Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Defense Advanced Research Projects Agency										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	316.166	248.683	224.378	0.000	224.378	260.518	304.072	309.564	313.391	Continuing	Continuing
TT-03: *NAVAL WARFARE TECHNOLOGY*	60.373	32.654	32.118	0.000	32.118	52.349	83.525	80.306	80.255	Continuing	Continuing
TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*	40.732	29.202	18.411	0.000	18.411	25.303	28.236	25.210	25.185	Continuing	Continuing
TT-06: *ADVANCED TACTICAL TECHNOLOGY*	122.827	81.739	69.018	0.000	69.018	75.920	48.862	69.513	69.443	Continuing	Continuing
TT-07: *AERONAUTICS TECHNOLOGY*	31.316	31.956	42.334	0.000	42.334	70.431	99.504	90.214	94.245	Continuing	Continuing
TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*	60.918	73.132	62.497	0.000	62.497	36.515	43.945	44.321	44.263	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) This program element is budgeted in the Applied Research Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The Tactical Technology program element funds a number of projects in the areas of Naval Warfare, Advanced Land Systems, Advanced Tactical Technology, Aeronautics Technology and Network Centric Enabling technologies.

(U) The Naval Warfare Technology project develops advanced enabling technologies for a broad range of naval requirements. Technologies under development will increase survivability and operational effectiveness of small and medium surface vessels in rough seas and demonstrate advanced technologies for hypersonic flight. New areas to be investigated include ship self defense techniques, novel underwater propulsion modalities, vessels for estuary and riverine operations and predictive tools for small craft hydrodynamic design.

(U) The Advanced Land Systems project is developing technologies for enhancing U.S. military effectiveness and survivability in operations ranging from traditional threats to military operations against irregular forces that can employ disruptive or catastrophic capabilities, or disrupt stabilization operations. The emphasis is on developing affordable technologies that will enhance the military's effectiveness while decreasing the exposure of U.S. or allied forces to enemy fire.

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Defense Advanced Research Projects Agency	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602702E: *TACTICAL TECHNOLOGY*

(U) The Advanced Tactical Technology project is exploring the application of compact and solid state lasers; high performance computational algorithms to enhance signal processing, target recognition and tracking, electromagnetic propagation, and processing of advanced materials and microelectronics; precision optics components for critical DoD applications; aerospace electronic warfare systems; new tactical systems for enhanced air vehicle survivability, advanced airbreathing weapons, and enabling technologies for advanced space systems; and Training Superiority programs that will create revolutionary new training techniques.

(U) The Aeronautics Technology project explores technologies to reduce costs associated with advanced aeronautical systems and provide revolutionary new capabilities for current and projected military mission requirements. This project funds development of micro adaptive flow control technologies; small-scale propulsion system concepts; and a high-strength, low structural weight airlift vehicle designed to control its buoyant lift independently of off-board ballast. New areas to be investigated are reusable hypersonic vehicles; novel helicopter blade designs that reduce acoustic signature; small, low cost high endurance UAV's capable of destroying most enemy UAV's; and short distance take-off and landing of fixed wing aircraft.

(U) The Network Centric Enabling Technology project funds sensor, signal processing, detection, tracking and target identification technology development required for true network-centric tactical operations. Technologies developed in this project will enable localized, distributed and cross-platform collaborative processing so that networks of sensors can rapidly adapt to changing force mixes, communications connectivity and mission objectives. Operational benefits will be smaller forward deployment of image and signal analysts, consistent integration of target and environment information, and flexible operational tactics and procedures for finding evasive targets in difficult environments.

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	352.924	276.075	0.000	0.000	0.000
Current President's Budget	316.166	248.683	224.378	0.000	224.378
Total Adjustments	-36.758	-27.392	224.378	0.000	224.378
• Congressional General Reductions		-1.042			
• Congressional Directed Reductions		-55.950			
• Congressional Rescissions	-10.023	0.000			
• Congressional Adds		9.600			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-16.820	0.000			
• SBIR/STTR Transfer	-9.915	0.000			
• Congressional Restoration for New Starts	0.000	20.000	0.000	0.000	0.000
• TotalOtherAdjustments	0.000	0.000	224.378	0.000	224.378

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Defense Advanced Research Projects Agency	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602702E: *TACTICAL TECHNOLOGY*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: TT-03: *NAVAL WARFARE TECHNOLOGY*		
Congressional Add: *Center of Excellence for Research in Ocean Sciences (CEROS)*	10.000	8.000
Congressional Add: *SeaCatcher Unmanned Aircraft Launch and Recovery System*	1.600	1.600
Congressional Add Subtotals for Project: TT-03	11.600	9.600
Project: TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*		
Congressional Add: *Optical Sensor System*	0.800	0.000
Congressional Add Subtotals for Project: TT-04	0.800	0.000
Congressional Add Totals for all Projects	12.400	9.600

Change Summary Explanation

FY 2009

Decrease reflects the Section 8042 rescission of FY 2010 Appropriation Act, Omnibus Reprogramming action for the H1N1 vaccine development, SBIR/STTR transfer and internal below threshold reprogramming.

FY 2010

Decrease reflects the reductions for the Section 8097 Economic Assumption, execution delays and FY 2010 new starts offset by congressional adds (as identified above) and FY 2010 Congressional Restoration for New Starts.

FY 2011

Not Applicable

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
TT-03: *NAVAL WARFARE TECHNOLOGY*	60.373	32.654	32.118	0.000	32.118	52.349	83.525	80.306	80.255	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. Enabling and novel technologies include concepts for expanding the envelope of operational naval capabilities such as drag reduction, ship stability, hypersonic missiles, logistically friendly distributed lighting systems, ship self defense techniques, novel underwater propulsion modalities, vessels for estuary and riverine operations, high speed underwater vessels, improved techniques for underwater object detection and discrimination, long endurance unmanned surface vehicles, and high bandwidth communications.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Super-Fast Submerged Transport	16.638	13.554	2.411	0.000	2.411

(U) The Super-Fast Submerged Transport program (Underwater Express) will explore the application of supercavitation technology to underwater vehicles, enabling high speed transport of personnel and/or supplies. The inherent advantages of traveling underwater are: the ability to transit clandestinely, no radar or visible signature, and avoidance of rough sea conditions that may limit or deny mission execution. Supercavitation places the vehicle inside a cavity where vapor replaces the water, and drag due to fluid viscosity is reduced by orders of magnitude, thus reducing the power requirement dramatically. This program will use modeling, simulation, experiments and testing to develop the understanding of the physical phenomena associated with supercavitation and the application to underwater vehicles. Innovative failsafe controls will be required for stability and maneuverability at speed. The program will culminate in an at-sea demonstration of an unmanned vehicle capable of fully wetted to supercavitating operations and autonomous maneuvering.

FY 2009 Accomplishments:

- Developed vehicle control system and algorithms.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Conducted extensive simulation testing with increasing vehicle and environmental fidelity. - Conducted modeling, simulations, and experiments to refine understanding of cavity and vehicle control and stability. - Continued development of vehicle design including propulsion system design and integration, and design, fabrication and testing of a scaled prototype vehicle. *FY 2010 Plans:* - Complete design, fabrication and component testing of a scaled vehicle. - Conduct initial at-sea testing of a scaled vehicle. - Analyze vehicle performance for speed, power and stability. - Complete development of vehicle control system. - Modify vehicle systems for at-sea testing series based on testing results. *FY 2011 Base Plans:* - Complete at-sea testing of a scaled vehicle.					
Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) *Formerly Extremely Long Endurance Surface Vessel (ELEUSV) (U) The Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) program will develop an unmanned X-ship design based on the premise that a human is never intended to step aboard at any point in the operations cycle. In doing so, an unexplored design space emerges without constraint on structure, stability, or crew support, in contrast to their significant impacts in conventional ship design. ACTUV will be an independently deployed unmanned naval vessel under spares remote supervisory control. This, coupled with a novel suite of sensors capable of robustly tracking quiet modern diesel electric submarines, will demonstrate a game changing ASW operational capability. Key technical areas include sensor fusion to integrate diverse sensors applied in non-traditional ways,	2.400	3.500	6.500	0.000	6.500

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
system autonomy to execute independent deployment under sparse remote supervisory control, and system integration due to the complexity and unique configuration of the ACTUV platform. *FY 2009 Accomplishments:* - Conducted analysis of unmanned naval vessel concepts and operational employment. - Identified core technologies required to enable unique large scale unmanned naval vessel capabilities. - Developed exploratory system concept designs. - Conducted preliminary operations effectiveness analysis and developed concept of operations to take advantage of unique system characteristics. *FY 2010 Plans:* - Conduct mission-focused integrated system concept development. - Make critical enabling technology assessments and preliminary selections. - Conduct producibility and manufacturing sourcing analysis. - Generate preliminary system performance specifications. - Complete user assessment of strategic and operational value. - Expand concept to underwater applications. *FY 2011 Base Plans:* - Integrate best of breed system performance specifications from competing system concepts to underpin detail design process. - Conduct system preliminary design. - Conduct critical subsystem technology demonstration planning and risk reduction testing. - Demonstrate enabling manufacturing processes and validate production cost estimates. - Initiate high fidelity operational effectiveness analysis and concept of operations development. - Commence development of promising technologies for extension to underwater applications.					
Submersible Aircraft	0.000	3.000	8.000	0.000	8.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) This program will combine the speed and range of an airborne platform with the stealth of an underwater vehicle by developing a vessel that can both fly and submerge. The program will exploit lightweight materials, unique dynamic structures and advanced propulsion systems to overcome the technical barriers to achieving this capability. If successful, the program will enable insertion and extraction of special operations and expeditionary forces at greater ranges, and higher speeds in locations not previously accessible with minimal direct support from additional military assets. The program goals are to demonstrate a vessel capable of multimodal operations (airborne, surface, and submerged) and that can easily transition between these modes. *FY 2010 Plans:* - Conduct concept design studies and perform feasibility analysis in order to quantify extent of possible operational envelope. - Identify key technology limitations and performance objectives that need to be overcome in order to achieve concept design. *FY 2011 Base Plans:* - Complete developmental activities including modeling and experiments, demonstrating technologies, and approaches that can overcome the identified performance objectives. - Complete objective system design based on the results of developmental activities, providing an accurate projection of the systems operational envelope.					
Non-traditional Active Sonar (U) The goal of the Non-traditional Active Sonar program is to develop alternative solutions for anti-submarine warfare active sonar. Given the trend of submarine quieting, passive sonar is of diminishing value to the Navy for large area searches. The existing alternatives are high power active sonar systems which are overt and difficult to use in peace time given concerns for the environment. The program will investigate new approaches which exploit special acoustic phenomena through advanced	0.000	2.000	6.000	0.000	6.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
active sonar signal processing to counter the need for high peak power sonar. Emphasis is on data-driven algorithms applicable across existing Navy towed and bottom arrays. *FY 2010 Plans:* - Develop initial processing algorithms for use with the initial data set. - Exercise the algorithms with surrogate or simulated data. - Conduct controlled data collection with surrogate sources and targets. - Develop and assess algorithms using collected data. *FY 2011 Base Plans:* - Iterate on algorithm designs to assess detection capability (e.g., range) and extrapolate performance to other environments and concepts of operations. - Conduct at-sea demonstration with real targets to assess performance under realistic conditions and to justify relevant systems concepts.					
Very High Speed Vessel (VHSV) (U) The Very High Speed Vessel (VHSV) program will explore the development of a small tactical surface vessel capable of protecting high value naval vessels in contested littoral environments. The VHSV will exhibit tactical mobility and mission endurance well beyond that of any current or proposed littoral warfare platform. The vessel will be able to operate as either a manned or unmanned naval combat vessel and will be optimized to defend against irregular naval warfare threats such as Fast Inshore Attack Crafts (FIACs), high speed swarming combatant boats, and conventional diesel submarines operating in shallow coastal waters. The VHSV will leverage emerging developments in reconfigurable hull forms, fluid drag reduction, hybrid naval propulsion design, and dynamic control in fully cavitated flow to develop a vessel with significantly superior maximum speed and seakeeping in elevated sea states.	0.000	0.000	4.207	0.000	4.207

