Exhibit R-2, PB 2010 Defense Advanced Research Projects Agency RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	170.518	214.582	243.056						Continuing	Continuing
SEN-01: SURVEILLANCE AND COUNTERMEASURES TECHNOLOGY	63.234	72.323	57.553						Continuing	Continuing
SEN-02: SENSORS & EXPLOITATION SYSTEMS	107.284	142.259	128.621						Continuing	Continuing
SEN-CLS: Classified	0.000	0.000	56.882						Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Sensors Technology program element is budgeted in the Advanced Technology Development Budget Activity because it funds sensor efforts that will improve the accuracy and timeliness of our surveillance and targeting systems for improved battlefield awareness, strike capability and battle damage assessment.

(U) The Surveillance and Countermeasures Technology project will exploit recent advances in multispectral target phenomenology, signal processing, low-power high-performance computing and low-cost microelectronics to develop advanced surveillance and targeting systems. Timely surveillance of enemy territory under all weather conditions is critical to providing our forces with tactical information needed to succeed in future wars. Additionally, this project encompasses several advanced technologies related to the development of techniques to counter advanced battlefield threats.

(U) The Sensors and Exploitation Systems project develops and demonstrates advanced sensors, and exploitation technologies. These efforts provide warfighters with situational awareness and precision target identification. The project is driven by five needs: 1) integrating data from multipath sources into consistent situational assessments; 2) countering camouflage, concealment and deception of mobile ground targets; 3) providing near-real-time, semi-automatic exploitation of wide-area moderate and high-resolution imagery; 4) obtaining real-time, accurate battle damage assessment; and 5) accomplishing robust, precise identification, precision fire control tracking and engagement of ground targets.

Exhibit R-2, PB 2010 Defense Advanced Research Projects Agency RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	195.213	226.470	224.477	
Current BES/President's Budget	170.518	214.582	243.056	
Total Adjustments	-24.695	-11.888	18.579	
Congressional Program Reductions	0.000	-11.888		
Congressional Rescissions	-9.000	0.000		
Total Congressional Increases	0.000	0.000		
Total Reprogrammings	-10.350	0.000		
SBIR/STTR Transfer	-5.345	0.000		
TotalOtherAdjustments			18.579	

Change Summary Explanation

FY 2008
Decrease reflects Section 8042 rescission, below threshold and OMNIBUS reprogrammings, and the SBIR/STTR transfer.

FY 2009
Decrease reflects reductions for Section 8101 Economic Assumptions and new starts.

FY 2010
Increases reflect the establishment of new project SEN-CLS to merge classified programs from the Guidance Technology Program Element, offset by cancelation of the SALTI program in Project SEN-02, and completion and anticipated transition of underground facilities efforts in project SEN-01.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY					PROJECT NUMBER SEN-01	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
SEN-01: SURVEILLANCE AND COUNTERMEASURES TECHNOLOGY	63.234	72.323	57.553						Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) This project funds sensor efforts that will improve the accuracy and timeliness of our surveillance and targeting systems for improved battlefield awareness, strike capability, and battle damage assessment. Timely surveillance of enemy territory under all weather conditions is critical to providing our forces with the tactical information needed to succeed in future wars. This operational surveillance capability must continue to perform during enemy efforts to deny and deceive the sensor systems, and operate, at times, in a clandestine manner. This project will exploit recent advances in multispectral target phenomenology, signal processing, low-power high-performance computing, and low-cost microelectronics to develop advanced surveillance and targeting systems. In addition, this project encompasses several advanced technologies related to the development of techniques to counter advanced battlefield threats.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Low-Altitude Airborne Sensor System (LAASS)	15.619	15.750	4.000	

(U) The Low-Altitude Airborne Sensor System (LAASS) program is developing an airborne sensor system to find and characterize underground facilities (UGFs) used to shield and protect strategic and tactical activities, including command and control, weapons storage, and manufacture of weapons of mass destruction (WMD) and tunnel networks that breach secure borders and perimeters. By passively capturing emissions associated with underground facility presence and operations, and doing so using airborne sensors (acoustic, electromagnetic, gravity gradiometry), LAASS can significantly increase our ability to seek out underground facilities and map out their vulnerabilities and backbone structure. LAASS technologies are planned to transition to Northern Command, Southern Command, Strategic Command, or Defense Threat Reduction Agency in FY 2011.

FY 2008 Accomplishments:
- Developed system requirements for LAASS gravity gradiometer payloads (sensor characteristics, platform envelope) against targets of interest.
- Explored gravity gradiometry system concepts for tunnel detection.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY		PROJECT NUMBER SEN-01

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Commence evaluation of candidate sensor technologies for development of gravity gradiometer prototype evaluation system. - Produce system design and initiate development of gravity gradiometer prototype evaluation system. *FY 2010 Plans:* - Complete development and build gravity gradiometry sensor suite and perform major system design trades. - Optimize signal processing to detect target of interest in the areas of interest and reject clutter in geo-technically challenging environments. - Design, develop and integrate a prototype system on a tactical air vehicle.				
Cross-Border Tunnel (CBT) (U) The Cross-Border Tunnel (CBT) program is developing technologies and systems to detect small tunnels used to breach security perimeters and national borders. The program goal is to develop innovative technologies inspired by geophysical exploration techniques that detect and characterize these threat tunnels while simultaneously satisfying operational considerations such as search rate, site access, monitoring persistence, and exposure of friendly forces. The initial CBT program thrust performed collections of seismic and electromagnetic (EM) data at a test bed using current state of the art sensors from the geophysical industry. (U) The program's current focus is on a Fast-Scan CBT detection technique. This technique will develop a tunnel detection system focused on providing a fast linear scan rate, for operationally tractable protection of large controlled areas or national borders. Current subterranean interrogation techniques based on geophysical exploration methods have the combined impediments of slow interrogation rate, need for complete site access, or exposure of forces. Contrary to invasive imaging methods, the Fast-Scan concept will provide rapid detection of anomalous subsurface structures consistent with voids. Additional techniques will be investigated to provide situational awareness to the warfighter for the underground environment. Technical challenges include: 1) identification of optimal detection strategies, source characteristics, and sensor geometries, 2) rejection of clutter with length scales similar to tunnels or	1.852	3.750	3.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-01

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
response from non-threat structures (utilities), and 3) technology migration to a moving platform. This program will transition to the Services in FY 2010. *FY 2008 Accomplishments:* - Performed field campaign to collect Electromagnetic (EM) signature data. - Evaluated the inversion of the EM data from the data collection campaign. - Determined the performance of CBT for use in protection of controlled areas and borders. *FY 2009 Plans:* - Identify a detection concept suited for use in protection of controlled areas and borders. - Determine the design requirements for the source characteristics and sensor/source geometry that optimizes the detection performance. *FY 2010 Plans:* - Commence the development of the Fast Scan CBT detection technique for an off board platform integration. - Complete the development of Fast Scan CBT detection technique for an off board platform integration. - Demonstrate the Fast Scan CBT detection technique. - Investigate techniques and conduct proof of concept demonstrations to provide the warfighter situational awareness for the underground environment. - Initiate underground situational awareness technology development efforts.				
Airborne Tomography using Active Electromagnetics (ATAEM) (U) The Airborne Tomography using Active Electromagnetics (ATAEM) program is developing an active electromagnetic (EM) system for airborne imaging of subsurface structures, such as underground facilities (UGF) or perimeter-breaching tunnels. The ATAEM system illuminates the ground with electromagnetic energy and interprets resulting distortions of the electric and magnetic fields to detect and characterize surreptitious structures. The ATAEM program will investigate and develop the component technologies, (including EM illumination sources, noise-isolated sensor payloads and signal processing), and demonstrate them on an appropriate airborne platform. The ATAEM program will first validate	6.409	9.136	7.271	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY		PROJECT NUMBER SEN-01

