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 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603760E: *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*

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	297.643	269.198	219.809	0.000	219.809	202.240	221.808	241.455	247.523	Continuing	Continuing
CCC-01: *COMMAND & CONTROL INFORMATION SYSTEMS*	40.870	89.702	69.450	0.000	69.450	69.510	58.418	45.555	45.510	Continuing	Continuing
CCC-02: *INFORMATION INTEGRATION SYSTEMS*	163.681	91.301	64.376	0.000	64.376	64.155	63.412	63.442	64.730	Continuing	Continuing
CCC-CLS: *CLASSIFIED*	93.092	88.195	85.983	0.000	85.983	68.575	99.978	132.458	137.283	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The Command, Control and Communications Systems program element is budgeted in the Advanced Technology Development Budget Activity because its purpose is to demonstrate and evaluate advanced information systems research and development concepts.

(U) The goals of the Command and Control Information Systems project are to develop and test innovative, secure architectures and tools to enhance information processing, dissemination and presentation capabilities for the commander. This will give the commander insight into the disposition of enemy and friendly forces, a joint situational awareness picture that will improve planning, decision-making and execution support capability and provide secure multimedia information interfaces and assured software to “on the move” users. Integration of collection management, planning and battlefield awareness programs is an essential element for achieving battlefield dominance through assured information systems.

(U) The goals of the Information Integration Systems project are to take diverse data inputs from a variety of sources, efficiently disseminate the information, and perform distributed and dynamic all-source correlation and fusion to produce an integrated, geo-spatially referenced, battlefield database and knowledge-base. The principal element of this project is assured communications using standard and non-traditional means, on and off the battlefield.

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B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	328.073	293.476	0.000	0.000	0.000
Current President's Budget	297.643	269.198	219.809	0.000	219.809
Total Adjustments	-30.430	-24.278	219.809	0.000	219.809
• Congressional General Reductions		-1.128			
• Congressional Directed Reductions		-23.150			
• Congressional Rescissions	-14.511	0.000			
• Congressional Adds		0.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-6.702	0.000			
• SBIR/STTR Transfer	-9.217	0.000			
• TotalOtherAdjustments	0.000	0.000	219.809	0.000	219.809

Change Summary Explanation

FY 2009

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

FY 2010

Decrease reflects reductions for the Section 8097 Economic Assumption, execution delays and FY 2010 new starts.