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Complete military and tactical utility study and establish vessel's development metrics. - Conduct major system trade off analyses. - Initiate concept design and risk reduction analysis and testing.					
Caiman (U) The Caiman program will develop a prototype amphibious robotic vehicle which will navigate tropical rivers autonomously for long range/long duration missions (~100 kilometers and ~7+ days) while gathering intelligence. Navigating tropical rivers requires traversing long stretches of sandbars, very shallow water and avoiding small to large obstacles. It also demands new advances in perception, autonomy and locomotion to enable the system to make progress in cluttered, shallow waters, including occasionally exiting the water, traversing ground such as sandbars, and then reentering. The Caiman mission is targeted for the interface between water and land, which will result in the vehicle being able to access riverine and swamp areas which are inaccessible. *FY 2011 Base Plans:* - Develop, analyze and assess preliminary designs to achieve a system capable of a hundred kilometers of travel over a 7 day mission. - Simulate water to land to water transitions to validate design. - Build subsystems that prove design validity.	0.000	0.000	5.000	0.000	5.000
Hypersonics Flight Demonstration (HyFly) (U) The Hypersonics Flight Demonstration (HyFly) program will develop and demonstrate advanced technologies for hypersonic flight. The ultimate goal of the program is to demonstrate vehicle performance that could lead to an operational tactical surface launched missile range of 600 nautical miles. Specifically, the program will demonstrate an F-15 launched missile configuration with a range of 400 nautical miles, a maximum sustainable cruise speed in excess of Mach 6, and the ability	2.200	1.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to accurately terminate the missile on a GPS guided impact target. Technical challenges include the scramjet propulsion system, lightweight, high-temperature materials for both aerodynamic and propulsion structures, and guidance and control in the hypersonic flight regime. Based on the results of the first two test flights, subsystem components will be modified and a third flight test has been added to the program development schedule. *FY 2009 Accomplishments:* - Conducted testing of modified subsystems. - Conducted fuel system and nose assembly shock and vibration testing. - Fabricated major engine components. - Assembled flight vehicle, perform ground testing and check-out. *FY 2010 Plans:* - Continue assembly of flight vehicle and perform ground testing and subsystem check outs. - Complete final testing activities.					
Long Range Anti-Ship Missile (LRASM) (U) The Long Range Anti-Ship Missile (LRASM) program is investing in advanced component and integrated system technologies capable of providing a dramatic leap ahead in U.S. surface warfare capability, focusing on organic wide area target searches and discrimination in a network denied environment, innovative terminal survivability in the face of advanced defensive systems, and high assurance target lethality approaches. Specific technology development areas include robust precision guidance, navigation and control with GPS denial, multi-modal sensors for high probability target identification in dense shipping environments, and precision aimpoint targeting for maximum lethality. Component technologies will be developed, demonstrated, and integrated into a prototype demonstration weapon system. The program will result in high fidelity demonstration to support military utility assessment. This program is funded from PE 0603286E, Project AIR-01, Advanced Aerospace Systems in FY 2010.	27.535	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Conducted threat modeling. - Conducted system performance operations analysis. - Conducted analytical trade studies to select seeker and datalink subsystems. - Conducted subsystem preliminary designs. - Initiated integrated system preliminary designs. - Commenced risk reduction testing of critical seeker, propulsion, and aerodynamic components.					
Accomplishments/Planned Programs Subtotals	48.773	23.054	32.118	0.000	32.118

	FY 2009	FY 2010
Congressional Add: Center of Excellence for Research in Ocean Sciences (CEROS) *FY 2009 Accomplishments:* - Completed projects started in FY 2008. - Selected projects for FY 2009 funding. - Contracted for selected projects and monitored progress of ocean related technologies of high interest to the DoD. *FY 2010 Plans:* - Select projects and monitor progress of ocean related technologies of high interest to the DoD.	10.000	8.000
Congressional Add: SeaCatcher Unmanned Aircraft Launch and Recovery System *FY 2009 Accomplishments:* - Explored launch and recovery system concepts.	1.600	1.600

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-03: *NAVAL WARFARE TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
FY 2010 Plans: - Continue to explore launch and recovery system concepts.		
Congressional Adds Subtotals	11.600	9.600

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, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*	40.732	29.202	18.411	0.000	18.411	25.303	28.236	25.210	25.185	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) This project is developing technologies for enhancing U.S. military effectiveness and survivability in operations ranging from traditional threats to military operations against irregular forces that can employ disruptive or catastrophic capabilities, or disrupt stabilization operations. The emphasis is on developing affordable technologies that will enhance the military's effectiveness while decreasing the exposure of U.S. or allied forces to enemy fire.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Recognize Improvised Explosive Devices and Report (RIEDAR)	1.463	1.000	0.000	0.000	0.000
(U) The goal of the Recognize Improvised Explosive Devices and Report (RIEDAR) program is to develop and demonstrate a capability for stand-off detection of various devices. *FY 2009 Accomplishments:* - Demonstrated operation of compact, tunable lasers from deep ultraviolet (UV) to near infrared (NIR). *FY 2010 Plans:* - Investigate designs for sub-system consisting of optical detector and compact laser for detection of explosives.					
Magneto Hydrodynamic Explosive Munition (MAHEM)	2.705	1.616	1.210	0.000	1.210
(U) The Magneto Hydrodynamic Explosive Munition (MAHEM) program will demonstrate compressed magnetic flux generator (CMFG)-driven magneto hydrodynamically formed metal jets and self-forging penetrators (SFP) with significantly improved performance over explosively formed jets and fragments. Explosively formed jets (EFJ) and SFP are used for precision strike against targets such as armored					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
vehicles and reinforced structures. Current technology uses chemical explosive energy to form the jets and fragments. This is highly inefficient and requires precise machining of the metal liners from which the fragments and jets are formed. Generating multiple jets or fragments from a single explosive is difficult and the timing of the multiple jets or fragments cannot be controlled. MAHEM offers the potential for higher efficiency, greater control, the ability to generate and accurately time multiple jets and fragments from a single charge, and the potential for aimable, multiple warheads with a much higher EFJ velocity, hence increased lethality precision, than conventional EFJ/SFP. MAHEM could be packaged into a missile, projectile or other platform, and delivered close to target for final engagement. This could provide the warfighter with a means to address stressing missions such as: lightweight active self-protection for vehicles (potential defeat mechanism for a kinetic energy round), counter armor (passive, reactive, and active), mine countermeasures, and anti-ship cruise missile final layer of defense. *FY 2009 Accomplishments:* - Successfully tested a static brassboard prototype of a self-contained MAHEM munition to demonstrate the ability to package a MAHEM device into a shoulder-launched munition form factor. *FY 2010 Plans:* - Using theoretical models, design flux compression generator (FCG) components in preparation for fabrication and testing of the armature and stator configuration with static and dynamic loads. - Perform testing of FCG components. - Design, model, and fabricate shaped charge liners and magnetically formed penetrators (MFPs) that will provide maximum penetration against hardened targets of interest. - Test shaped charge liners and MFPs. *FY 2011 Base Plans:* - Design and model dual liners composed of the main shaped charge liner and an MFP liner wherein both are powered by the same FCG.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Lightweight Ceramic Armor (LCA)	4.529	2.000	0.000	0.000	0.000

(U) The Lightweight Ceramic Armor (LCA) program leverages recent breakthroughs in novel ceramic fabrication processes developed in the Materials Processing Technology project to drive a dramatic performance shift in the trade-off between weight and ballistic projectile protection of body armor. Currently fielded Boron Carbide body armor is heavy and limited in the diversity of shapes that may be molded. Its weight and bulk limit a soldier's agility and mobility, and its cost prohibits consideration of using it to protect vehicles. Recent breakthroughs in ceramics processing technology offers the opportunity for cost effective fabrication of molded shapes, the retention of nanostructured grains for significantly higher energy dissipation, a fifty percent reduction in weight for equal ballistic protection, and similar reduction in cost. The focus areas of the program are: the optimization of the material composition and nanostructure for maximum protection per unit weight and cost, and scale up of the fabrication technology to body armor size scale articles. The program will additionally investigate the potential for the development of dramatically improved ballistic armored headgear along these same lines.

FY 2009 Accomplishments:
- Optimized integrated backing materials - ceramic armor materials systems for minimum weight at Enhanced Small Arms Protective Inserts ESAPI ballistic performance.
- Evaluated the characteristics of an optimized LCA system optimized for minimum weight at ESAPI ballistic performance.