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
the system concept for EM sources, sensor payloads, and associated signal processing through modeling and data collection against relevant underground structures. An integrated system combining active illumination, sensing, and detection processing will then be developed and demonstrated on an appropriate unattended air system. This capability is expected to transition to the U.S. Army, U.S. Marine Corps, and U.S. Special Operations Command in FY 2012. *FY 2008 Accomplishments:* - Developed low-noise electric and magnetic field sensors. - Designed and constructed vibration isolation system for the sensor suite. - Built sensor payload comprised of vibration-isolated electric and magnetic field sensors. - Conducted sensor tow pod design analysis. *FY 2009 Plans:* - Integrate sensor suite into helicopter tow pod. - Investigate and develop electromagnetic illumination sources. - Collect and analyze operationally relevant data over multiple targets of interest using helicopter tow pod. - Document performance as a function of operational parameters (illumination sources, flight parameters). - Develop system requirements for final demonstration system. *FY 2010 Plans:* - Fabricate and evaluate critical components for prototype system. - Commence fabrication of prototype system.				
Strategically Hardened Facility Defeat (U) Building upon the successes of this technology developed under the Counter Underground Facilities program, the Strategically Hardened Facility Defeat program will continue to develop alternative earth-penetrating technologies for the defeat of strategically hardened targets. The threat posed by the proliferation of hard and deeply buried targets with major strategic capabilities around the world is	11.909	15.500	17.016	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-01

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
increasing dramatically. These strategically hardened facilities are used to harbor our adversaries' most dangerous assets including leadership bunkers, command and control functions, and weapons of mass destruction. However, because the size and weight of traditional earth penetrating weapons scale exponentially with the depth of the facility, current warhead penetration depths are and always will be insufficient to reach many of these targets. As a result, a strategic capability gap exists and new approaches to earth penetration and warhead delivery are needed. This program seeks to leverage recent advances in earth-penetrating technologies for full defeat of strategically hardened facilities. This program will transition to the Defense Threat Reduction Agency (DTRA) in FY 2011. *FY 2008 Accomplishments:* - Integrated advanced penetration and energy supply technologies. - Demonstrated penetration, energy, sensing, and navigation capabilities through field trials. - Demonstrated deployment capabilities. *FY 2009 Plans:* - Develop robust, self-contained aerial deployment options that can interface with existing air platforms. - Develop packaging and integration technologies that can withstand harsh environments. - Design and initiate development of deployable system with advanced penetration and navigation capabilities. *FY 2010 Plans:* - Integrate component subsystems into deployable platform. - Commence the demonstration of system capabilities in multiple field exercises with transition partner.				
Visibuilding (U) The Visibuilding program is developing technologies and systems for new building surveillance capabilities to detect personnel within buildings, determine building layouts, and locate weapons caches and shielded enclosures within buildings. Radar signals are being used to image static structures directly. Doppler processing of radar signals is also being exploited to find, identify, and perform feature-aided tracking of moving personnel within a building and allow mapping of building pathways and stairways	15.091	15.970	15.560	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-01	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
by monitoring traffic through buildings. Multipath and propagation effects are modeled and iteratively compared with hypotheses of building structures to provide 3-D building maps and large concentrations of metal materials like weapons. This program is developing techniques to inject and recover probing waveforms and unravel the complicated multipath in the return signals to enable the mapping and characterization of buildings. Other sensing modalities and component technologies are concurrently being investigated, such as acoustic, seismic, and thermal. These modalities offer the possibility of providing complementary information about the interior of large buildings as well as their associated underground areas. Transition of component pieces to the Army's Program Executive Office (PEO) Soldier and U.S. Special Operations Command will commence in FY 2011. *FY 2008 Accomplishments:* - Demonstrated ability to reconstruct building floor plans and track insurgents. - Developed radar system architectures for building imaging and insurgent localization. - Transitioned RADAR Scope, a handheld through the wall radar device, to PEO Soldier and U.S. Special Operations Command. - Initiated investigations into alternative sensing modalities. *FY 2009 Plans:* - Design and build functional prototype instrumentation radar system. - Perform experiments on full-scale buildings to demonstrate floor plan reconstruction and insurgent localization within structures. - Begin validating alternative sensing technologies. *FY 2010 Plans:* - Design and integrate advanced prototype demonstration system. - Commence demonstrations to show ability to determine building layout and track insurgents within furnished multi-story buildings.					
Speckle Exploitation for Enhanced Reconnaissance (SEER)		5.000	6.000	0.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-01	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
(U) The Speckle Exploitation for Enhanced Reconnaissance (SEER) program will provide long-range, non-cooperative identification of moving/stationary targets using incoherent scattered laser speckle reflected off a target surface. Laser speckle has reduced sensitivity to adverse turbulence-induced distortion and so should provide a viable signal at ranges exceeding those projected for other active laser systems. Technical achievements under other programs in this PE/Project provide the basis for radically new approaches to measuring target characteristics under conditions that limit the performance of conventional sensors. Target characteristics potentially obtainable may include target image, shape, size, structural features, and other advanced threat properties. By extending the operating range of current active electro-optic sensors, SEER enables the friendly platform to stand off from the maximum operating range of hostile sensors/weapons, while executing the targeting task and directing weapons against targets. *FY 2008 Accomplishments:* - Demonstrated concept performance on an outdoor range. *FY 2009 Plans:* - Develop algorithms that reliably and uniquely associate target signatures with speckle patterns. - Implement algorithms using optical Micro Electro-Mechanical systems (MEMs) or other related technologies to achieve reduced size, weight and power.					
Rescue Transponder (RT) (U) Building upon technologies developed in other sensor programs, the Rescue Transponder (RT) program will investigate the use of a unique localization and tracking technology to provide a very low probability of detection (LPD) call for help signal. The system will use a wide band radio frequency signal with low power and extremely low duty cycle. The goals of the RT program are to develop a small, rugged, transponder that provides a call for help to friendly forces. The RT system will operate over ranges that enable rescue forces or surveillance systems to receive its signals. It will support accurate localization by rescue forces, and permit transmission of identifying, authenticating, and status information. The RT technology is planned for transition to the U.S. Marine Corps in 2010.		3.582	2.217	2.450	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY		PROJECT NUMBER SEN-01