FY 2011

Not Applicable

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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
CCC-01: *COMMAND & CONTROL INFORMATION SYSTEMS*	40.870	89.702	69.450	0.000	69.450	69.510	58.418	45.555	45.510	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) Military operations since the end of the Cold War illustrate that current theater-level command, control, communications, and intelligence/information systems lack the ability to fully support operations in complex, time-critical environments. Warfighters must be prepared for operations ranging from conflict and peacekeeping in urban centers to heavy battle actions in remote areas. Current capabilities do not provide the commander with real-time, secure, situational awareness or the ability to orchestrate high-tempo planning, rehearsal, and execution. The programs in this project are developing and testing innovative, secure architectures and tools to enhance information processing, dissemination, and presentation capabilities. The programs provide the commander insight into the disposition of enemy and friendly forces, a joint situational awareness picture that will improve planning, decision-making, and execution, secure multimedia information interfaces, and software assurance to the warfighter "on the move." Integration of collection management, planning, and battlefield awareness are essential elements for achieving battlefield dominance through assured information systems.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Heterogeneous Airborne Reconnaissance Team (HART)	4.000	7.901	6.000	0.000	6.000
(U) The Heterogeneous Airborne Reconnaissance Team (HART) program develops integrated tactical planning and sensor management systems for heterogeneous collections of manned and unmanned platforms operating in urban environments. HART employs a model-based control architecture with dynamic teaming and platform-independent command and control. The system registers new platforms with the battle manager (kinematics, maneuverability, endurance, payloads, and communications links) to facilitate platform-independent tasking. HART provides a commander's interface that allows collaborative tasking of the platforms in the form of operational missions, such as search, track, identify, or engage, rather than routes and events. Additionally, it supplies computationally intensive decision aids, such as advanced 4-D airspace and groundspace deconfliction tools, route planners, and task/platform assignment algorithms. The technology presents mission status and future courses of action					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to commanders for collaborative adjudication. HART enables augmentation of low-footprint, rapidly deployable, easily sustainable human command structures with teams of machines operating together. There is a Memorandum of Agreement in place with the U.S. Army for technology transition. *FY 2009 Accomplishments:* - Supported user training operations at Ft. Bliss/Ft. Hood. - Conducted training and field testing with the Army Evaluation Task Force (AETF) to identify capabilities ready for rapid transition. - Extended operational area of small unmanned aerial vehicle (SUAV) via planning and control for "fling forward." - Added moving target indicator (MTI) for target tracking. - Provided dynamic overwatch to mobile warfighters by adapting flight paths, sensor and communications footprints, and by planning for UAV handoffs. - Demonstrated HART interoperability with service airspace management and imagery dissemination systems. - Expanded HART capability to rotorcraft (FireScout). *FY 2010 Plans:* - Test and demonstrate cooperative interaction with Tactical Airspace Integration System (TAIS) to achieve permissive airspace management for manned and unmanned platforms and indirect fires. - Support operational evaluation and certification of capabilities and limitations. - Collaborate with Program Manager, Unmanned Aircraft Systems and Army G-2 Intelligence, Surveillance, Reconnaissance Task Force lead to integrate and transition selected capabilities to the U.S. Army. - Ruggedize and miniaturize hardware suite. - Ensure scalability appropriate to anticipated areas of employment. - Support operational transition of technology in Program Execution Office Aviation Programs of Record.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Formulate and assess geo-registration algorithms suitable for highly variable terrain. - Develop new collection management methods that account for terrain-induced routing constraints, ground field of view mapping, and sensor visibility constraints.					
Deep Green (U) Deep Green is a next-generation, battle command and decision support technology that interleaves anticipatory planning with adaptive execution to help the commander think ahead, identify when a plan is going awry, and prepare options before they are needed. Deep Green will radically reduce the time needed to plan and execute military operations and will reduce the number of staff officers needed in an operations center. Through rapid mission planning and execution and reduced staff overhead, Deep Green will save lives and reduce costs. Deep Green will automatically induce a plan and commander's intent from the commander's hand-drawn sketches with accompanying speech to facilitate rapid option creation. Deep Green generates a broad set of possible futures from those options for all sides in an operation and predicts the likelihood of each future. It supports anticipatory planning by using information about the ongoing operation to nominate future states that are no longer feasible and probable future states upon which the commander should focus additional planning efforts. By anticipating decision points early and allowing the commander to explore the future option space, Deep Green supports commander's visualization and adaptive execution, enabling correct, timely decisions by the commander. Deep Green technology will transition to the U.S. Army. *FY 2009 Accomplishments:* - Developed sketching and speech tools to help commanders generate options quickly. - Developed fast, multi-resolution models to generate possible futures. - Developed the ability to automatically evaluate diverse possible futures. - Developed interface allowing commanders to foresee downstream effects of decisions.	10.949	19.282	17.727	0.000	17.727

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Extend technologies to monitor an ongoing operation and update the likelihoods that the possible futures being generated by Deep Green will actually occur. - Integrate major components to produce an initial prototype Deep Green system that enables proactive (vice reactive) battle management. - Extend the Deep Green system to support both mid-intensity conflict and counter-insurgency operations. - Extend the Deep Green system to support additional battlefield functional areas, such as air defense, intelligence, and military engineering. - Begin the process of transitioning Deep Green technologies to fielded battle command systems. *FY 2011 Base Plans:* - Extend Deep Green to support multi-echelon operations, including Deep Green systems at brigade and battalion levels coordinating among themselves. - Demonstrate functional battle command technology in force-on-force exercises against a live, intelligent enemy. - Demonstrate fully-functional, multi-echelon, full-spectrum battle command technology. - Complete transition of the technology to fielded battle command systems.					
Urban Leader Tactical Response, Awareness and Visualization (ULTRA-Vis) (U) The Urban Leader Tactical Response, Awareness and Visualization (ULTRA-Vis) program will develop an integrated, soldier-worn situational awareness system that allows the small unit leader to generate iconic representations of hand/arm signals and transmit the iconic commands to a networked squad. The icons are geo-registered on the battlefield and viewed from each warfighter's perspective using a see-through, head-mounted display. The system will enable the small unit leader to conduct non-line-of-sight combat operations using hands-free, iconic command and control while on the move. Information management protocols will support the dissemination of tactical information to allow the	10.000	11.050	8.823	0.000	8.823