FY 2010 Plans:
- Validate an initial fifteen percent reduction in weight for equal performance compared to currently fielded ESAPI armor inserts.
- Investigate the potential for significantly improved ballistic characteristics of meta-structured ceramic systems incorporating multiple materials layers in a monolithic plate.
- Develop and evaluate initial concepts for ballistic headgear incorporating the LCA materials.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Demonstrate key manufacturing steps at pilot scale throughput with consistent and reliable yielded ceramic part performance.					
Crosshairs	9.211	6.000	3.900	0.000	3.900
(U) The Crosshairs program seeks to develop a vehicle mounted threat detection and countermeasure system that will detect, locate, and engage enemy shooters against a variety of threats to include bullets, Rocket Propelled Grenades (RPGs), Anti-Tank Guided Missiles (ATGMs), and direct fired mortars, both stationary and on the move. Threat identification and localization will be accomplished in sufficient time to enable both automatic and man-in-the-loop responses. Phase I of the program focused on initial development and testing of the Crosshairs sensor system. Phase IA culminated with a static live fire test to determine the most effective candidate sensor system. During Phase IB, enhancements were made to the sensor system for on the move performance, and on the move testing against multiple threats was conducted. DARPA and the U.S. Army Rapid Equipping Force (REF) entered into an MOA for Phase IIA. Phase IIA consisted of a moving demonstration of the hardened, packaged, and enhanced Phase I sensor system on two networked HMMWVs (Humvee), integration with candidate response systems, and testing and evaluation of the complete systems in relevant environments. The program is currently in Phase IIB. During this phase, the Crosshairs sensor system is being integrated with the Iron Curtain Active Protection System (IC-APS) on four up-armored vehicles. At the end of Phase IIB, the Crosshairs systems will be ready for field testing. (U) The Concept of Operations is to provide a military vehicle with an affordable vehicle mounted detection and response system that operates both stationary and on the move for light tactical vehicles. Bullets will be detected and localized using the DARPA-developed Boomerang acoustic gunfire detection system. Radar detection of all other threats will be made using the CrossCue radar. Protection against incoming RPGs will be provided by the IC-APS. The CrossCue radar is a dual mode, continuous wave, and pulsed Doppler radar, which will be used to determine range, velocity, and angle of bearing of the incoming threat. IC-APS uses the CrossCue Radar to alert the optical break screen of incoming RPGs. The optical break screen characterizes the threat and activates the cutting					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
charge to engage the warhead and cut the fuse. Technology challenges include: improving target classifier, reducing navigational drift, reducing effects of acoustic noise, improving estimates for point of closest approach and velocity, and integration of the IC-APS and CrossCue Radar. (U) DARPA is working with the Army Rapid Equipping Force (REF) and the Project Manager Mine Resistant Ambush Protected Vehicles (PM-MRAP) to validate the capabilities and initiate transition to combat forces in the 2010/2011 time frame. *FY 2009 Accomplishments:* - Demonstrated final hardened CrossCue system capabilities. - Performed on the move tests with hardened system against simultaneous RPGs. - Demonstrated ability to slew, acquire, and track a specific target. - Demonstrated networking capability between two Crosshairs sensor systems. *FY 2010 Plans:* - Complete integration of the APS and CrossCue system. - Validate system performance and field-worthiness through testing by the Army Test and Evaluation Command (ATEC). *FY 2011 Base Plans:* - Demonstrate final integrated system capability including active protection in live fire tests. - Transition Crosshairs technology to the military.					
Rocket Propelled Grenade (RPG) Nets (U) The goal of the Rocket Propelled Grenade (RPG) Nets program is to develop a near-term counter RPG net system that has performance at least equivalent to bar or slat armor but that is lighter and easier to deploy; and a mid-term net-based system with active elements that has greatly improved performance. Development of these systems will be supported by modeling to enhance understanding	5.079	3.306	0.900	0.000	0.900

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
of the net interactions and with extensive live fire testing against RPGs. Successful candidates will be installed on vehicles for evaluation in an operational context. DARPA is working with the USMC Program Manager for Motor Transport (PMMT) to develop, test and transition this capability to combat forces. *FY 2009 Accomplishments:* - Developed near-term net concepts and performed initial live fire evaluation. - Conducted all-up live fire evaluation on competing net concepts. - Determined vehicle type for net application and joint path forward with USMC. *FY 2010 Plans:* - Install near-term net systems on military vehicles and perform initial user evaluation. - Commence evaluation of near-term net system and initiate transition. *FY 2011 Base Plans:* - Complete evaluation of near-term net system and initiate transition.					
Helicopter ALert and Threat Termination (HALTT) (U) The Helicopter ALert and Threat Termination (HALTT) program will provide Army and Navy/Marine helicopters with a way to detect small arms and provide shooter location to improve their ability to respond. System effectiveness with emphasis on low false alarm rates is critical. The program goal is to successfully demonstrate protection of helicopters by automatic threat detection of small arms with an "o'clock" accuracy in azimuth as well as elevation and range to shooter. *FY 2009 Accomplishments:* - Integrated the acoustic system on a UH-60 Blackhawk and validated system performance against live fire in all flight regimes. - Demonstrated light and heavy caliber shooter location determination and multi-shooter performance.	4.800	3.850	2.500	0.000	2.500

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Developed HALTT system preliminary design and system integration plan. - Began analysis of defeat mechanisms against RPGs. *FY 2010 Plans:* - Install prototype HALTT systems on platforms for CONOPS evaluations. - Demonstrate the HALTT prototype system in operational evaluation scenarios. - Enhance sensor design and platform interface. - Integrate the acoustic sensors on unmanned aircraft to determine true system accuracy. *FY 2011 Base Plans:* - Integrate and demonstrate acoustic system on multiple platforms. - Demonstrate a fully integrated HALTT system in operational scenarios.					
C-Sniper (U) Based on promising results obtained under the Crosshairs program, the C-Sniper effort will develop the capability to detect and neutralize enemy snipers before they can engage U.S. Forces. The program will lead to the delivery of a field testable prototype suitable for experimentation as an integrated part of the DARPA Crosshairs system. The C-Sniper system will identify threats before they can fire. The enemy snipers may be operating both with, and without, telescopic sights, and other optical systems in highly cluttered urban environments. The C-Sniper system will operate day and night from a static or moving military vehicle and will provide the operator with sufficient information to make a timely engagement decision. Once the decision is made, the C-Sniper will provide data and control to point and track the on-board weapon on the selected target. The final decision to fire the weapon will be left to the operator. *FY 2009 Accomplishments:* - Developed the key technologies (laser system, sensor head, and system processing designs). - Developed the interfaces of the sensor system to integrate with Crosshairs.	8.645	9.845	9.901	0.000	9.901

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Conducted systems integration and test on stationary vehicle. - Developed and incorporated system design enhancements required for a moving vehicle. *FY 2010 Plans:* - Develop, deliver and demonstrate the operation of C-Sniper on moving vehicles. - Demonstrate system capability to correctly detect optical systems in highly cluttered urban environment. - Integrate C-Sniper into Crosshairs and demonstrate full system capability. - Commence demonstration of a fully integrated system capable of combining C-Sniper and Crosshairs technologies. *FY 2011 Base Plans:* - Complete demonstration of fully integrated system capabilities. - Transition to the Army and Marine Corps.					
Rocket Propelled Grenade (RPG) Pre-launch Detection and Cueing (U) The Rocket Propelled Grenade (RPG) Pre-launch Detection and Cueing program will enable the development of an omni directional, visual, vehicle mounted surveillance system for threat detection using cognitive swarm recognition technology to rapidly detect and identify the locations of attackers with RPGs before they are launched. During the first phase of the program, a system will be demonstrated capable of 360 degree coverage and detection rates of greater than ninety-five percent. Minimizing false alarms and false positives will be key, as will be true day/night operation and the simultaneous identification of multiple threats. *FY 2009 Accomplishments:* - Investigated methods to develop and mature detection and classification algorithms.	1.500	1.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Analyze and document promising methods for detection and classification algorithms.					
Counter Improvised Explosives Laboratories (CIEL) (U) Improvised explosives (IEs) are one of the most popular weapons used by terrorist groups. Over the past twenty years, IEs have become very common due to their easy preparation and the high availability of raw materials. Efficient methods for detecting and neutralizing/desensitizing sensitive explosives labs in an urban environment will minimize interference with troop operations and minimize collateral damages. The goal of the Counter Improvised Explosives Laboratories (CIEL) program is to develop the infrastructure and methodology for novel chemo-sensors that would identify labs that are building IEs to a very high degree of specificity and reliability; and develop the infrastructure for tools for safe handling of improvised explosives and their mixtures. The CIEL program will also examine methods to improve current collection techniques used to detect sensitive explosives and their residues in an urban environment. The goal is to develop a detection system that is sufficiently selective and sensitive for collection of trace explosives; this system will be field-deployable and will provide clear and fast identification of the target explosive with minimal impact on troop operations. *FY 2009 Accomplishments:* - Developed prototype sensor kit with built-in validation techniques to reduce occurrence of false positive results. - Deployed prototype sensor kit for end-user feedback. - Tested neutralization/desensitization methods on “field-form” mixtures of explosives. - Evaluated design concept for multi-structured “smart” wipe. - Developed direct spectroscopic methodology for analysis of wipe and contaminate particles. - Developed prototypes of multi-scaled nano-fiber based “smart” wipe. *FY 2010 Plans:* - Assess field configuration of neutralization technology.	1.000	0.585	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Demonstrate final prototype field kit for desensitization/decomposition on mixtures of explosives. - Demonstrate nanostructure based “smart” wipe. - Develop detection reagents for contaminant particles collected by "smart" wipe. - Develop and field test prototype “smart” wipe.					
Guided Projectiles (U) The Guided Projectiles program developed and demonstrated highly maneuverable gun-launched projectiles, and associated fire control and launch systems for employment against critical enemy infrastructure and point targets, such as command, control and communication nodes and radars. This program focused enabling technologies to give U.S. warfighters the ability to allow weapons platforms, such as mortars, to receive updated target information from other munitions or sense target changes on their own. (U) The program developed low-cost, non-imaging optical seeker/guidance technology exploiting technology development in the visible and infrared spectrum, designed to replace the current 60mm mortar fuse and improve firing precision. Additionally, research was conducted with explosives to improve the effectiveness of 60mm explosive rounds. The goal was to develop a 60mm projectile with the effectiveness of a 105mm high explosive projectile. Technology developed for the 60mm projectile was investigated for application to the 81mm and 120mm mortars to increase the accuracy and effectiveness of all fielded mortar rounds at a low cost. *FY 2009 Accomplishments:* - Designed integration plan for incorporating test seeker-guidance system on large caliber (81mm or 120mm) mortar rounds.	1.000	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	39.932	29.202	18.411	0.000	18.411

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-04: *ADVANCED LAND SYSTEMS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Add: Optical Sensor System *FY 2009 Accomplishments:* - Selected sensor and developed processing for defeat of explosively formed projectiles.	0.800	0.000
Congressional Adds Subtotals	0.800	0.000