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Initiated limited prototype production to support U.S. Marine Corps operational field assessment. - Completed a Memorandum of Agreement between DARPA and U.S. Marine Corps Combat Development Center for transition of the RT technology. *FY 2009 Plans:* - Evaluate deployable unit performance in U.S. Marine Corps EXERCISE Talisman Saber 2009. - Develop and conduct field experiments in support of U.S. Marine Corps initial end-user field evaluations. - Research enhancements to support system performance capabilities for military use. *FY 2010 Plans:* - Develop advanced prototypes with self-calibration and non-synchronization tag capabilities to simplify operations. - Develop and conduct field experiments to support major U.S. Marine Corps operational field exercise. - Complete transition between DARPA and U.S. Marine Corps.				
Combat Laser Infrared Countermeasure (IRCM) Proactive Survivability System (CLIPSS) (U) The Combat Laser Infrared Countermeasure (IRCM) Proactive Survivability System (CLIPSS) will enable air dominance at low altitude and at night against current and near term near infrared (NIR) and mid-wave infrared (MWIR) based threats including man portable air defense (MANPAD), based on proactive infrared countermeasures (PIRCM). Leveraging the ongoing systems and focal plane array (FPA) technology development established by the Multifunction Electro-Optics for Defense of U.S. Aircraft (MEDUSA) program (budgeted in PE 0603768E, Project GT-01) in the near and MWIR bands and the reactive capability of the Affordable Laser IRCM Survivability System (ALISS), CLIPSS will provide a near term demonstration and transition of the proactive capability and serve as a pathfinder for the longer range, all band objectives of MEDUSA. CLIPSS will provide U.S. aircraft the same ability to geo-locate, evade, jam, or destroy optically based air defenses and will evolve U.S. capabilities from reactive end game countermeasures to proactive capabilities that increase threat-warning times, deny launch and put electro-optical/IR air defense threats at risk. This program will demonstrate an initial integrated	0.000	3.000	4.256	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-01	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
proactive and reactive IRCM pod based flight system that will address shorter range, high duty cycle threats for vulnerable low altitude platforms in the NMIR wavebands. The primary technical obstacles will be the continued development and integration of high sensitivity infrared Focal Plane Array (FPA) and multi-frequency laser technologies into compact, efficient packages for demanding IRCM environments. The real-time processing of the range resolved laser returns over wide fields of view to rapidly cue the proactive countermeasures poses a significant systems integration challenge as well. CLIPSS technology is planned for transition to the Services in FY 2012. *FY 2009 Plans:* - Complete wide-area proactive search flight demonstration design. - Initiate subsystem fabrication for flight demonstration. - Initiate integrated proactive/reactive IRCM pod design. *FY 2010 Plans:* - Complete subsystem fabrication for flight demonstration. - Initiate wide-area proactive search demonstration integration. - Complete preliminary design review for integrated IRCM pod.					
Lightning Based (Sferic) Underground Geo-positioning (U) The Lightning Based (Sferic) Underground Geo-positioning program will address the challenges presented when navigating and tracking within underground structures, both manmade and natural, by exploiting the abundance and long propagation range of naturally occurring global lightning events. As conceived, surface receivers at known locations will compare time difference of arrival of very low frequency (VLF) sferic events and employ super-resolution correlation techniques to accurately determine the VLF source locations. Any subsurface receiver will also detect the sferics, and correlation with the surface data will enable geo-location of the subsurface receiver. Exploitation of naturally-occurring, non-deniable signals has the potential to significantly reduce logistical requirements and increase operational standoff by orders of magnitude (1000+ km). Transition to U.S. Special Operations Command (SOCOM) and the U.S. Army is anticipated by FY 2012.		0.000	1.000	4.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-01

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Map global signal availability as function of geographic coordinates, hourly and seasonal means, and geologic overburden. - Conduct field tests to determine geolocation accuracy with varying geologic overburdens. - Revise and validate propagation models for selected geographic regions to support mission planning and performance prediction. *FY 2010 Plans:* - Develop and demonstrate through-the-earth communications for navigation (surface-to-subsurface communications) and tracking (subsurface-to-surface communications) scenarios. - Design prototype hardware for subsurface receivers and processors. - Evaluate potential for integration of global lightning receiver network data into the sferic system.				
Surveillance and Threat Neutralization in Urban Environments (U) This program investigated technologies to demonstrate the detection and defeat of threats specific to conflict and stabilization operations in the urban environment. These threats include roadside bombs, car bombs, suicide bombers, snipers, rocket propelled grenades, and mortars launched from inside urban boundaries. Detection technologies studied included detection of anomalies in vehicle dynamics, stand-off identification and localization of explosive vapors/effluents, high fidelity 3-Dimensional (3-D) mapping performed from a high altitude (>15,000 feet) airborne platform for Improvised Explosive Device (IED) detection, high fidelity 3-D surveillance performed from autogyro mortar rounds utilizing stereo vision, and precision emplacement of sensors in an urban environment. *FY 2008 Accomplishments:* - Evaluated candidate technologies for wide-area/stand-off and choke-point/portal-screening applications. - Proved feasibility in lab on sub-scale tests.	3.772	0.000	0.000	

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency	RDT&E Project Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603767E SENSOR TECHNOLOGY	**PROJECT NUMBER** SEN-01

D. Acquisition Strategy

N/A

E. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY					PROJECT NUMBER SEN-02	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
SEN-02: SENSORS & EXPLOITATION SYSTEMS	107.284	142.259	128.621						Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Sensors and Exploitation Systems project develops and demonstrates advanced sensor and exploitation technologies to provide accurate situational awareness and precise target identification. The project is driven by five needs: (a) integrating data from multiple sources into consistent situation assessments; (b) countering camouflage, concealment and deception of mobile ground targets; (c) providing near-real-time, semi-automatic exploitation of wide-area, moderate- and high-resolution imagery; (d) obtaining real-time, accurate battle damage assessment; and (e) accomplishing robust, precise identification, precision fire control tracking and engagement of ground targets. U.S. forces and sensors are increasingly networked across service, location, domain (land, sea and air), echelon, and platform. This trend increases responsiveness, flexibility and combat effectiveness, but also increases the inherent complexity of sensor and information management. This project is creating systems that can derive high-level information from sensor data streams (from both manned and unmanned systems), produce meaningful summaries of complex dynamic situations, and scale to thousands of sources. Future battlefields will continue to be populated with targets that use mobility and concealment as key survival tactics, and high-value targets will range from mobile missile/artillery to specific individual insurgents. This project develops and demonstrates system concepts that combine novel approaches to sensing, sensor processing, sensor fusion, and information management to enable pervasive and persistent surveillance of the battlespace and detection, identification, tracking, engagement and battle damage assessment for high-value targets in all weather conditions and combat environments.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Persistent Exploitation	15.522	19.178	19.500	
(U) The Persistent Exploitation program integrates a wide variety of sensors, data links, exploitation tools, correlators, and pattern analyzers into an end-to-end capability, focusing on counter-insurgency missions. These missions must be supported at all hours of the day, over large areas, and against a diverse set of targets, characteristics that no homogeneous sensor architecture can address. Persistent Exploitation ties separate hardware and software components together so that interactions among them can be defined, assessed, evaluated, and refined. It emphasizes real-time testing in realistic environments (e.g., the National Training Center (NTC)) so that subtle dependencies and interactions can be discovered.				

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
(U) The Persistent Operations Surface Surveillance and Engagement (POSSE) program is developing the capability to integrate sensor input from multiple modalities to find indications of insurgent activities. Combined with dynamically updated information from soldiers on the ground, POSSE will enable near-real-time generation of the evidence necessary for further investigation or interdiction. POSSE experiments are conducted at the National Training Center (NTC) with realistic role players emulating typical residential, commercial and light industrial activity. Within this environment, insurgent activity is simulated by qualified experts using the latest and most complete intelligence available. Measurements include precision collections of insurgent activities, as well as the realistic surrounding background clutter of typical civilian activity. Results will inform future experiments, lead to specifications for future sensor design, and provide insights into how to integrate other narrow and wide area sensors into an integrated approach to countering insurgencies. Transition is planned for U.S. Army Intelligence and Security Command. *FY 2008 Accomplishments:* - Expanded investigation of close proximity sensor experiments designed to differentiate a location being used for insurgent activities from adjacent structures. - Initiated design and preliminary infrastructure development in conjunction with NTC. *FY 2009 Plans:* - Evolve close proximity experiments in the NTC environment to assess potential sensor technologies applicable to insurgent activity detection. - Continue spiral development with semi-annual exercises at the NTC and spin off mature capabilities to deployed analysis cells. - Integrate proximity sensor capabilities into the near-real-time POSSE exploitation process. - Correlate close and stand-off sensors into an integrated exploitation capability to detect insurgent networks. - Test operational capabilities at the NTC with operational analysis cells. *FY 2010 Plans:* - Continue experimentation with semi-annual exercises at the NTC and spin off mature capabilities. - Examine the feasibility of new sensor designs.				

