics for communications and for photoluminescent detection of biological threats. In FY09, evaluated methods for classifying dismounted Soldiers using biometric signatures. Developed waveforms and algorithms for implementing biometric techniques in an unattended compact radar. Researched high-power 280-nm light-emitting-diode (LED) sources for UV opto-electronic applications. In FY10, 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-millimeter Wave (mmW) phenomenology for application to human-borne IED detection. Pursue high-efficiency 280-nm LED sources. In FY11, will apply RF biometric algorithms to an unattended compact radar for perimeter watching as part of a | 2.286 | 3.365 | 1.236 | 0.000 | 1.236 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| larger Unmanned Ground System network and establish baseline designs of a sub-mmW imager for human-borne IED detection. Extend UV source research to 250-nm optical source.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #7<br><br>Information Fusion: 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 FY09, conducted lab experiments 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, devised and developed 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). In FY11, will 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. | 2.605 | 2.392 | 2.611 | 0.000 | 2.611 |

| **Exhibit R-2A**, PB 2011 Army **RDT&E Project Justification** | | **DATE:** February 2010 |
|---|---|---|
| **APPROPRIATION/BUDGET ACTIVITY**<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | **R-1 ITEM NOMENCLATURE**<br>PE 0602120A: *Sensors and Electronic Survivability* | **PROJECT**<br>H16: *S3I TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #8<br>Small Business Innovative Research/Small Business Technology Transfer Programs<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 0.136 | 0.000 | 0.000 | 0.000 |
| Accomplishments/Planned Programs Subtotals | 19.388 | 19.465 | 17.910 | 0.000 | 17.910 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>H16: *S3I TECHNOLOGY* |

**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 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total 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)* | 30.900 | 18.304 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 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 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 2.392 | 1.591 | 0.000 | 0.000 | 0.000 |
| Advanced Detection of Explosives Program. In FY09 this Congressional Interest Item accelerated development of an innovative remote sensor monitoring technology designed to lead to a mobile test bed for advanced stand-off detection of explosives.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2 | 0.797 | 0.796 | 0.000 | 0.000 | 0.000 |

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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Wearable Video Capture System. In FY09 this Congressional Interest Item developed wearable video capturing technology for soldier applications. The program improved on optical designs and electronics to better meet Army applications.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #3<br><br>Terahertz Spectrometer Technology. This Congressional Interest Item developed a system demonstrator that improves signal to noise ratio and lessens scan time for more rapid spectrum acquisition.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base | 0.797 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #4<br>Semi-Autonomous or Unattended PsychOp and Recon Tool (SUPORT). This Congressional Interest Item developed open architecture software that can autonomously control unattended ground sensors and various Psy-Op tools.<br>*FY 2009 Accomplishments:*<br>FY 2009<br>*FY 2010 Plans:*<br>FY 2010<br>*Base FY 2011 Plans:*<br>FY 2011 Base<br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 2.392 | 0.000 | 0.000 | 0.000 | 0.000 |
| Program #5<br>Self-Deploying Autonomous Sensor Platforms for Situational Awareness. This Congressional Interest Item conducted research and development of nanotechnology useful for defining novel sensors and confirmers that were applicable to the development of a point bio-aerosol detection system that combined a high-confidence IR trigger, sample collector and immunoassay-based identifier in a single integrated unit responsive to the Joint Biological Tactical Detection System (JBTDS) program and the basic framework for integrating the next-generation CB sensors on a mobile platform that is capable of addressing the requirements of the Chemical Biological Distributed Early Warning System (CBEWS) program. | 3.987 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #6<br>Adaptive Infrastructure for SOF Experimentation. This Congressional Interest Item researched capitalization of the emerging wireless networks with various Unmanned Vehicles (UV's) and other battlefield equipment allowed increased capability to our warfighters.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 2.392 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #7 | 0.797 | 0.000 | 0.000 | 0.000 | 0.000 |
| Wearable Gyro-Compensated Personnel Tracking During GPS Interference. This Congressional Interest Item developed initial prototypes for testing, conducted operational evaluations, and delivered a number of final systems for formal Army testing and evaluation.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #8 | 1.993 | 0.000 | 0.000 | 0.000 | 0.000 |
| Lookout Small Scale Radar Program. This Congressional Interest Item developed the Lookout Small Scale Radar (LSSR) which ultimately is to be mounted on a Special Operations Craft-Riverine where it detects Small Arms Fire (up to 50 caliber rounds) and provided the location of the shooter to the crew. Use of Radio Frequency (RF) Reflector Tags enabled Identification Friend or Foe functionality and a basic research effort investigating the feasibility of a hybrid RF/Acoustic system that is more robust than either sensor alone shall also be undertaken.<br><br>*FY 2009 Accomplishments:*<br>FY 2009 | | | | | |