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, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
TT-06: *ADVANCED TACTICAL TECHNOLOGY*	122.827	81.739	69.018	0.000	69.018	75.920	48.862	69.513	69.443	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) This project focuses on four broad technology areas: a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasures, laser radar, holographic laser sensors, communications, and high-power laser applications; b) high performance computational algorithms for signal processing, target recognition and tracking, electromagnetic propagation, and processing of advanced materials and microelectronics; c) enabling technologies for advanced aerospace systems and emerging payload delivery concepts; and d) new approaches for training and mission rehearsal in the tactical/urban environment. Additionally, this project will develop new tactical systems for enhanced air vehicle survivability, precision optics, electronic warfare, and advanced air breathing weapons.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
High Power Efficient and Reliable Laser Bars (HiPER)	2.240	4.872	9.800	0.000	9.800
(U) The goal of the High Power Efficient and Reliable Laser Bars (HiPER) program is to develop linear bars of laser diodes that are more than seventy percent efficient in converting electrical power to optical output power. These laser diode bars will be used for supplying the optical pump power to ytterbium (Yb) and neodymium (Nd) solid state lasers operating near 1060 nanometers (nm). Such high efficiency laser pumps will lead to dramatic reductions in the size and weight of 100 kW class diode pumped solid state lasers based on reduced size and weight of not only the electrical power supply, but also reduced size and weight of the thermal management system. The goal of the HiPER program is also to retain high wall-plug efficiency of over seventy percent while ultimately producing compact laser diode bars with more than 250 W/bar-cm at lifetimes of greater than 100 hours.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Demonstrated operation of 1cm laser diode bar at a power of 250 watts with a lifetime greater than 100 hours to allow an additional factor-of-2 reduction in diode pumped solid-state laser system size and weight. - Demonstrated novel, compact impingement cooling technology to increase laser diode bar cooling technology and enable 1000 W laser diode bars operating with 1.8mm pitch. *FY 2010 Plans:* - Determine operational status of Super High Efficiency Diode Sources (SHEDS) lasers operated at 120 Watts after the fault rate has saturated and the laser is switched from fault protected mode to a standard power supply. - Acquire commercial off-the-shelf (COTS) 860 nm wavelength, 2mm long cavity laser bars for test set development. *FY 2011 Base Plans:* - Perform data reduction and failure mode analysis. - Test laser bars for fault rate saturation and laser switching from fault protected mode to standard power supply. - Demonstrate reduced failure rate for laser bars.					
High Energy Liquid Laser Area Defense System (HELLADS) (U) The goal of the High Energy Liquid Laser Area Defense System (HELLADS) program is to develop a high-energy laser weapon system (150 kW) with an order of magnitude reduction in weight compared to existing laser systems. With a weight goal of <5 kg/kW, HELLADS will enable high-energy lasers (HELs) to be integrated onto tactical aircraft, and will significantly increase engagement ranges compared to ground-based systems, enabling high precision, low collateral damage, and rapid engagement of fleeting targets for both offensive and defensive missions. The HELLADS program has completed the design and demonstration of a revolutionary prototype unit cell laser module that has	48.300	26.000	11.500	0.000	11.500

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
demonstrated power output and optical wavefront performance that supports the goal of a lightweight and compact 150 kW high energy laser weapon system with near-diffraction limited beam quality. An objective unit cell laser module with integrated power and thermal management is being designed and fabricated by two laser suppliers and will demonstrate an output power of >34 kW. Based on the results of the unit cell demonstration, additional laser modules will be fabricated to produce a 150 kW laser that will be demonstrated in a laboratory environment. The 150 kW laser will then be integrated with beam control, prime power, thermal management, safety, and command and control subsystems that are based upon existing technologies to produce a laser weapon system demonstrator. The capability to shoot down tactical targets such as surface-to-air missiles and rockets and the capability to perform ultra-precise offensive engagements will be demonstrated in a realistic ground test environment. Additional funding for this integration effort will be provided for HELLADS testing in Project NET-01, PE 0603766E starting in FY 2011. The HELLADS laser will then be transitioned to the Air Force for modification and aircraft integration and flight testing. *FY 2009 Accomplishments:* - Fabricated a prototype unit cell and characterized power output and optical wavefront of the prototype unit cell. - Initiated field testing of individual laser weapon system components. - Performed static lethality testing against key components of targets to be utilized in the field demonstration of the 150 kW laser weapon system. *FY 2010 Plans:* - Complete a unit cell laser module with integrated power and thermal management subsystems and demonstrate power, beam quality, run-time, weight, and volume. - Complete the detailed design of a ground-based 150kW laser weapons system demonstrator. - Initiate fabrication of additional unit cell laser modules to complete the 150 kW laser. - Initiate fabrication of the demonstrator laser weapon system. - Perform demonstrator laser weapon system component and subsystem testing.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate the fabrication and laboratory testing of the 150 kW laser. - Commence aircraft integration studies and design. *FY 2011 Base Plans:* - Integrate the 150 kW laser with the ground-based demonstrator laser weapon system. - Complete low power and high power testing of the ground-based demonstrator laser weapon system. - Conduct a ground-based field demonstration and analyze initial results of the performance of the demonstrator laser weapon system against tactical targets of interest to the Air Force and other users.					
Aero-Adaptive/Aero-Optic Beam Control (ABC) (U) The goal of the Aero-Adaptive/Aero-Optic Beam Control (ABC) program is to improve the performance of high energy lasers on tactical aircraft against targets in the aft field of regard. In order to achieve high off-boresight targeting capability, current optical turret designs protrude into the flow. This causes severe aero-optic distortions in the aft field of regard due to turbulence in the wake and the unsteady shock movement over the aperture. These distortions decrease the power flux on target (the measure of lethality for a directed energy system) and consequently limit the directed energy system to targets in the forward field of regard. This program will optimize flow control strategies for pointing angles in the aft field of regard. The program will also explore the ability of the flow control system to be synchronized with adaptive optics. This effort will initially focus on wind tunnel testing to prove the feasibility of steady and periodic flow control techniques to reduce or regularize the large scale turbulent structures surrounding an optical turret. These tests will culminate in a hardware-in-the-loop demonstration utilizing flow control with an adaptive optics system in a full-scale wind tunnel test for the turret. Following successful wind tunnel demonstrations, a preliminary design of a flight test turret incorporating flow control will be undertaken. *FY 2009 Accomplishments:* - Used Computational Fluid Dynamics (CFD) analyses to optimize blowing slot configuration.	5.360	4.446	5.100	0.000	5.100

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Assessed wavefront measurements for a range of pointing angles to evaluate system performance in sub-scale tests. - Downselected flow control actuation technique. - Modeled effects of adaptive optics on system performance. - Assessed military utility of system improvements achievable with flow control and adaptive optics. *FY 2010 Plans:* - Design and fabricate ABC optics for full-scale wind tunnel test of turret. - Design and fabricate ABC flow control actuators for full-scale wind tunnel test. - Perform bench-level evaluation of system functionality using phase screens. *FY 2011 Base Plans:* - Perform initial testing of flow control in open-loop testing of ABC turret. - Demonstrate and validate ABC concept with closed-loop adaptive optic system and flow control in a full-scale wind tunnel test.					
High Performance Algorithm Development (U) The High Performance Algorithm Development programs identify, develop and demonstrate new mathematical paradigms enabling maximum performance at minimum cost in a variety of DoD systems applications. The programs look for opportunities to aggressively leverage the power of mathematical representations in order to effectively exploit large-scale computational resources as they apply to specific problems of interest. They also cultivate theoretical breakthroughs in areas of basic mathematics having relevance to emerging defense sciences and technologies. The products are typically advanced algorithms and design methodologies. DARPA is pursuing the development of well-conditioned fast algorithms and strategies for the exploitation of high-dimensional data (i.e., data with a high number of degrees of freedom) in order to deal with a variety of complex military problems including digital representation and analysis of terrain and other geospatial data, efficient high fidelity scattering computations of radar scattering for predictive design and exploitation of radar cross	6.200	5.000	5.000	0.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total

sections, and efficient automatic mapping and optimization of signal processing kernels onto advanced departmental computational hardware architectures.

FY 2009 Accomplishments:
- Developed a quantitative methodology in the area of information propagation, impact and persistence for the military and coalition environment relying on observations from neuroscience, cognitive science and social networking.
- Identified the intrinsic signatures of information/target message endurance among disparate groups and cultures through measures of neuroscience and behavior.
- Demonstrated that by using the Discovery and Exploitation of Structure in Algorithms (DESA) tools non-expert users can design end-to-end systems in 1/10th the time of expert designers.
- Extended DESA tool suite to other common signal processing and image formation algorithms.
- Extended time reversal methods to acoustic channels and increased the computational speed of the Green's function by 100.
- Employed topological tools to analyze higher-order datasets in biology, sensing, and neuroscience.
- Developed geometric theory of higher dimensional clustering for novel data analysis.

FY 2010 Plans:
- Develop the neural signatures for key variables in information propagation and persistence in the brain specifically related to military and coalition operations.
- Develop brain imaging methodologies and tasks to specifically measure attributes such as altruism, persuasion, and trust in individuals, dyads and groups.
- Develop a comprehensive and quantitative theory of information movement and persistence among individuals and groups to better predict and control responses to specific messages and events.
- Implement geometric theory of higher dimensional clustering for novel data analysis to produce user-friendly fast algorithms.
- Develop multi-parameter and multi-dimensional topological persistence algorithms to extract high dimensional, dynamic, hidden features in massive data sets across DoD applications; including

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
communications, biology, neuroscience as well as classically important radar and other digitally represented applications. - Develop a new family of non-increasing stochastic processes that enables the replacement of propensity by probability in uncertainty modeling. - Develop an Ito-style stochastic calculus to build theoretical models to improve uncertainty prediction. *FY 2011 Base Plans:* - Develop and use novel topological tools to analyze non-linear dynamical systems. - Design specific information or message content to be delivered in controlled experiments based on insights gained from neural recordings related to key perceptual variables. - Predict information transmission and/or message success solely on the basis of neural pattern activation in the key brain regions. - Demonstrate quantitative nature of brain imaging technologies for information transmission.					
Integrated Sensing and Processing (U) The Integrated Sensing and Processing program will open a new paradigm for application of mathematics to the design and operation of sensor/exploitation systems and networks of such systems by developing and applying novel optimization methodologies for integrating sensing, processing, and information exploitation functionality in sensor systems. This program will create tools enabling the design and global optimization of advanced sensor system architectures comprising fully interdependent networks of functional elements, each of which can fill the roles and functions of several distinct subsystems in current generation sensor systems. Payoffs will include improved performance with reduced complexity of hardware and software in a wide variety of systems, including agile adaptive arrays for missile seekers, unmanned air vehicles, and space-borne sensors; novel waveforms, and novel approaches to multiplexed hyper-spectral chemical/biochemical sensing systems.	7.500	6.400	6.200	0.000	6.200