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Network Centric Sensing and Engagement		8.470	7.097	7.000	
(U) The Network Centric Sensing and Engagement thrust develops technology and tools to support precise situational awareness, rapid targeting, and precision engagement in highly-networked environments. Network-centric sensing acknowledges a group of sensors as a system and leverages networked intercommunication to enable system performance superior to that of uncoordinated individual sensors. Applications include advanced target detection, acquisition, tracking, and combat identification. The technology is suited to both ground-based sensors and airborne multi-ship sensor systems. Exploiting the potential of network-centric sensing requires a number of approaches. Required technology advances include: sensor-to-sensor communications, multi-sensor management, sensor system georegistration, real-time data fusion, advanced tracking, and network-centric sensor operational modes. Network technologies enabling precision electronic warfare will also be investigated. Programs in this thrust include: • The Quint Networking Technology (QNT) is a modular, multi-band, network data link program focused on providing capabilities that close the seams between four nodes - manned aircraft, weapons, tactical unmanned air vehicles (UAVs) and air control ground units. The program designs, develops, evaluates and demonstrates robust, affordable data link technologies suitable for use by weapons, tactical UAV's, and air control units. This includes shrinking the package size of data link capabilities to the size of a cell phone. These data links enable precision strike and efficient machine-to-machine targeting against time critical and mobile targets, support combat identification of targets, disseminate tactical UAV and ground sensor data, and provide bomb impact assessment. The data links allow secure weapon handoff from the launch platform to any of several control platforms in the combat area, both air and surface. The QNT units provide two modes: a low rate bi-directional mode and a high data-rate mode capable of either continuous or a burst imagery/video transmission. Dynamic net resource management technology will scale to support hundreds of vehicles in flight. Advanced information security techniques provide secure weapon data links and controller handovers. DARPA has established a Memorandum of Agreement (MOA) with the Air Force Command and Control & Intelligence, Surveillance, and Reconnaissance Center, Navy Program Executive Officer, Strike Weapons and Unmanned Aviation, and Air Force Research Laboratory to transition the QNT technology.					

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
• The Tactical Level Operations Capability (T-LOC) program (formerly Expeditionary Dismount Geolocation and Exploitation System) will develop and deploy technologies to integrate temporal-spatial data from multiple sources to increase situational awareness. The program uses organic reconnaissance, surveillance and target acquisition data to update tactical users and planners over multiple echelons with critical environmental and operational information. There is particular interest in riverine operations, and within this context, sensor, delivery systems, exploitation algorithms, and information management and display technologies will be developed. T-LOC will provide the means to discover vulnerabilities in opposing forces and cues for intelligence, surveillance, and reconnaissance planning. Technologies are planned to transition to the U. S. Navy and U.S. Marine Corps. *FY 2008 Accomplishments:* Quint Networking Technology (QNT) - Built and evaluated brassboard in Stage 1 tests. *FY 2009 Plans:* Quint Networking Technology (QNT) - Cycle and test brassboard in Stage 2 tests and flight tests. - Start transition to Air Force and Navy. Tactical Level Operations Capability (T-LOC) - Evaluate the effect of combining multiple organic sensor updates on situation assessment for rapid military riverine operations. *FY 2010 Plans:* Tactical Level Operations Capability (T-LOC) - Evaluate the effect of combining multiple semi-autonomous organic sensor updates and novel display technologies on situation assessment for rapid military riverine operations.				
Pattern Analysis Technology	2.000	1.000	0.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
(U) The Pattern Analysis Technology thrust develops exploitation tools to form and analyze tracks of vehicle movement, and distinguish hostile behavior from benign civilian activities. It develops tools for movement pattern analysis, algorithms to predict target motions, and dynamic control methods for sensor tasking and observation scheduling. Programs in this thrust include: • The Video Verification and Identification (VIVID) program developed technology to automate moving target strike operations for remotely piloted aircraft. Program products support both precision strike operations and military surveillance. VIVID enables the handoff of targets between wide area coverage intelligence, surveillance, and reconnaissance systems and local video surveillance platforms. The technology provides techniques for precision target identification in video including fingerprinting techniques and related technology to reacquire previously observed vehicles. The VIVID technology transitioned to the Air Force at the conclusion of Phase II, at the end of FY 2008. • The Forensic Target Motion Analysis program develops and demonstrates exploitation tools to analyze Ground Moving Target Indicator (GMTI) Radar tracks of multiple targets to separate militarily-interesting target movement from nominal background traffic (e.g. civilians, coalition operations). It develops libraries of movement patterns, logic to generate hypotheses about which patterns are being observed, algorithms to correlate sensor data to those patterns, and mechanisms to quantitatively score the consistency of the data with each hypothesis. It also includes tools to provide short-term predictions of target motions, thereby supporting some forms of predictive threat analysis. *FY 2008 Accomplishments:* Video Verification and Identification (VIVID) - Demonstrated real-time software components on tower. - Demonstrated real-time software components in flight test. - Started transition to the U.S. Air Force. Forensic Target Motion Analysis - Obtained ground-truthed, wide-area GMTI data from operational airborne sensors.				

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: Forensic Target Motion Analysis - Evaluate performance of motion analyses algorithms.					
Target Identification Technology (U) The Target Identification Technology thrust develops semiautomatic methods to identify targets from sensors operating in all spectral bands. Its objective is to detect, characterize, and identify military threats, and to assess the environment around them. Data sources include national, theater, and organic sensors. Exploiting the acoustic emissions of potential targets is of interest because acoustics has the advantage of not requiring an unobstructed line of sight between the emitter and sensor, and under certain circumstances sound may propagate great distances. Critical performance metrics are timeliness, accuracy, error rates, and interpretation workload. The thrust addresses the challenges of target identification, acquisition and tracking under restrictive rules of engagement. The technologies will apply advanced signal processing and machine vision to leverage advances in sensor capabilities. Three programs are funded in this thrust: • The Exploitation of 3-D Data (E3D) program developed techniques for rapidly exploiting 3-D sensor data. The initial program effort consisted of three distinct processes: Target Acquisition, Target Recognition, and Modeling. The resulting software tools were integrated into operational ground stations processing 3-D sensor data. The E3D technology was transitioned to Special Operations Command (SOCOM). • The All-Source Target Characterization program develops a collection and measurement capability to characterize new targets as they emerge on the battlefield. This effort develops tools to permit rapid user interaction with imagery, sensor data, and processing results and provides real-time feedback to operators indicating key target features and other discriminates. This initiative will also develop and demonstrate robust target cueing and identification over large classes of targets within a computational form factor appropriate for insertion into strike aircraft and unmanned aerial vehicles. The technology provides tools to process and disseminate target signatures to the field in usable formats for direct insertion into operational		8.896	9.000	8.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

systems. Technologies are planned for transition to the Air Force Distributed Common Ground Station in FY 2011 and subsequently to the U.S. Army Future Combat System.

• The Small Unmanned Aerial Vehicle Detection System (SUDS) program, formerly Detect Unmanned Aerial Vehicle (UAV), develops techniques to detect, track, and provide discrimination between friend and foe against small UAVs that are easily built, inexpensive, easy to operate, and offer the asymmetric adversary an ability to reach into U.S. defended locations causing potentially large amounts of damage. It includes antenna and signal processing techniques to passively detect small air targets using radar, video, acoustic, and radio-frequency sensors; to correlate those data with known objects (e.g., civilian aircraft); to analyze the motion of any uncorrelated data; and to rapidly task narrow-field-of-view sensors to collect more-detailed data. It will transition to the military in FY 2012 to meet both static force protection needs and tactical air defense operations.

FY 2008 Accomplishments:

Exploitation of 3-D Data (E3D)
- Conducted real time data collection for models in library.
- Transitioned E3D to SOCOM.

All-Source Target Characterization
- Developed tools to permit rapid user interaction with imagery and processing results.

Small UAV Detection System
- Generated candidate system architecture, focusing on an effective sensor suite, to detect and track small UAVs.
- Conducted flight tests to collect small UAV and clutter signatures.
- Completed post processing of acoustic data.
- Performed initial trade studies and analyses.