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**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #9<br>Intelligent Fault Protected Laser Diodes. This Congressional Interest Item developed integrated power circuits and innovative cooling systems for high power laser diodes.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.797 | 0.000 | 0.000 | 0.000 | 0.000 |
| Program #10<br>Large Aluminum Nitride Crystals for Effective Deep Ultraviolet Sources. This Congressional Interest Item developed growth of UV light emitting devices on bulk aluminum nitride substrates. | 0.797 | 0.000 | 0.000 | 0.000 | 0.000 |

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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #11<br>Advanced Magnetic Nanosensors for Defense Applications. This Congressional Interest Item developed nanosensors with unprecedented sensitivity, reduced noise, optimal compatibility with electronic systems, and the capability to detect explosives, chemicals and motion.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 4.784 | 0.000 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #12 | 1.595 | 0.796 | 0.000 | 0.000 | 0.000 |
| Advanced UV Light Diode Sensor Development. In FY09 this Congressional Interest Item developed and implemented strategies for improvement of wall plug efficiency in deep UV sources.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #13 | 2.990 | 0.000 | 0.000 | 0.000 | 0.000 |
| Hydrogen Batteries for the Warfighter. This Congressional Interest Item developed a high accuracy, reliable, inexpensive and rugged, distributed nanosensor system for protecting U.S. forces from nuclear, chemical, and biological weapon threats concealed in buildings, cargo containers, trucks, and other vehicles in a conventional theater of war.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010 | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #14<br>Single Crystal Chemical Vapor Deposition Diamond Lens Elements for High-Energy Lasers. This is a Congressional Interest Item.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 0.795 | 0.000 | 0.000 | 0.000 |
| Program #15<br>Surveillance Augmentation Vehicle. This is a Congressional Interest Item.<br><br>*FY 2009 Accomplishments:*<br>FY 2009 | 0.000 | 1.194 | 0.000 | 0.000 | 0.000 |

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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #16<br>Nanophotonic Devices. This is a Congressional Interest Item.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 1.592 | 0.000 | 0.000 | 0.000 |
| Program #17<br>Terahertz Sensing and Imaging Technology. This is a Congressional Interest Item. | 0.000 | 1.592 | 0.000 | 0.000 | 0.000 |

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| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #18<br>Electronic Keel. This is a Congressional Interest Item.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 1.592 | 0.000 | 0.000 | 0.000 |
| Program #19 | 0.000 | 1.990 | 0.000 | 0.000 | 0.000 |

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|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Advanced Bonded Diamond for Optical Applications. This is a Congressional Interest Item.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #20<br>Advanced Composite Nickel-Manganese-Cobalt Lithium Ion Battery. This is a Congressional Interest Item.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 2.387 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #21<br>Advanced Communications for Mobile Networks. This is a Congressional Interest Item.<br>*FY 2009 Accomplishments:*<br>FY 2009<br>*FY 2010 Plans:*<br>FY 2010<br>*Base FY 2011 Plans:*<br>FY 2011 Base<br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 3.183 | 0.000 | 0.000 | 0.000 |
| Program #22<br>Advanced Tactical Laser Flashlight Devices. This is a Congressional Interest Item.<br>*FY 2009 Accomplishments:*<br>FY 2009<br>*FY 2010 Plans:*<br>FY 2010<br>*Base FY 2011 Plans:*<br>FY 2011 Base<br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 1.201 | 0.796 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA1: *Sensors and Electronic Initiatives (CA)* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #23 | 3.189 | 0.000 | 0.000 | 0.000 | 0.000 |
| Boston University Photonics Center<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Accomplishments/Planned Programs Subtotals | 30.900 | 18.304 | 0.000 | 0.000 | 0.000 |

**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 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA2: *BIOTECHNOLOGY APPLIED RESEARCH* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | FY 2014 Estimate | FY 2015 Estimate | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SA2: *BIOTECHNOLOGY APPLIED RESEARCH* | 5.584 | 5.769 | 5.884 | 0.000 | 5.884 | 5.985 | 6.295 | 6.703 | 7.306 | 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 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 5.584 | 5.619 | 5.884 | 0.000 | 5.884 |
| ICB: In FY09, optimized the design of biologically-based and inspired sensors and materials and investigated incorporation of biologically-inspired control systems and networks, investigated bioelectronic properties of biologically-derived conductive nano-fibers. Established supporting infrastructure to select Molecular Recognition Elements (MREs) using novel micro-fluidic system. Designed and fabricated novel materials for uncooled thermal imagers to reduce cost and power consumption. Optimized protein system for conversion | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA2: *BIOTECHNOLOGY APPLIED RESEARCH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| of methane to methanol for fuels to reduce logistics burden. Optimized bio-inspired control system for data collection from networks to optimize information flow to users. Fabricated reversible adhesive pads based on gecko-inspired design and design integration with small robots for covert robotic surveillance. Transitioned MRE selection devices to ECBC and NSRDEC. In FY10, 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. In FY11, will 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, will experimentally validate surface-enhanced Raman spectroscopic detection of explosives in open-channel microfluidic devices, and will implement bio-inspired flocking (mass grouping of algorithms) and search algorithms for unmanned vehicles in GeoTrack system.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2<br>Small Business Innovative Research/Small Business Technology Transfer Programs | 0.000 | 0.150 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>SA2: *BIOTECHNOLOGY APPLIED RESEARCH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Accomplishments/Planned Programs Subtotals | 5.584 | 5.769 | 5.884 | 0.000 | 5.884 |