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Transitioned compression technology to National Geospatial Agency commercial geospatial products. - Extended deterministic theory to cover spaces for network systems and sensing applications. *FY 2010 Plans:* - Extend graph topology to simplex methods to develop novel algorithms in strategy complexes and Bayesian decision trees. - Generate algorithms to provide flexible, movable, reactive border generation for dynamics and unpredictable events. - Develop multi-body algorithms to enable formation flight and interaction of sensors in zero-gravity environments. *FY 2011 Base Plans:* - Develop stochastic topological theory of non-parametric statistics and apply to automatic target recognition problems. - Develop clock-free strongly open-loop controls and information state estimation and comparison for minimal-sensing in localization and navigation problems. - Test multi-body algorithms to enable formation flight and interaction of sensors in zero-gravity environments.					
Training Superiority (U) The Training Superiority program will change the paradigm for military training by creating new approaches to increase technical competence. Passive teaching approaches, including web-based training, will not succeed in instilling the skills and knowledge needed in the new land-battlefield, with higher demands on fewer soldiers, including the need to control and interact with highly technical unmanned systems. These new training approaches will include elements of human-tutor interactions and the emotional involvement of computer games coupled with the fidelity and feedback of Combat	12.371	8.900	8.400	0.000	8.400

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Training Center learning. In addition, this thrust will scale-up new digital tutor methodologies, deliver these to a large cohort of warfighters, and demonstrate a convincing benefit compared to standard training in an operational environment. *FY 2009 Accomplishments:* - Demonstrated Digital Tutor, including teaching one week of content, in a production software configuration, running continuously in Navy schoolhouse setting. - Created and beta tested an additional two weeks of Digital Tutor content, in Navy schoolhouse setting. - Established stand-alone experimental school for collecting and validating data necessary for building full 16 weeks of Digital Tutor content. - Conducted three-stage Information Warfare Cup (IWAR) training effectiveness evaluation in coordination with Navy's 3rd Fleet and Naval Education and Training Command's Center for Information Dominance. Results indicated superior performance of Digital Tutor-trained students over Navy-selected Fleet experts in solving a wide range of Information Technology (IT) challenges in a controlled Laboratory setting; several ship settings; and during deployment. - Digital Tutor-trained students were requested by name to assist in preparing a single Navy ship for its Computer Network Defense in Depth Baseline Assessment. *FY 2010 Plans:* - Develop the underlying engine and the hardware/software architecture necessary to create large scale Digital Tutor system, with focus on scaling, capacity and performance. - Elaborate intrinsic, instrumental and extrinsic motivation models in order to maintain student motivation over two months of instruction demonstrated over one week. - Port two months of Navy IT-School content from a human-tutored course to the Digital Tutor. - Create an automatic capability to identify students requiring remediation. - Develop methodology for establishing correspondence between Digital Tutor content/training and existing Navy curriculum, to facilitate transition of Digital Tutor to Navy Schoolhouse.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Extend Natural Language Understanding to encompass the full range of the IT domain. - Create a semantic model, abstractions, and Application Program Interface (API) that allows Socratic dialogs capable of handling large number of semantic responses rather than a predefined set of answers. - Complete full sixteen weeks of content and integrate results of theoretical work. - Demonstrate deployment to pier-side and harden the system (full course). - Establish effectiveness of Digital Tutor system in creating Mastery-level students by conducting second IWARs competition between Digital Tutor trained students and Navy-selected Fleet experts.					
RealWorld (U) The RealWorld program exploits technical innovation and integration to provide any U.S. warfighter with the ability to open a laptop computer and rehearse a specific mission in the relevant geo-specific terrain, with realistic physics. Because the system will be scalable and distributed, warfighters can practice by themselves, in small groups, or with as many other warfighters as needed for the mission over a local or distributed network, and across all relevant platforms (dismounts, vehicles, helicopters, and fast movers). Most important is the understanding that RealWorld is not a static simulation; it is a simulation builder with applications across the spectrum of modern kinetic and non-kinetic warfare. The program is building tools that allow warfighters to rapidly and easily build their own missions though the introduction of new methodology for building simulation software. These methodologies and adherence to a highly modular approach will cause a fundamental paradigm shift in the acquisition, as well as the construction, of DoD modeling and simulation products. *FY 2009 Accomplishments:* - Demonstrated dynamic path finding such that entities will be able to maneuver in a terrain deformed geo-specific area.	17.473	6.250	5.650	0.000	5.650

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Integrated a full Newtonian physics modeling engine in a real-time 3-D engine in both a hardware enhanced and software only modality. - Transformed a laser imaging detection and ranging (LIDAR) data collection set into a 3-D model (using topology graph analysis and parametric model fitting) capable of being utilized by a real-time 3-D engine. - Ingested up to one square mile of LIDAR terrain data and rendered 3-D models in less than one hour. *FY 2010 Plans:* - Scale to 1000 warfighter entities. - Integrate meteorological capability so real-time weather can be imported into training and rehearsal scenarios. - Demonstrate integration of data from Google Earth. - Transform pictures taken by a cell phone camera into a 3-D model capable of being ingested by a real-time 3-D engine with an accuracy of one or less. *FY 2011 Base Plans:* - Demonstrate ability to support joint air/land/sea operations in a Special Operations Mission Planning Environment (SOMPE). - Integrate RealWorld with a mission planning/C2 system (e.g., SOMPE) and demonstrate two-way data flow. - Add voice capability to avatar system. - Create an application programming interface that will allow external artificial intelligence systems to be easily integrated into RealWorld.					
Efficient Mid-Wave Infrared Lasers (EMIL) (U) The Efficient Mid-Wave Infrared Lasers (EMIL) program will develop efficient solid-state coherent sources to cover the atmospheric transmission bands in the mid-wave infrared (MWIR; 3-5	5.140	3.160	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
micrometers). Infrared countermeasure (IRCM) systems in particular depend on intense sources at these bands. The current generation IRCM systems utilize diode-pumped Thulium (Tm) lasers used to pump optical parametric oscillators, most commonly based on zinc germanium phosphide. (U) The lasers developed in this program will operate across the three relevant bands within the MWIR at 10 W power with wall plug efficiencies of at least 10 percent. By virtue of the enormous volumetric reduction (100-1000 times), power reduction (ten times), and superior pulse format (cw-operation), such sources will enable new architectures and approaches permitting IRCM systems to be deployed on platforms (e.g., rotocraft) which are highly vulnerable to Man Portable Air Defense Systems and other threats but for which current IRCM systems are prohibitive or are inadequate (e.g., unable to defeat staring sensors). At least two diode-based laser approaches will be explored in this program, both involving antimonide-based compound semiconductor materials. These include intersubband-based quantum cascade lasers (QCLs) and type-II antimonide lasers, including so-called “W-configuration” approaches, the name taken from the shape of the conduction band profile. *FY 2009 Accomplishments:* - Scaled the power, in a parallel development, of the efficient individual QCL sources developed previously. *FY 2010 Plans:* - Demonstrate epitaxial growth and preliminary characterization of final structures.					
Revolution in Fiber Lasers (RIFL) (U) The goal of the Revolution in Fiber Lasers (RIFL) program is to develop multi-kilowatt, single-mode, narrow line fiber laser amplifiers using efficient, high brightness laser diode pump arrays. These narrowline fiber laser amplifiers can then be coherently combined to develop ultra-high power electronically steerable optical phased arrays. In Phase 1 of this program, a 1 kW narrowline, single mode, single polarization fiber laser amplifier will be developed with 15% electrical efficiency and a	11.294	10.551	5.368	0.000	5.368

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
beam quality of better than 1.4x diffraction limited. In Phase 2 of this program, a 3 kW narrowline, single mode, single polarization fiber laser amplifier will be developed with 30% overall electrical efficiency and better than 1.4x diffraction limited beam quality. Coherent arrays of these high power fiber laser amplifiers will then be developed as part of the DARPA Adaptive Photonic Phase-Locked Elements (APPLE) program (PE 0603739E, Project MT-15) to achieve the requisite power and coherence for future multi-kilowatt high power laser weapons. *FY 2009 Accomplishments:* - Initiated construction of 1 kW coherently combinable fiber amplifiers (single mode, single polarization, narrow line) that will support development of a high power fiber laser optical phased array and that will provide >15% electrical efficiency and near-diffraction-limited beam quality (M2 < 1.4). - Completed final engineering design of a 3kW, 30% efficient, near-diffraction-limited coherently combinable fiber laser amplifier (single mode, single polarization, narrow line) that will support development of high power fiber laser optical phased arrays for laser weapon applications. *FY 2010 Plans:* - Demonstrate and test 15% efficient, single mode, single polarization, coherently combinable fiber laser amplifiers with near diffraction-limited beam quality at 1kW power level. *FY 2011 Base Plans:* - Demonstrate and test 30% efficient, single mode, single polarization, coherently combinable fiber laser amplifiers with near diffraction-limited beam quality at 3kW power level.					
Coherently Combined High-Power Single-Mode Emitters (COCHISE) (U) The Coherent Combination of High-Power Single Emitters (COCHISE) program will develop kilowatt-class, coherent arrays of single-mode laser diodes at overall electrical efficiencies of 50%. These coherent laser diode arrays will provide not only the power for each sub-aperture, but also the multi-kilohertz bandwidth, sub-centimeter-resolution adaptive optics required to efficiently propagate	1.500	3.000	5.000	0.000	5.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
high power laser beams through the turbulent atmosphere at distances up to multiple kilometers. Such capability is required for Army ground-to-ground and Navy missile defense applications. The program will construct a 2-dimensional array of laser diodes coherently combined at an overall electrical efficiency of more than 40%. The near-field intensity of the array will exceed 300 watts/cm2, to insure compatibility with driving sub-apertures demonstrated in other DARPA programs. *FY 2009 Accomplishments:* - Demonstrated coherent combination of a bar of single mode slab-coupled optical waveguide laser (SCOWL) diodes at 10 W with 1.4x diffraction limited beam quality. - Developed electrical power supply, microscale power distribution, and holographic optical elements to support coherent combination of 10 bars of SCOWL diodes with each bar operating at a power level of 10 watts. *FY 2010 Plans:* - Demonstrate coherent combination of 10 bars of single mode SCOWL diodes at a total power of 100 W with better than 1.4x diffraction limited beam quality and at better than 30% electrical efficiency. *FY 2011 Base Plans:* - Demonstrate coherent combination of 30 bars of single mode SCOWL diodes at a total power of 1000 W with better than 1.4x diffraction limited beam quality at better than 40% efficiency. - Demonstrate coherent combing with high electrical efficiency.					
Fiber Laser Pulse Source (FLIPS)* *Formerly GORGON - High Power Mid-IR Laser (U) The Fiber Laser Pulse Source (FLIPS) program will develop a compact fiber laser system that generates short high-energy pulses, at a high average-power level. The system will enable applications	3.700	3.160	3.000	0.000	3.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
such as remote detection of biological and chemical agents, free space communications, advanced photolithography as well as long-range high-resolution laser-radar systems. (U) Future efforts under this program will include the integration of these technologies into the development of a compact, UAV compatible system that efficiently generates sub-nanosecond duration pulses with peak powers exceeding several megawatts (MW), pushing past fundamental limits of existing fiber based laser amplifiers. The initial intended application for the laser source is a rapidly deployable, UAV based, long-range laser radar tracking system. *FY 2009 Accomplishments:* - Developed a system design for a compact, efficiency high-energy pulsed laser system with a MW-class peak power level. - Performed major system design trades. *FY 2010 Plans:* - Demonstrate techniques for power scaling of pulsed fiber lasers beyond the fundamental nonlinear limitations of individual amplifiers. - Demonstrate environmental robustness of the components and system design to allow for integration on a high-altitude UAV platform. *FY 2011 Base Plans:* - Demonstrate a small-scale laboratory laser system traceable to the final system design. - Demonstrate the ability to phase-lock, control, and synchronize highly nonlinear laser amplifiers for power scaling applications.					
JOULE (U) The JOULE program will exploit new architectures, reversible electrode structures, materials, and chemistries for the development of rechargeable, high energy density batteries that match or exceed	0.000	0.000	4.000	0.000	4.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-06: *ADVANCED TACTICAL TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
energy density of hydrocarbon fuels (e.g. gasoline, JP8, etc.). This technology will target replacing gasoline in both military and civilian transportation applications. These high energy density batteries will also lighten the payload and extend mission capabilities for the dismounted soldier. The program will significantly increase the stoichiometric limits on reducible charge capacity in reversible batteries by developing non-crystalline positive electrode structural materials with lightweight structural approaches and new chemistries. Three-dimensional structures with very high surface areas for electrodes will increase the power density of these batteries. The program will develop new chemistries for positive electrodes to demonstrate reversibility in the graphite fluorite (a high-voltage, high-capacity material) class of positive electrode materials in reversible batteries for the first time. The energy density will increase over ten-fold current lithium ion batteries commonly in use. *FY 2011 Base Plans:* - Investigate chemistry and materials to enable rechargeable high energy density batteries.					
Discharge Excited Catalytic Oxygen Iodine Laser (DECOIL) (U) The Discharge Excited Catalytic Oxygen Iodine Laser (DECOIL) program investigated the potential of the electric oxygen iodine lasers to make maximum use of air (80%N2/20%O2) in the laser device. The DECOIL device is an alternative to the well known chemical oxygen iodine laser (COIL) developed in 1977 and scaled to megawatt (MW) levels. *FY 2009 Accomplishments:* - Demonstrated laser outcoupled power of = 100 Watts. - Demonstrated beam quality (M2) of = 1.2. - Demonstrated wallplug electrical efficiency of = 10 percent.	1.749	0.000	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	122.827	81.739	69.018	0.000	69.018