FY 2009 Plans:

All-Source Target Characterization

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Evaluate performance in field exercises and demonstrations. Small UAV Detection System - Develop algorithms to identify and classify targets and objects of interest. - Perform tests against UAV and radio controlled (RC) aircraft of known and unknown characteristics to demonstrate the system's ability to improve target detection and classification. - Perform data collection to determine acoustic features/signatures/characteristics. - Apply results to physics models of aircraft and propulsion systems. *FY 2010 Plans:* Small UAV Detection System - Develop and demonstrate target identification capability. - Integrate multiple sensors for target classification. - Evaluate system performance for positive identification of friend or foe.					
Advanced Radar Sensor Technology (U) The Advanced Radar Sensor Technology thrust develops radar systems to provide significant improvements in our ability to detect, identify, and track surface targets and threats over very wide areas in all climatic conditions. Program efforts focus on exploiting emergent and novel RF sensing technology and phenomenology. Key elements are advancements in ultra-wide band, bistatics, UHF/VHF, emitter location and direction-finding, polarimetric change detection, tomographic imaging, space-time adaptive processing and other advanced signal processing, advanced Ground Moving Target Indicator (GMTI) techniques, and foliage, building, and ground-penetrating radar phenomenology. Program developments are integrated with current and emerging military platforms with emphasis on the most stressing military radar sensor challenges. Examples are operations featuring complex cluttered ground environments; those against small and slow moving surface targets; urban operations, and situations where camouflage, decoys and countermeasures must be overcome. Programs in this thrust include: • The NetTrack program will extend capabilities for persistent tracking and targeting of moving vehicles from airborne radars. Operational GMTI radars can display the locations of thousands of movers over a		11.527	18.960	22.890	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY		PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
wide area. Operators of these systems can focus on an individual GMTI detection and follow the vehicle down a road network until a so-called "confusion event": the vehicle reaches an intersection at the same time as other traffic; another vehicle comes close to it traveling in the same direction; the GMTI platform has to make a turn. After the confusion event the operator has no way to determine which of several local target detections is the vehicle that the operator was following. NetTrack will improve capabilities in two ways: the system will network radars together and use advanced radar techniques to gather "signatures" of vehicles. The signatures, which are collections of radar features, will be stored and passed over the radar network. The system will compare vehicle signatures taken before and after confusion events to maintain the track of the target vehicles. Extended long-term airborne radar tracking will be an important long-range, all-weather capability. It will extend the kill chain to enable vehicle engagement hours after target designation, enable behavioral analysis of vehicle movements to gauge enemy operational structure, force composition, and intentions, and provide a higher level of situational awareness at every level. Technologies are planned for transition to the Navy, Army and Air Force. • The Dual Beam Lynx program will enhance the capabilities of the Lynx radar system to track slow-moving vehicles more accurately. The program modifies a Lynx I radar to create two beams with different phase centers and uses space-time adaptive processing to detect moving targets in the main beam clutter. The goals of this program include demonstrating improvement in minimal detectable velocity, improving geolocation accuracy, and achieving a low manufacturing cost. The radar performance will be demonstrated from flight data collected from the radar flying on a UAV surrogate. Technology is planned for transition to the U.S. Air Force. • The Next Generation RF Antenna System program will develop and demonstrate a light-weight wide-band RF antenna that enables high gain over a broad frequency range. This system will enable signal detection at extended ranges, detecting faint or distant signals with high gain. This program is planned for transition to the U.S. Air Force. • The Airborne Passive Direction Finding with a Tactical Vector Sensor (ATVS) program will develop and demonstrate a compact, lightweight, airborne, real-time, tactical emitter detection and location system suitable for supporting small tactical units. ATVS sensors will fly on a tactical UAV such as the Scan Eagle				

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

and will provide company/battalion size forces with a dedicated airborne sensor for detecting and locating emitters. ATVS provides accurate estimates of the angle of arrival in both azimuth and elevation. This program is planned for transition to the U.S. Army.

• The Efficient Digitization of Element Signals program will exploit new and emerging techniques in signal coding and compressive sensing to allow large, element-count, radio frequency (RF) arrays to be digitally sampled using small numbers of receivers. Most existing RF arrays used in radar, communications and Signal Intelligence systems have highly constrained digital beamforming capabilities since the element-level signals are not digitally sampled; rather, these signals are combined into a single beam or sometimes sub-array beams before digitization. This sub-optimal combining was necessary because the number of receivers, analog-to-digital converters and data rate of the system are limited by the available size, weight, and power. However, compressive sensing techniques present the opportunity to reclaim this lost performance. Technologies are planned for transition to the Navy, Army and Air Force.

FY 2008 Accomplishments:

NetTrack

- Improved capabilities for using vehicle radar signatures to associate vehicle observations.
- Demonstrated NetTrack operations in simulation.

Dual Beam Lynx

- Conducted preliminary design review.
- Developed algorithms.
- Modified Lynx radar to add dual beam capabilities.

FY 2009 Plans:

NetTrack

- Demonstrate radar signature-aided vehicle tracking and simulate the cooperative use between radar platforms of those radar features.
- Implement NetTrack capabilities in an operational airborne radar system.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Dual Beam Lynx - Develop space time adaptive processing. - Perform flight test and data collection. Next Generation RF Antenna System - Refine electromagnetic models. - Fabricate and measure RF properties. - Measure pattern of antenna to validate predictions on gain, bandwidth and signature. *FY 2010 Plans:* NetTrack - Demonstrate NetTrack capabilities in real-time on operational networked radar platforms. Next Generation RF Antenna System - Design a novel antenna with superior gain and bandwidth. - Validate design using electromagnetic modeling. - Commence fabrication of first prototype antenna. Airborne Passive Direction Finding with a Tactical Vector Sensor (ATVS) - Develop prototype ATVS antenna and measure RF performance characteristics in an outdoor range. - Design complete ATVS system. Efficient Digitization of Element Signals - Develop general compressive sampling techniques which exploit sparsity in RF signal space and/or time. - Use a combination of signal coding and sample selection to allow the element signals to be received and sampled by a small number of digital receivers and to recover the original element signals digitally through a combination of decoding and interpolation.					
Advanced Airborne Optical Sensing		13.000	14.885	19.271	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY		PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
(U) The Advanced Airborne Optical Sensing program develops electro-optical and infrared sensors and surveillance for aerial platforms. Significant challenges arise as the result of two warfighting trends. First, the ever-changing mix of airborne platforms, now includes greater numbers of smaller UAVs. Second, the target set is increasingly challenging and now includes vehicles and individual dismounts that operate under foliage and in urban canyons, using camouflage, obscurants, and other means of concealment. In response to these challenges the Advanced Airborne Optical Sensing program brings recent advances in optical, electro-optical, photonic and other technologies to airborne optical sensing systems. Specific examples of these technologies includes: embedded image processors tailored to real-time detection, identification, and tracking of military targets; hyper-spectral sensing technologies; flash detection; and underwater object detection; advanced laser radar technologies; advanced digital signal processing to support onboard image reconstruction, atmospheric correction, and system calibration; video exploitation techniques including new approaches to scene understanding and activity detection; adaptive optics techniques, such as deformable mirrors and liquid crystal spatial light modulators. The program extends these technologies and makes them practical for airborne surveillance systems. Technologies developed in the Advanced Airborne Optical Sensing program are planned for transition to the U.S. Army and the U.S. Air Force. Efforts in this program include: • The Standoff Precision ID in 3-D (SPI 3-D) program is developing an affordable sensor package capable of high-resolution 3-D images for confirmatory target ID at long ranges as well as full field of view (FOV) ranging to support precise geolocation of targets. The system provides intensity, range and polarization information for each pixel in the field of view with each laser pulse. The program includes a series of ground-based and airborne demonstrations of SPI 3-D precision ID capabilities and track fusion techniques. The objectives are to provide: (1) high range resolution 3-D imaging; (2) full FOV range to pixel determination; (3) multiple frame-to-frame registration of imagery, and (4) GPS-based cueing from search systems. Results will provide commanders with significantly improved long-range identification of enemy ground targets, as well as targeting information to support guided weaponry. The SPI 3-D system employs optics, focal plane arrays, and gimbals combined with a range measurement technique. SPI 3-D technologies are being designed to achieve a Class IV UAV-compatible (Predator, Firescout & Warrior) configuration for installation into a Multi-spectral Targeting System (MTS) turret for transition to the U.S. Air Force at the conclusion of Phase III. The program will produce high speed, ultra sensitive photodetectors				

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

for systems requiring operation at very low photon counts. This will support long range sensors that can detect highly obscured targets under canopy/camouflage as well as very wide-area search for submerged targets including sea mines and semi-submerged mobile vessels.