**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 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS1: *TACTICAL SPACE RESEARCH* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | FY 2014 Estimate | FY 2015 Estimate | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TS1: *TACTICAL SPACE RESEARCH* | 1.585 | 1.652 | 1.695 | 0.000 | 1.695 | 1.725 | 2.757 | 3.787 | 4.815 | Continuing | Continuing |

**A. Mission Description and Budget Item Justification**

Efforts in this project research and investigate technologies with the potential for space-based and high altitude 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. The applied research and technology evaluation 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 Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 1.585 | 1.606 | 1.695 | 0.000 | 1.695 |
| 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 interface standardization. These technologies allow for the rapid integration and development of tactical satellites in support of responsive space and high altitude environments. In FY09, continued investigation of a small on-station digitally reprogrammable radio for insertion into a tactical radio relay payload for high altitude and/or space environments; conducted a Joint Space Experiment (JSE) with the US Air Force to measure illumination of the ground. In FY10, investigate multi-nano-satellite architectures and integration of multi-spectral and hyper-spectral bands for imaging sensors operating in high altitude and space environments; investigate use of multiple waveforms on single tactical radio relay payloads operating in high altitude and space environments; continue to conduct the JSE for measurement of ground illumination. In FY11, will 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; will investigate protection technologies for uplinks, downlinks, and cross-links of space and high | | | | | |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS1: *TACTICAL SPACE RESEARCH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| altitude assets; will 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.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2<br><br>Small Business Innovative Research / Small Business Technology Transfer Programs<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 0.046 | 0.000 | 0.000 | 0.000 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS1: *TACTICAL SPACE RESEARCH* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Accomplishments/Planned Programs Subtotals | 1.585 | 1.652 | 1.695 | 0.000 | 1.695 |

**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 2011 Army RDT&E Project Justification | | | DATE: February 2010 |
|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS2: *ROBOTICS TECHNOLOGY* | |

| COST ($ in Millions) | FY 2009 Actual | FY 2010 Estimate | Base FY 2011 Estimate | OCO FY 2011 Estimate | Total FY 2011 Estimate | FY 2012 Estimate | FY 2013 Estimate | FY 2014 Estimate | FY 2015 Estimate | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TS2: *ROBOTICS TECHNOLOGY* | 0.000 | 15.693 | 15.566 | 0.000 | 15.566 | 15.828 | 15.925 | 16.400 | 18.475 | 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. 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 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| Program #1 | 0.000 | 6.652 | 6.895 | 0.000 | 6.895 |
| Robotics CTA: Conduct research to provide 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 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, investigate ways to improve understanding of urban scenes and activities to promote enhanced autonomous situational awareness for safe, | | | | | |

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|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS2: *ROBOTICS TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| effective operations and survivability, to enhance techniques to plan and execute missions in uncertain and dynamic environments, and to examine concepts for dexterous manipulation. In FY11, will 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.<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #2<br><br>Perception and Intelligent 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, investigate perception and control algorithms for safe operations in dynamic urban environments. In FY11, will investigate tactical behavior appropriate to military missions in "urban-like" environments. | 0.000 | 4.853 | 4.828 | 0.000 | 4.828 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS2: *ROBOTICS TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #3<br><br>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, evaluate ability to safely operate in mixed, dynamic, urban-like environments. In FY11, will evaluate the ability of unmanned systems to maneuver intelligently and autonomously in urban-like environments.<br><br>*FY 2009 Accomplishments:*<br>FY 2009 | 0.000 | 3.749 | 3.843 | 0.000 | 3.843 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS2: *ROBOTICS TECHNOLOGY* |

**B. Accomplishments/Planned Program ($ in Millions)**

| | FY 2009 | FY 2010 | Base FY 2011 | OCO FY 2011 | Total FY 2011 |
|---|---|---|---|---|---|
| *FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | | | | | |
| Program #4<br>SBIR/STTR<br><br>*FY 2009 Accomplishments:*<br>FY 2009<br><br>*FY 2010 Plans:*<br>FY 2010<br><br>*Base FY 2011 Plans:*<br>FY 2011 Base<br><br>*OCO FY 2011 Plans:*<br>FY 2011 OCO | 0.000 | 0.439 | 0.000 | 0.000 | 0.000 |
| Accomplishments/Planned Programs Subtotals | 0.000 | 15.693 | 15.566 | 0.000 | 15.566 |

| Exhibit R-2A, PB 2011 Army RDT&E Project Justification | | DATE: February 2010 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>2040: *Research, Development, Test & Evaluation, Army*<br>BA 2: *Applied Research* | R-1 ITEM NOMENCLATURE<br>PE 0602120A: *Sensors and Electronic Survivability* | PROJECT<br>TS2: *ROBOTICS TECHNOLOGY* |

**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.