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	**R-1 ITEM NOMENCLATURE** PE 0602702E: *TACTICAL TECHNOLOGY*	**PROJECT** TT-06: *ADVANCED TACTICAL TECHNOLOGY*

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, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
TT-07: *AERONAUTICS TECHNOLOGY*	31.316	31.956	42.334	0.000	42.334	70.431	99.504	90.214	94.245	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) Aeronautics Technology efforts will address high payoff opportunities that dramatically reduce costs associated with advanced aeronautical systems and/or provide revolutionary new system capabilities for satisfying current and projected military mission requirements. This includes advanced technology studies of revolutionary propulsion and vehicle concepts, sophisticated fabrication methods, and examination of novel materials for aeronautic system applications.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Helicopter Quieting	4.000	3.800	0.000	0.000	0.000
(U) Studies and analysis of military helicopter operations have shown that the survivability and lethality of U.S. helicopters can be increased by reducing the range at which their acoustic signature can be detected and recognized. The goal of the Helicopter Quieting program is to advance the capability for analytical development of advanced rotor technologies that will dramatically enhance the survivability of military rotor systems while enabling improvements to performance, affordability, availability and suitability. A critical element toward this goal is to create and demonstrate a physics-based toolset that enables analytical design of novel rotor systems and rotorcraft for reduced acoustic susceptibility (detection and recognition) by human and electro-acoustic threats.					
(U) Current rotor development is very costly involving a time-consuming iterative, trial and error cycle of analysis and model wind tunnel tests, or occasionally, a faster but much riskier analysis path directly to full-scale wind tunnel/flight test. Additionally, the primary limitation of existing computational models is their inability to accurately predict the pressure distribution on a rotor blade and in the flowfield away from the blade. Novel and creative concepts and ideas are being employed in this program for accurate aerodynamic analysis of helicopter rotor airloading, flowfield, and wakes using high-end computational					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
fluid dynamics techniques. The program will develop tools capable of accurately predicting noise signature of advanced rotor concepts that exhibit a significant reduction in low-frequency in-plane signatures. (U) The Helicopter Quieting program will also optimize survivability by developing propagation and perception modeling for rotorcraft acoustic signatures within state-of-the-art visualization architectures. Multiple advanced human perception and cueing models will be developed as a part of the integrated acoustic design and analysis environment. The ability of the toolset to accurately characterize the differences in these factors will support design decisions for advanced rotors and rotorcraft that exhibit dramatically reduced perceptibility. The toolset will also enable assessment of operational tactics, techniques, and procedures, to include pilot technique, toward optimization for survivability. *FY 2009 Accomplishments:* - Demonstrated capability of visualization architecture to incorporate detailed data about rotor configuration, vehicle performance, acoustic signature, terrain & feature mapping, mission profile, and atmospheric conditions as well as variable threat components. - Developed a visual display of value to the mission planner as well as the warfighter. - Transitioned tools to Services, Industry, and Academia. *FY 2010 Plans:* - Identify acoustic design criteria for new rotor system designs based on operational scenarios. - Integrate high-fidelity rotor acoustic signature prediction, physics-based propagation modeling and advanced human perception models.					
Nano Air Vehicle (NAV)* *Formerly Nano-Flapping Air Vehicles.	3.300	2.500	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) The goal of the Nano Air Vehicle (NAV) program is to develop a hummingbird-inspired flapping air vehicle technology with less than a five inch wingspan and gross take-off weight of fifteen grams or less. Operations in the urban terrain require sensors that can navigate in difficult terrain and be inserted without being detected. Small air vehicles capable of navigating interior domains without GPS would enable autonomous prosecution of a number of high risk missions that are currently performed by warfighters. Examples of such missions include intelligence, surveillance and reconnaissance (ISR) in buildings, underground facilities, caves, tunnels, and confined urban environments. Key enabling technologies include: flapping wing aerodynamics, kinematics and flight dynamics, lightweight aero-elastically tailored wing structures, miniature navigation systems, micro-propulsion systems, small payloads, and the ability to perch like a bird. *FY 2009 Accomplishments:* - Demonstrated roll-pitch-yaw control of a hovering, flapping air vehicle using only wing-stroke modulation, modeled after birds and insects. This is a first in the history of aviation. - Demonstrated sustained hover of a flapping air vehicle. - Developed preliminary design of a flapping wing nano air vehicle and control system to assist platoon/squad level operation in urban and indoor environments. - Demonstrated on-board, closed-loop control using miniature inertial sensors and micro actuators. *FY 2010 Plans:* - Demonstrate mission-relevant flight times of >5 minutes hovering and >10 minute forward flight. - Develop preliminary user controller and onboard vehicle navigation system to permit robust remote-controlled flight. - Demonstrate prototype vehicle in simulated combat missions and other realistic environments.					
Battlefield Helicopter Emulator (BHE) (U) The goal of the Battlefield Helicopter Emulator (BHE) is to develop a system capable of emulating rotorcraft signatures, compatible with installation as a payload on a small unmanned aerial system	3.514	3.356	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(UAS). The system will provide helicopter signature emulation of a variety of battlefield helicopters. BHE could be used for mine clearing/route determination as well as escort missions. An operational system could draw fire from ground based adversaries, and relay the information back to the operator for off-board location and prosecution. The system offers the opportunity to protect a large number of military aircraft assets and crews over long periods without aircraft performance impact. The reduced acoustic perception distance enabled by the BHE system can reduce the risk to Army and Special Operations Command helicopters from various hostile threats. *FY 2009 Accomplishments:* - Demonstrated numerous emulator systems in multiple signature bands in a field test. - Selected emulator systems for integration with a UAS. *FY 2010 Plans:* - Develop plan for installation, integration, and test on tactical unmanned aircraft. - Develop system Concept of Operations and tactics, techniques and procedures for employment.					
Formation Flight* *Formerly Drag Reduction Flight Demonstration. (U) The Formation Flight program will explore the development of drag reduction technologies for aircraft. Drag reduction allows aircraft to fly at increased ranges, reduces fuel consumption, and may allow increased payload capacity. Formation flight is used in nature by geese and other migratory birds to reduce drag, but requires the development of an autonomous system to maintain the optimum position for drag reduction to be practical for long duration aircraft flights. Safety of flight considerations require aircraft separation distances of up to one mile, necessitating automated sensing and tracking algorithms to track the lead aircraft wake. Flight testing a formation flight configuration will allow structural excitation and vehicle dynamic response to be addressed in proximity to the lead aircraft wake.	3.200	8.000	11.311	0.000	11.311

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Assessed mission benefit of formation flight for a typical mobility mission of a brigade deployment. - Assessed integration approaches for a formation flight system on legacy transport aircraft. - Identified approaches for autonomous control of aircraft to maintain position in the optimal location for formation flight benefits. *FY 2010 Plans:* - Conduct detailed flight test planning for assessment of autopilot faults, alarms, and structural response of the aircraft wing in proximity to the aircraft wake. - Conduct detailed stability and control law assessments for aircraft-wake interactions and trim effects. - Evaluate existing database of wake crossings to determine impacts on flight control systems. *FY 2011 Base Plans:* - Conduct flight tests in the wake of a lead aircraft to quantify structural excitation and stability margin in proximity of a lead aircraft wake. - Develop control algorithms and evaluate control strategies using high fidelity aerodynamic models which include the effects of formation flight.					
Mission Adaptive Rotor (MAR)* *Formerly Active Rotor. (U) The goal of the Mission Adaptive Rotor (MAR) program is to develop and demonstrate the capability to achieve dramatic improvements in rotor performance, survivability, and availability through the use of technologies that enable adaptation of the rotor throughout military missions and/or mission segments. Recent research indicates that significant performance benefits could be achieved by actively morphing the shape or properties of the rotor system, additionally, active rotors with on-blade control could eliminate the need for a rotor swashplate. MAR capability will result in dramatic improvements in	4.695	8.300	11.823	0.000	11.823