• Spatially Processed Image Detection and Ranging (SPIDAR) is a coherent imaging method that allows one to form a large, effective optical aperture from a set of smaller, lighter telescopes providing for very high-resolution 3-D and 2-D ladar imagery of distant targets with a compact system configuration. This capability is very well suited for long-range engagements from airborne or space-based platforms and could significantly enhance the current synthetic aperture imaging approaches by providing the desired cross-range resolution along the axis perpendicular to the direction of travel. This capability is also applicable on a small scale to provide very-high resolution imagery in a compact and potentially man-portable configuration for long-range ID. The gain in size, weight and power over more conventional lidar implementations will be assessed and demonstrated. The effort will improve performance of the technology, specifically using diffuse reflective targets, targets with lower contrast and reduced intensity reference beam. Additionally, suitable missions and platforms for the technology will be identified. SPIDAR technologies will be transitioned to the U.S. Air Force in FY 2013.

• The Tactical Aircraft to Increase Long Wave Infrared Nighttime Detection (TAILWIND) program (formerly Hyperspectral Framing) will develop and demonstrate a system for collecting and processing IR data operating as a framing sensor. The system will accept long wave infrared and color camera images permitting day/night reconnaissance for real-time target detection and tracking. The resulting sensor and processing system will provide an order of magnitude increase in the combination of area coverage over current systems, and a decrease in time to focus the sensor operator's attention on relevant targets. The TAILWIND system is planned for transition to the U.S. Army by FY 2012.

FY 2008 Accomplishments:

Standoff Precision ID in 3-D (SPI 3-D)

- Completed preliminary design for integration into Multi-Spectral Targeting Systems (MTS) turret.
- Demonstrated metric sensing concept using a manned airborne testbed.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: Standoff Precision ID in 3-D (SPI 3-D) - Hold critical design review and initiate fabrication of flight sensor components for turret integration. Spatially Processed Image Detection and Ranging (SPIDAR) - Perform initial outdoor demonstration against enhanced targets to show spatial heterodyne approach is able to form imagery under turbulent seeing conditions. - Perform initial assessment of the performance of the current system configurations and systems analysis of long-range, high-resolution imaging applications. - Identify the trade space for considering multi-aperture receivers and illuminators in the system designs. - Define and detail performance of underlying key component technologies (including stable, high-power laser sources, high-speed imaging focal planes and image processing analysis). - Develop conceptual system designs to achieve desired system performance. - Initiate system design for extended-range ground-based demonstration. Tactical Aircraft to Increase Long Wave Infrared Nighttime Detection (TAILWIND) - Complete preliminary design of infrared and color sensor package. - Develop system design and data flow through to the user. *FY 2010 Plans:* Standoff Precision ID in 3-D (SPI 3-D) - Complete fabrication of miniaturized components and initiate integration into turret system. Spatially Processed Image Detection and Ranging (SPIDAR) - Fabricate ground-based demonstration for >5 sub-apertures at short range. - Complete Critical Design Review (CDR) for airborne demonstration at long range. Tactical Aircraft to Increase Long Wave Infrared Nighttime Detection (TAILWIND) - Complete detailed design of infrared and color sensor package. - Develop parallel processing, compression, and image exploitation algorithm.				

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Wide Area Video Surveillance*	6.693	10.040	13.000	

*Previously this was part of Advanced Airborne Optical Sensing.

(U) The Wide Area Video Surveillance program is developing advanced electro-optical and infrared sensor technologies to enable persistent, wide-area, day-night video surveillance. Specific examples of these technologies includes: gigapixel focal plane arrays; advanced digital signal processors for giga-pixel image formation; advanced image processing algorithms for real-time detection, identification, and tracking of elusive and deceptive military targets; and advanced optics, telescopes and gimbals for high-resolution image capture. The Wide Area Video Surveillance program integrates these technologies in proof-of-concept prototypes for demonstration on military platforms including large and small, manned and unmanned aerial vehicles. Wide Area Video Surveillance technologies are planned for transition to the U.S. Air Force. Efforts in this program include:

• The Autonomous Real-time Ground Ubiquitous Surveillance – Imaging System (ARGUS-IS) program (formerly known as Advanced Optical Sensing) is developing an airborne sensor system that provides persistent, real-time, high-resolution, wide-area video surveillance. ARGUS-IS will provide the warfighter with a minimum of sixty-five “Predator like” video windows across the field of view. Each video window is electronically steerable and independent of the others. ARGUS-IS can also provide a global moving target indicator for vehicle size objects across the entire field of view. ARGUS-IS is comprised of three major subsystems: (1) a Gigapixel Sensor Subsystem (GSS) which consists of a set of four telescopes and is mounted in a 3-axis stabilized gimbal; (2) an Airborne Processing Subsystem (APS) which takes raw pixels from the GSS and performs all required processing; and (3) a ground processing subsystem which provides the interface to the user and records down-linked imagery. A Memorandum of Agreement (MOA) for the transition of ARGUS-IS from DARPA to the U.S. Air Force. The transition period is FY2009–FY2010.

• The Autonomous Real-time Ground Ubiquitous Surveillance – Infrared (ARGUS-IR) program is developing an airborne sensor system that provides a persistent, real-time, high-resolution, wide-area night video surveillance capability. ARGUS-IR uses an advanced infrared (IR) focal plane array (FPA) sensor. The nighttime persistent capability provided by ARGUS-IR combined with the daytime capability

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

provided by ARGUS-IS enables 24-hour day/night surveillance. ARGUS-IR's wide-area, high-update-rate, high-resolution imaging capability will enable detection and tracking of dismounts as well as vehicles. ARGUS-IR will utilize the signal/image processor developed as part of ARGUS-IS, enabling ARGUS-IS and ARGUS-IR to be combined into a common pod. ARGUS-IR must overcome a number of demanding technical challenges beyond those faced by ARGUS-IS. The most significant challenges relate to the IR FPA and size, weight, and power constraints for the IR sensor. Technologies are planned for transition to the U.S. Air Force.

FY 2008 Accomplishments:

Autonomous Real-time Ground Ubiquitous Surveillance – Imaging System (ARGUS-IS)

- Completed preliminary and critical design review for each of the ARGUS-IS subsystems.
- Developed advanced signal processing techniques for the rapid formation of optical imagery and verified that the processing performance meets all the requirements for the overall system.
- Verified that the sensor and ground processing systems satisfied the design parameters.
- Designed and built the telescopes and composite focal plane arrays for the gigapixel sensor.
- Designed the electronics associated with the gigapixel sensor.
- Validated the ground processing system's ability to command the airborne processing system, storage, and video window display.

FY 2009 Plans:

Autonomous Real-time Ground Ubiquitous Surveillance – Imaging System (ARGUS-IS)

- Complete the build of the gigapixel sensor.
- Integrate sensor, airborne processor, and data link into A-160 pod.
- Perform test flights utilizing a modified Blackhawk Helicopter.
- Complete software development for ground processing and airborne processing systems.
- Conduct flight experiments for video windows and video tracking.
- Begin building a copy of the sensor and airborne processor for U.S. Air Force.