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
system performance, operational availability, sustainability, and survivability, including reduction in acoustic susceptibility and rotor vibration while increasing useful payload fraction and range. (U) The MAR program will mature active rotor technologies that enable the effective operation of military rotorcraft in performance-limited environments of high-altitude mountainous terrain and deserts. The MAR program will also focus on development of advanced technologies for application to future helicopter, tiltrotor, and other rotorcraft platforms, with demonstration on a fielded system to enable application to new systems as well as facilitate upgrade of current multi-service rotorcraft systems. *FY 2009 Accomplishments:* - Evaluated concepts for novel adaptive rotor systems. - Characterized performance, survivability, support opportunities, and benefits of adaptive rotor technology. *FY 2010 Plans:* - Initiate conceptual designs of demonstrator rotor system. - Conduct component technology demonstrations and initiate preliminary design of the MAR system. *FY 2011 Base Plans:* - Define quantitative results of design trade studies and risk mitigation assessments. - Initiate preliminary design of the MAR demonstration system. - Define a rotor system design for technology demonstration. - Complete objective system application development and initial requirements definition.					
Advanced Aeronautic Technologies (U) The Advanced Aeronautics Technologies program will examine and evaluate aeronautic technologies and concepts through applied research. These may include feasibility studies of novel or emergent materials, devices and tactics for air vehicle applications, as well as manufacturing and	0.000	0.000	2.000	0.000	2.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
implementation approaches. The areas of interest range from propulsion to control techniques to solutions for aeronautic mission requirements. The result of these studies may lead to the design, development and improvement of prototypes. *FY 2011 Base Plans:* - Conduct feasibility and trade studies of candidate technologies and architectures. - Perform military utility analyses of proposed tactics and concepts of operation.					
Transformer (TX) Vehicle (U) The Transformer (TX) Vehicle program will examine the feasibility and approaches for developing vertical take-off and landing, road-worthy vehicles that carry a 4-person payload >250 NM on one tank of fuel, can safely travel on roads, and can be operated by a typical soldier. The goal is to define the major components and overall design of a TX vehicle that would be suitable for military scouting, personnel transport, and logistics missions. Technical areas that will be explored include: hybrid electric drive ducted fan propulsion system, ring motors, energy storage methods such as batteries and ultra capacitors, morphing vehicle bodies, and advanced flight controls and flight management systems. The TX vehicle is intended to make roads irrelevant for military small unit maneuvers. These units can use TX air vehicles to fly over obstacles or impassible terrain, avoid ambushes and improvised explosive devices (IEDs). Personal TX vehicles could be dispatched for downed airman recovery or for evacuating injured personnel from difficult to access locations, or to resupply isolated small units. Four-man versions would be suitable for enhanced company operations concepts which would allow the soldier/team to see the situation and pick the best place to “drop in” for urban operations. *FY 2010 Plans:* - Conduct trade studies of vehicle designs, lift motors, flight dynamics and control, energy conversion and storage, vehicle architectures, and concepts of operation. - Initiate preliminary design studies. - Conduct risk reduction experiments and modeling to validate designs.	0.000	6.000	12.100	0.000	12.100

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Conduct preliminary design review of TX concepts. - Initiate TX critical design activities.					
Counter-Unmanned Air Vehicles (C-UAV)	0.000	0.000	5.100	0.000	5.100
(U) The components to construct long range, autonomous unmanned air vehicles (UAVs) are ubiquitous. Off-the-shelf hobbyist navigation systems are capable of following GPS waypoints. Vision based systems can track roads or follow on-the-ground moving targets. Small engines and payloads can be accommodated in relatively small aircraft. Slow, low-altitude UAVs are difficult to distinguish from migratory birds, or even ground vehicles, and are frequently filtered out of radar systems by clutter filters for this reason. These vehicles pose a threat to future military operations. Already, UAVs have been used in combat operations against allies of the United States. Countries with little or no capability to field a manned air force are using UAVs for surveillance and reconnaissance. In the future, the electronics required to navigate and control these aircraft will become increasingly available and affordable. The Counter-Unmanned Air Vehicles (C-UAV) program will investigate methods for defeating such threats. The program will study a range of technologies from detection, to tracking and identification of UAVs, to intercept or defeat. Traditional detection systems, used for large manned aircraft, require modification to detect small, slow, low-altitude UAVs. Data fusion from multiple sensors may be required to unambiguously identify small UAVs and differentiate them from other objects such as birds and ground vehicles. The intercept of these UAVs, which may be launched from close range, may require novel approaches.					
FY 2011 Base Plans: - Assess current UAV threats; classify types of vehicles and missions. - Assess current UAV detection capabilities, including radar, acoustic, vision-based, infrared, and capabilities of each. - Perform initial assessment of viable approaches to UAV detection.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Integrated Compact Engine Flow Path (U) The goal of the Integrated Compact Engine Flow Path program was to fully integrate the aircraft structure and propulsion flowpath. The program evaluated multiple distributed inlets and nozzles to determine if they would allow a better integrated wing and propulsion system, exploiting aerodynamic control possible with engine blowing and suction. *FY 2009 Accomplishments:* - Performed design trade studies to develop a preferred engine/airframe integration design using many small fans and a single large turboshaft engine.	1.000	0.000	0.000	0.000	0.000
Adaptive Morphing Super-Maneuver Aircraft (AMSMA) (U) The goal of the Adaptive Morphing Super-Maneuver Aircraft (AMSMA) program was to demonstrate the practicality and the operational value of morphing aircraft technology in a full scale flight demonstration. The AMSMA approach was to build on the small scale demonstrations of the Morphing Aircraft Structures (MAS) program. The program goal was to demonstrate an advanced morphing, highly maneuverable air vehicle that achieves high fuel efficiencies, translating to prolonged endurance times. *FY 2009 Accomplishments:* - Identified capabilities, critical technologies, survivability approaches and performance goals for the morphing aircraft concept. - Established concept vehicle performance and operating goals.	1.607	0.000	0.000	0.000	0.000
Vulcan (U) The goal of the Vulcan demonstration program is to design, build, and ground test a Constant Volume Combustion (CVC) technology system that demonstrates a 20% fuel burn reduction for a ship based power generation turbine. CVC has been under development for more than a decade.	10.000	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-07: *AERONAUTICS TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Considerable progress has been made and the technology is believed mature enough to enable a dramatic new system capability. CVC, when combined with turbine engines, offers the ability to design a new class of hybrid turbine power generation engines and Mach 4+ air breathing engines. The Vulcan system will consist of a full scale CVC, a compressor, and a turbine. CVC architectures could include Pulsed Detonation Engines (PDEs), Continuous Detonation Engines (CDEs) or other unsteady CVC architectures. The CVC demonstrated in the Vulcan program would have direct application to aviation turbine engines, ship propulsion turbine engines, high mach air breathing engines, and commercial power turbine engines. This program is funded in PE 0603286E, Project AIR-01 in FY 2010-11. *FY 2009 Accomplishments:* - Completed engine system requirements review. - Identified technical risks and developed a critical technology development plan. - Developed Vulcan engine performance models.					
Accomplishments/Planned Programs Subtotals	31.316	31.956	42.334	0.000	42.334

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, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*	60.918	73.132	62.497	0.000	62.497	36.515	43.945	44.321	44.263	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Network Centric Enabling Technology project provides technology to build mission applications explicitly tailored to exploit the promise of network-centric system architectures. Mission applications include signal processing, detection, tracking, identification, situation understanding, planning, and control functions. These applications will integrate: 1) external sensors and processors that provide data on targets and mission contexts; 2) external platforms, both air and surface, that deliver sensors and munitions to designated areas; 3) intelligence processing systems at all levels of command; and 4) external communications networks that provide connectivity between computing nodes located on the platforms, at field command centers, and headquarters. The mission applications share data to form consistent battlespace understanding tailored to the needs of commanders at each node. The types of tailoring include common operational pictures, timelines, and resource usage descriptions. The mission applications also negotiate plans for future operations based on mission needs presented at each node. To maintain focus on operationally relevant problems, the project's technical goals are posed and evaluated in the context of mixed manned/unmanned forces.

(U) Technologies developed in this project enable localized and distributed collaborative processing. This allows networks of sensors to rapidly adapt to changing force mixes, communications connectivity, and mission objectives while enabling distributed command and intelligence systems to effectively collaborate in a dynamic environment. Technologies are demonstrated and evaluated in the laboratory and in hardware-in-the-loop demonstrations. Demonstrations employ both stationary and autonomous mobile platforms. Operational benefits are: 1) smaller forward deployment of image and signal analysts in complex operating conditions including urban battlefields; 2) deeper understanding of the evolving stability and support operational environment; 3) consistent integration of target and environment information; and 4) flexible operational tactics and procedures to find evasive targets in difficult environments.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Video and Image Retrieval and Analysis Tool (VIRAT)	16.241	15.159	13.716	0.000	13.716
(U) The Video and Image Retrieval and Analysis Tool (VIRAT) program will develop and demonstrate a system for video data exploitation that enables an analyst to rapidly find video content of interest from archives and to provide alerts to the analyst of events of interest during live operations. The					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
ability to quickly search large volumes of existing video data and monitor real-time video data for specific activities or events will provide a dramatic new capability to the U.S. military and intelligence agencies. Currently, video analysis for Predator and other aerial video surveillance platforms is very labor intensive, and limited to metadata queries, manual annotations, and “fast-forward” examination of clips. The software tools developed under VIRAT will radically improve the analysis of huge volumes of video data by: 1) alerting operators when specific events or activities occur at specific locations or over a range of locations and; 2) enabling fast, content-based searches of existing video archives. The VIRAT program is developing innovative algorithms for activity representation, matching and recognition which can support both indexing and retrieval. The primary focus of VIRAT is activity-based and dynamic information. Object/scene matching and recognition are also of interest, but only to the extent they support activity analysis. The final product of the VIRAT program is a system that can be transitioned to and integrated within an operational military system, such as the Distributed Common Ground System (DCGS). *FY 2009 Accomplishments:* - Developed multiple initial sets of descriptors for activities in videos. - Developed initial indexing methods for activity descriptors and several search methods against those indices. - Developed initial interactive query refinement methods to fine tune and improve the query and retrieval process. - Developed preliminary interactive retrieval processes to either alert the user or return to the user matching "activities of interest". *FY 2010 Plans:* - Refine and further develop critical technologies to accommodate concatenated and more complex activities. - Continue developing efficient indexing and interactive retrieval against thirty activities.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Extend development of the interactive retrieval process to incorporate improved algorithms and enhanced human factors. - Introduce other airborne video sources and ensure that activity descriptor extraction technologies can still perform as needed. *FY 2011 Base Plans:* - Further develop critical technologies to accommodate stationary, ground-mounted video sources. - Continue developing efficient indexing and interactive retrieval against sixty activities. - Complete development and optimization of critical technologies to accommodate larger datasets. - Integrate final prototype system in accordance with the architecture of the Program of Record transition target. - Finalize system transition efforts and formalize concept of operations for transition to operational activities.					
Home Field (U) The Home Field program develops networked video and Laser Detection and Ranging (LADAR) processing technology to rapidly and reliably update a 3-Dimensional (3-D) model of an urban area. It provides 3-D situational awareness with sufficient detail and accuracy to remove the “home field advantage” enjoyed by opponents. Detailed mobility maps to support ground vehicle routing will be inferred and generated, and detailed visibility data to support sensor positioning will then be derived to maximize coverage and minimize detectability. High fidelity baselines will be created to support change detection to cue searches for targets and anticipate changes due to current or impending meteorological events. The program will supply real-time context information to sensor managers, maneuver controllers, weapons operators, and commanders. Furthermore, the program will filter natural change from artificial change indicative of human (threat) activity and permit operation of military forces in hostile terrain normally deemed favorable to opponents because of their historical familiarity with hide points, sight lines, and mobility characteristics.	12.513	20.578	8.225	0.000	8.225