FY 2010 Plans:

Autonomous Real-time Ground Ubiquitous Surveillance – Imaging System (ARGUS-IS)

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete build and delivery of sensor and airborne processing systems for U.S. Air Force. - Integrate sensor and airborne processing systems into a compatible pod. - Integrate ARGUS-IS pod with target platform. - Conduct flight tests that will validate the video windows and video tracking functionality. Autonomous Real-time Ground Ubiquitous Surveillance – Infrared (ARGUS-IR) - Develop prototype IR FPA. - Develop packaging approach appropriate for the target gimbal. - Begin development of optics for IR sensor.					
Large Area Coverage Search-while-Track and Engage (LACOSTE)* *Previously this was part of Advanced Airborne Optical Sensing. (U) The Large Area Coverage Search-while-Track and Engage (LACOSTE) program enables a persistent, tactical-grade ground moving target indicator (GMTI) capability in dense urban areas. Wide-area continuous tracking of moving vehicles requires very small coverage gaps, small resolution cells, and target separation and identification features. The ideal sensor has the area coverage rates of GMTI radar and the resolution/identification capabilities of an electro-optical infrared system. The LACOSTE program will provide wide area surveillance, simultaneous tracking, and target engagement with electro-optical and infrared sensors for tactical GMTI operations. The program is developing a sensor with a very wide field of regard (90 degree cone angle), and a wide instantaneous FOV that is rapidly scanned in a search-while-track mode, tracking up to 10,000 targets in an urban area. Additionally, the LACOSTE sensor will provide next-generation precision tracking to enable engagement on a large number of (approximately 100) targets in dense urban areas within that same field of regard with minimal penalty on the search-mode area coverage rate. The program is also developing a rapid “zoom” capability for target identification that enables feature-aided tracking through dense target environments, plus sufficient target identification for separating like-targets when back-tracking a particular target via the historical track data. The LACOSTE technology is planned for transition to the U.S. Air Force and the U.S. Army at the conclusion of the program.		4.407	12.150	15.460	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2008 Accomplishments: - Developed objective system designs and demonstrated the core technologies – electronically addressable mask and computational imaging algorithms. *FY 2009 Plans:* - Complete scaled integration of core system technologies. - Develop and test computational imaging and tracking algorithms. *FY 2010 Plans:* - Manufacture and test full-scale components. - Perform system integration and laboratory testing. - Demonstrate performance (sensitivity, resolution, and tracking) via tower testing.					
Synthetic Aperture Ladar for Tactical Imaging (SALTI) (U) The Synthetic Aperture Ladar for Tactical Imaging (SALTI) program will develop and demonstrate an airborne synthetic advanced laser radar (LADAR) capable of creating a synthetic aperture for high-resolution, three-dimensional imagery at long ranges. The technical objective of the SALTI program is to provide a proof-of-feasibility for operation at tactically relevant high altitudes and at long ground ranges. The SALTI approach combines the long-range day/night imaging afforded by conventional synthetic aperture radar techniques exploiting high power, high bandwidth laser radars. The result is 3-D imagery for target location and identification at high fidelity and potentially small size and weight. The SALTI program has produced the first-ever synthetic aperture LADAR images from aircraft. *FY 2008 Accomplishments:* - Developed lasers for higher power and higher bandwidths to support Long Range Demonstration (LRD). - Characterized propagation through the atmosphere under operational conditions to assess long range operational performance. - Generated and modified system design to support LRD.		6.689	16.000	0.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Develop high power, high bandwidth ladars for meeting SALTI requirements. - Develop mitigation techniques to counter atmospheric turbulence effects. - Develop and test acquisition, pointing and tracking subsystem for creating synthetic aperture ladar images at long range. - Review feasibility of designs to place SALTI in a pod.					
Ground Targeting Sensors (U) The Ground Targeting Sensor thrust provides sensors and signal processing systems to detect, identify, and engage close-in ground targets. Its products are installed on platforms that operate on the ground (HUMVEE, convoy elements) and near the ground (helicopters). They employ technologies that defeat or compensate for the unusual atmospheric conditions near the surface (turbulence, dust, strong propagation losses) in order to provide timely and accurate detection and classification of dismounts, small vehicles, and terrain obstacles. Programs in this thrust include: • The SandBlaster program will develop a helicopter pilot performance enhancement system for landing in degraded visual environments such as Iraq and Afghanistan dust clouds. Sandblaster addresses this important operational challenge in a Blackhawk platform environment, in four distinct areas: (1) Advanced flight controls which enable the helicopter to auto-land at a pilot-selected landing point; (2) See-through sensing based on a forward-looking three dimensional W-band radar, which enables the pilot to see through the dust and select a safe landing point; (3) A powerful fusion engine which combines map and obstacle database knowledge with real-time radar data to construct a full current assessment of landing zone hazards; and (4) An enhanced synthetic vision display to present this evolving real-time landing zone information to the pilot in the most useful manner, combined with all necessary aircraft-state symbology needed to complete a safe landing. The technology developed under this program will transition to U.S. Special Operations Command (USSOCOM), the U.S. Air Force and the U.S. Army. • The Super-Resolution Vision System (SRVS) program will develop and build a field prototype soldier-portable optical system that will demonstrate improved recognition and identification range over existing		17.540	17.952	15.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

systems. The key technical innovation is exploitation of atmospheric turbulence-generated micro-lensing phenomena to generate images that are superior to diffraction-limited images. A variation of lenses approach, to include adaptive polymer lenses, will also be investigated. SRVS will facilitate new operational and tactical opportunities for land forces. Through enhanced resolution imaging, SRVS will (1) extend target recognition and identification to decisively longer distances; (2) overcome atmospheric turbulence, which now limits the ability of high-resolution optics; and (3) increase target identification confidence to reduce fratricide and/or collateral damage. It will culminate in a field demonstration of a prototype. Technology developed under this program will transition to Special Operations Forces.

• The Short Wave Infrared through Fog and Clouds (SWIF) program will develop and demonstrate advanced signal processing and optical imaging technology to allow detection of collision and grounding threats in fog and clouds at useful ranges (day or night), which substantially degrade performance in precision handling operations. Humans are able to operate successfully with sensor assistance, but situational awareness significantly degrades. Successful development of this technology will restore this situational awareness to tactically relevant distance and time scales. Significant technical obstacles that must be overcome include development of an ultra-short pulse laser with sufficient bandwidth and fast enough pulse rise time to create transient-like propagation characteristics in an aerosol cloud, distributed active sources, and advanced filtering techniques. Technologies are planned for transition to the U.S. military.

FY 2008 Accomplishments:

SandBlaster

- Completed SandBlaster flight-simulator testing and evaluation.
- Completed and installed millimeter-wave radar in the JUH-60A Blackhawk helicopter.
- Completed and installed fusion engine in the JUH-60A Blackhawk helicopter.
- Completed and installed Advanced Flight Control subsystem in the JUH-60A Blackhawk helicopter.
- Completed and installed synthetic vision display in the JUH-60A Blackhawk helicopter.
- Conducted initial radar testing in the JUH-60A Blackhawk helicopter.

Super-Resolution Vision System (SRVS)

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Investigated optimal control algorithms and implementation.
- Completed prototype design; fabricated brassboard system.
- Conducted field experiments and testing to optimize system performance.
- Conducted Probability of Identification (PID) testing and obtained 90% PID on SRVS resolved imagery.

Short Wave Infrared through Fog and Clouds (SWIF)
- Completed tradespace analysis of pulse propagation characteristics.

FY 2009 Plans:

SandBlaster
- Complete Sandblaster system performance testing and demonstrate capabilities in the JUH-60A Blackhawk helicopter.
- Transition Sandblaster technology to the services.

Super-Resolution Vision System (SRVS)
- Conduct demonstration and testing of prototype systems.
- Modify design based on experiments and testing to support transition.