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) Drawing upon technologies developed in the Home Field program, the Urban Photonic Sandtable Display (UPSD) program is developing revolutionary interactive holographic displays for complex volumetric 3-D data to replace current 3-D visualization technologies that are either static or have limited effective field-of-view. Current technologies include traditional holography, computer graphics on 2-Dimensional (2-D) screens, slice stacking, parallax autostereo, and goggles/glasses. These techniques not only give a poor image quality and poor movement, they also are not created quickly and do not allow for collaborative viewer interaction. The desire to improve these components has launched the development of the UPSD. Applying the design fundamentals of the monochrome active grouping of pixels for a light modulator element into a single 3-D holographic pixel (hogel-based proof-of-concept) display and further developed module, a scalable and tileable laboratory prototype has been validated by transforming computer data to optical data, making sophisticated integration possible to optimize image quality. The UPSD program will develop an affordable 3-D display that operates at full video rate, displays red-green-blue (RGB) color, increases viewing angle, and increases display size. The result will be the world's first full-motion, full aspect 3-D imaging technology system. Utilizing the technologies developed under the Novel Technologies for Optoelectronics Materials Manufacturing (NTOMM) program in ELT-01, the Emissive Micro Displays program will develop technologies to support the fabrication of Low-cost High pixel density Power efficient Direct emission Microdisplays (LHPDM). Current microdisplay systems use light modulation systems (liquid crystal displays, digital micromirror devices,) and by using LHPDM, it will enable the transmission of larger fractions of light from the illumination source. *FY 2009 Accomplishments:* - Researched advanced technologies for improving the production methods of pixilated emissive displays. - Demonstrated the final reconfigurable system at full video rate, color display, and with the capability of tiling to larger display scales (e.g., 6-feet by 6-feet). - Developed cost effective synthesis methods for Group II-VI and III-V materials.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Utilized controlled arrays of indium gallium nitride (InGaN) to form high efficiency Light Emitting Diode (LED) structures and imaging sensors in IR. *FY 2010 Plans:* - Assemble layer-by-layer heterostructures (characterized by dissimilar materials with non-equal bandgaps) from ordered planar arrays of nanocrystals. - Develop and demonstrate techniques for layer doping of heterostructure materials. - Evaluate and select approaches for the development of affordable emissive microdisplays. - Demonstrate initial LHPDM. - Select fabrication technologies with five times cost reduction potential. - Commence demonstration of fabrication technologies that support the fabrication of affordable emissive microdisplays. *FY 2011 Base Plans:* - Complete demonstration of fabrication technologies that support affordable emissive microdisplays.					
Integrated Crisis Early Warning System (ICEWS) (U) The Integrated Crisis Early Warning System (ICEWS) program develops and integrates a set of data analysis tools into a unified information system to support Theater Security Cooperation (TSC). The ICEWS system monitors, assesses and forecasts leading indicators of events that make countries vulnerable to crises. ICEWS technologies include quantitative and computational social science modeling and simulation, scenario generation, ontological modeling of security problems, advanced interactive visualization techniques, and agent-based programming. When integrated, these tools allow combatant commanders and their staff to understand and anticipate conditions that precipitate instability and conflict while there is still time to influence them. ICEWS also helps anticipate unintended consequences of actions taken to influence or remediate situations, consequences that may be delayed by months or years.	10.608	10.195	5.063	0.000	5.063

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Developed a prototype system to systematically filter millions of digital news reports of global political events, making them easily searchable and visually displayed on timelines by country, theme and actor. - Identified preliminary patterns in how U.S. diplomatic, information, military, and economic (DIME) actions influence factors associated with nation-state crises and instability. *FY 2010 Plans:* - Conduct in-theater test and evaluation of ICEWS at PACOM HQ. - Develop tools that can be transitioned to the staff at Combatant Commands (PACOM HQ). *FY 2011 Base Plans:* - Refine the system based upon user feedback and transition to PACOM HQ.					
Extreme Accuracy Tasked Ordnance (EXACTO) (U) The objective of the Extreme Accuracy Tasked Ordnance (EXACTO) program is to revolutionize rifle accuracy and range by developing the first ever guided small caliber bullet. The EXACTO 50-caliber round and optical sighting technology will more than double the day and nighttime range over current state-of-the-art sniper systems while allowing the sniper to prosecute moving targets even in high wind conditions, such as those commonly found in Afghanistan. Prosecution of these types of targets is impossible with current technology. This system will not only improve sniper effectiveness, but also enhance troop safety by allowing greater shooter standoff range and reduction in target engagement timelines. The system combines a maneuverable bullet and a real-time guidance system to track the target and deliver the projectile to target. Technology development includes the design and integration of aero-actuation controls, power sources, optical guidance systems, and sensors. The components must fit into the limited volume (2 cm to the third power) of a 50-caliber projectile and be designed to withstand a high acceleration environment. The EXACTO technology is planned for transition to the Army by FY 2012.	15.670	19.700	22.218	0.000	22.218

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Designed guidance system. - Designed maneuverable projectile. - Constructed all novel 1x scale components. - Performed successful live fire tests of guidance system and key components. *FY 2010 Plans:* - Demonstrate potential system performance using Hardware-in-the-Loop (HITL) simulation based on measured component and subsystem performance, at a number of ranges under varying environmental and target conditions. - Perform initial system integration of all subsystems. - Evaluate initial integrated system performance in the laboratory. *FY 2011 Base Plans:* - Revise component and system design as necessary to meet design goals. - Conduct initial field testing of weapon system under controlled conditions. - Optimize system design. - Demonstrate field performance of complete system under realistic, but controlled, conditions.					
Digital Media Exploitation (MEDEX) (U) The Digital Media Exploitation (MEDEX) program will develop technology to extract intelligence of tactical value from digital media found on computers captured in the field. MEDEX will automatically search content (text documents, audio files, images, videos, applications, etc.) and identify data of high intelligence value. Traditionally, the objective of a digital media exploitation system has been to extract content for later analysis, so accuracy (e.g., precision and recall) and scalability to multiple processors for large data volumes have been emphasized. However, warfighters may have very limited time to process the data for key evidence that may result in tactical advantage; therefore, speed and accuracy are critical. The MEDEX program will develop digital media exploitation technology suitable for tactical	0.000	0.000	4.275	0.000	4.275

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
environments which have constrained computational resources, accelerated operational timelines, and specific intelligence objectives. The MEDEX program will develop fast algorithms and techniques for processing evidence from digital media to deliver distilled intelligence that is accurate and scalable to large datasets, and can execute quickly on a single mobile computing platform, such as a notebook or ultraportable computer. *FY 2011 Base Plans:* - Develop automated media exploitation algorithms that determine the intelligence value based on content analysis of text, image, and video files. - Integrate algorithms into a digital media exploitation platform capable of producing a human-readable summary of the content of a captured hard drive. - Demonstrate intelligence extraction by testing digital media. - Develop alternative imaging techniques for hard drives, which enable their contents to be replicated rapidly onto another storage media device. - Develop methods for extracting geospatial intelligence from digital multimedia. - Integrate MEDEX technology into a portable digital media triaging system.					
PERsistent Stare Exploitation and Analysis System (PerSEAS)	0.000	7.500	9.000	0.000	9.000
(U) The PERsistent Stare Exploitation and Analysis System (PerSEAS) program will develop and demonstrate a tool to automatically and interactively identify events of interest from persistent, wide area, motion imagery data with support from signal intelligence and other sources. Persistent, wide area surveillance imagery is an ever increasing source of operational data, but exploitation of this data at present is mostly manual and requires hours to days to produce results. Tools are needed to automatically detect potentially significant adversary activities and to discriminate these from nominal background activity. These tools would be supported by libraries of activity patterns, logic to generate hypotheses about which activities are being observed, and mechanisms to quantitatively score the consistency of the data with each activity hypothesis. Such capabilities are necessary to detect and					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
defeat threats in real-time. The major thrust of the program is the processing of extracted features (such as context and tracks) to yield events of interest, which in turn would be linked to form activities and then integrated to discover potential threat patterns. The discovery and identification of the potential threat patterns would then produce alerts and cues. PerSEAS technologies and system are planned for transition to the Distributed Common Ground Station and other intelligence applications. *FY 2010 Plans:* - Formulate approaches to network discovery based on normalcy estimates, improved tracking algorithms using pattern analysis, and contextual analysis for anomaly detection. *FY 2011 Base Plans:* - Implement and evaluate techniques on wide area motion imagery data. - Develop a system prototype.					
Automated Battle Management (U) The Automated Battle Management program developed novel technologies for multi-platform, automated battle management at the tactical level, in the air, the sea, on the ground, and within mobile sensor networks. Such technologies enable U.S. forces to keep up with the increasing pace of battle as more-capable platforms and higher-bandwidth communication networks become operational. (U) The Collaborative Networked Autonomous Vehicles (CNAV) effort was the primary demonstration of Automated Battle Management techniques. CNAV developed autonomous control methods to cause a distributed set of unmanned undersea vehicles to self-organize and distribute tasks through judicious transactions conveyed over a shared communications network. CNAV utilized these capabilities to provide submerged target detection, localization, and tracking in restrictive littoral waters. CNAV created a field of vehicles, networked through acoustic wireless communications. The vehicles worked collaboratively and autonomously to detect, classify, localize and track target submarines transiting the	5.886	0.000	0.000	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602702E: *TACTICAL TECHNOLOGY*	PROJECT TT-13: *NETWORK CENTRIC ENABLING TECHNOLOGY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
field. The field was capable of self-organizing to adapt to changes in target locations, environmental conditions, and operational factors. *FY 2009 Accomplishments:* - Demonstrated collaborative automated target detection, classification, localization and tracking. - Demonstrated self-healing and reconfiguration, and threat pursuit and interception.					
Accomplishments/Planned Programs Subtotals	60.918	73.132	62.497	0.000	62.497

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.