Short Wave Infrared through Fog and Clouds (SWIF)
- Develop imaging algorithms.
- Conduct modeling and simulation to optimize system range and resolution.
- Conduct experiments under various scattering and absorption conditions to characterize optical link budget.
- Demonstrate imaging algorithm performance in controlled conditions.
- Develop distributed active obscurant technologies.
- Package and test distributed obscurant.

FY 2010 Plans:

Super-Resolution Vision System (SRVS)
- Conduct conceptual studies to identify possible lens variations, including adaptive polymer lenses.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY		PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Commence fabrication and testing of soldier portable prototype. - Conduct field testing of system performance. Short Wave Infrared through Fog and Clouds (SWIF) - Distribute obscurant chamber testing and system validation.				
Soldier-borne Sensor Technology (U) The Soldier-borne Sensor Technology thrust provides sensors for improved situational awareness and effectiveness of individual soldiers. It builds small unit enemy weapon fire detection and classification tools, more precise target designation sensors, and methods for improved small arms weapon effectiveness. Programs in this thrust include: • The Crosswind Sensor System for Snipers (C-WINS) program will provide optical techniques to correct for crosswinds on ballistic objects. The C-WINS program will develop a novel weapon mounted optical correction sighting system for various rifles and machine guns. An eye safe laser and a high speed camera will record motion of eddies in the atmosphere to measure wind profile that will used to provide ballistic correction. The system will provide offset corrections to the shooter for compensating the aim point affected by the crosswind. Key parameters of interest are: a) bullet hit points less than the target size at any range up to weapons effective range; b) down range profiling up to weapons effective range; c) ranging accuracy sufficient to provide elevation correction; d) automatic ballistic correction; e) day/night operation; and f) no setup or calibration. Additional capabilities could include: increased effective ranges for a wide range of weapons; eye safe ranging; increased ID range during day and night; and shimmer compensation. This program is planned for transition to the U.S. Army and Marines. • The Laser Geospatial Referencing (LGR) system will allow ground troops to designate targets for engagement by air forces where the pilot or UAV operator can see the designated spots within the field of view of their visible or forward looking infrared system. The LGR concept provides nearly instantaneous target location, identification and designation capabilities to weapon platforms supporting urban or other ground operations. The LGR concept enables these assets to be immediately directed by dismounted soldiers. LGR technology could dramatically reduce the time required for targeting existing firepower in the	7.930	11.997	3.500	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

form of man-portable missiles, light armor, tanks, artillery and ground attack aircraft. LGR technologies will be transitioned to the U.S. Army and Marine ground forces, and U.S. Air Force and Army.

• The Sensor Tape program will develop and demonstrate a low-cost, one-time-use, low-power, band-aid size, adhesive-applied blast dosimeter that records accumulative blast effects for integration into combat medical care. Significant technical obstacles that must be overcome include achieving adequate switching frequencies, packaging, print-on ink technologies and production costs. Sensor Tape is planned for transition to the Air Force and Army.

FY 2008 Accomplishments:

Omni-Directional Flash & Launch Detection, Positioning, Classification and Observation System (MEGA)
- Developed and demonstrated IR sensor prototype.
- Developed and demonstrated stationary omni system.
- Developed and demonstrated mobile platform omni system.

Crosswind Sensor System for Snipers (C-WINS)
- Designed and built electronics board sufficient to trigger laser at required rates, receive, store and process data (on line and offline).
- Integrated system and conducted field tests to validate the proposed concept as a function of the crosswind and scintillation index.
- Demonstrated system capability to correct crosswind effects on ballistic trajectory.

FY 2009 Plans:

Crosswind Sensor System for Snipers (C-WINS)
- Develop transition and manufacturing plans.
- Develop and build three prototype systems and integrate and test system in the lab and field.

Laser Geospatial Referencing (LGR)
- Complete initial feasibility study to determine concept of operations (CONOPS) and design requirements.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY			PROJECT NUMBER SEN-02	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Assess technology development required to meet objectives and developed program plan. - Initiate supporting focal plane array technology development for LGR. Sensor Tape - Demonstrate proposed sensors and communications capability in controlled laboratory experiments. - Integrate modules into a complete first generation prototype blast dosimeter. - Develop jet-printing processes required for printed sensors, printed electronics and printed memory components. - Develop printed pressure, acceleration, light and acoustic sensors. - Develop proposed sensors and communications capability in controlled laboratory experiments. *FY 2010 Plans:* Crosswind Sensor System for Snipers (C-WINS) - Implement transition and manufacturing plans. - Transition to the Army and Marine Corps. Sensor Tape - Demonstrate web-printing process for sensors, printed electronics and memory components. - Fabricate prototype sensor tapes. - Demonstrate sensor tape performance in field test.					
Precision Electronic Warfare (PreEW) (U) Precision Electronic Warfare (PreEW) will develop a system to enable highly precise communications jamming. This program will develop and demonstrate robust, low cost, small size, weight and power (SWAP) distributed electronic warfare (EW) platforms to allow the warfighter to disrupt and impede an adversary's communication network. The PreEW program uses an array of nodes that have synchronized clocks to enable the signal from each node to be aligned so that the carrier and phase are focused on the desired location. The effect will be to place the desired energy on the specific target area while not affecting the non-target area. The node is planned to contain localization, network, synchronization and jamming processing and communication in a low-cost, easily deployable package. Key technology		0.000	0.000	5.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
challenges include oscillator synchronization, accurate pointing, and energy focusing to impact quality of service of intended target. The PreEW program is planned for transition to the Services in FY 2013. *FY 2010 Plans:* - Design and develop precision clock synchronization techniques for evaluation and selection for static scenarios. - Design beamforming and inter-mode communication architecture. - Experiment with brassboard design to validate ability for small SWAP. - Perform experiments to validate clock synchronization, precision pointing, and precision jamming capabilities.				
Foliage Penetration Reconnaissance Surveillance Tracking and Engagement Radar (FORESTER) (U) The Foliage Penetration Reconnaissance Surveillance Tracking and Engagement Radar (FORESTER) program is developing an ultra high frequency (UHF) ground moving target indicator (GMTI) radar that can detect dismounts and vehicles moving under dense foliage. In the first phase of the program, the FORESTER was installed on a Black Hawk and flown in a series of successful demonstrations in the U.S. and OCONUS. In the second phase of the program, FORESTER was successfully flown on the A160, a revolutionary high-altitude long-endurance unmanned helicopter developed by DARPA and the U.S. Army. FORESTER development is now finishing up with radar field experiments conducted jointly with operational users to refine and optimize FORESTER radar performance and concepts of operation. At the conclusion of these experiments FORESTER will transition to Service partners. The FORESTER program was previously budgeted in PE 0603764E, Land Warfare Technology, Project LNW-03, Future Combat Systems which ended in FY 2007. Work is continuing in the Sensor Technology PE to complete demonstrations and program transition. *FY 2008 Accomplishments:* - Flew FORESTER antenna on A160 and demonstrated sufficient stability for radar imaging. - Flew full FORESTER on an A160 and demonstrated electromagnetic compatibility.	4.610	4.000	0.000	

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY	PROJECT NUMBER SEN-02

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Conduct radar field experiments and then, based on the results, refine and optimize FORESTER radar performance and concepts of operation. - Transition FORESTER to the operational user.				

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.

Exhibit R-2a, PB 2010 Defense Advanced Research Projects Agency RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 0400 - Research, Development, Test & Evaluation, Defense-Wide/BA 3 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603767E SENSOR TECHNOLOGY					PROJECT NUMBER SEN-CLS	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
SEN-CLS: Classified	0.000	0.000	56.882						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds Classified DARPA Programs. Details of this submission are classified.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Classified DARPA Program	0.000	0.000	56.882	
This project funds Classified DARPA Programs. Details of this submission are classified.				
FY 2010 Plans: Details will be provided under separate cover.				

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Details will be provided under separate cover.