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
squad leader to hand-off actionable information and direct alerts to the squad/fire teams for real-time collaboration without overload. ULTRA-Vis will develop the key technologies that allow small unit leaders and members to selectively transmit critical combat information in the form of icons using existing, low-bandwidth soldier voice and data radios to covertly relay standard phrases and visual annotations. ULTRA-Vis empowers the small unit leader with a clear tactical advantage through inter/intra-squad collaboration, heightened situational awareness and the ability to take decisive action while on-the-move. The ULTRA-Vis prototype units are planned for transition to the U.S. Army, Air Force Special Operations Command (AFSOC), and U.S. Marine Corps at the completion of the program. *FY 2009 Accomplishments:* - Developed see-thru display conformal visor using holographic waveguides and substrate guided relays. - Developed optically-assisted navigation for continuous geo-location and pose estimation. - Developed interface to actuate non-verbal commands and post icons onto a shared urban landscape. *FY 2010 Plans:* - Develop the capability to recognize standard hand and arm signals used by small unit leaders in close range combat operations. - Develop the capability to create geo-registered icons and affix the icons with high placement accuracy to the shared urban landscape for display from each warfighter's perspective. - Develop a non-occluding, head-mounted see-through visor for viewing iconic overlay on the battlespace. *FY 2011 Base Plans:* - Create network protocols for alerts and information management for inter-squad collaboration. - Integrate a multi-mode testbed to evaluate system functionality and capabilities.					
Advanced Tactical Battle Manager	3.000	10.800	7.900	0.000	7.900

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) The Advanced Tactical Battle Manager program develops automated decision support tools for Army and Marine Corps tactical commanders at the division level and below. The program provides support for combined operations employing dismounted soldiers, manned platforms, and autonomous vehicles through a graphical interface with unit commanders. The program also extends plans by applying adversarial reasoning techniques to identify vulnerabilities and opportunities in the predicted enemy course of action. Finally, it examines modifications or counteractions to reduce vulnerabilities. Program products will transition to the Services. (U) The effort is developing a support tool that autonomously and continuously, during the execution of a military operation, tracks the state of what is known about the environment and provides automated assistance to the process of collections planning to enable more effective, rapid, complete identification of the enemy's state. (U) The program will also develop integrated, in-theater tools for organizational design, cognitive resource configuration, and adaptive management of complex, often unconventional command and control (C2) structures. These tools will enable the U.S. military in real time to modify responsibilities, relations, tasks, and priorities to meet the rapidly changing needs of the command across multiple units, echelons, and organizations, while shaping the choices of countries at strategic crossroads. U.S. forces increasingly encounter complex C2 structures that include Coalition forces (manned and unmanned), civilian agency resources, indigenous formal and informal powers, and non-governmental organizations, and the U.S. Army Training and Doctrine Command has identified a critical gap in the technologies for agile configuration and analysis of C2 structures. *FY 2009 Accomplishments:* - Created algorithmic approaches for converting commander's and staff's information needs into tangible surveillance requests.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Develop and evaluate via simulation system solutions. - Conduct laboratory tests and obtain user feedback. - Provide predictive and diagnostic estimation of C2 system health and status in terms of the ability of those systems to support operational missions. - Proactively prosecute anomalies in context operational mission priorities. *FY 2011 Base Plans:* - Automatically determine the impact of multiple correlated anomalies on operational activities. - Develop dynamic approaches to allocating critical C2 functions, relations, and information flows over space and time. - Adapt C2 plan to support mission needs. - Develop active visualizations to support C2 system situation awareness and understanding.					
Increased Command and Control Effectiveness (ICE) (U) The Increased Command and Control Effectiveness (ICE) program develops and integrates cognitive systems technology into operational Command, Control, and Intelligence (C2I) systems. DARPA's Cognitive Systems programs have been developing the machine learning, reasoning, and human-machine dialogue technologies necessary to create cognitive assistants. This new technology promises to enable information systems to adapt automatically, during deployment and in real time, to the changing conditions that military commanders confront. It enables commanders to more rapidly adapt to evolving situations and priorities, and accelerates the incorporation of new personnel into command operations. This program funds portions of the technologies developed in PE 0602304E, Project COG-02 that are ready for application to command and control and situational awareness systems.	6.005	10.909	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) Efforts to integrate cognitive technology into a number of operational systems are underway. The very positive initial results obtained with these important command and control systems suggest that nearly all command and control systems can benefit from an infusion of cognitive technology if the software integration effort itself is made simple. A cognitive software framework will provide basic applications that can be customized by an application developer in a relatively straightforward fashion. *FY 2009 Accomplishments:* - Developed and refined advanced operational prototypes of cognitively-enhanced versions of operational systems that would provide users with advanced information and task-management capabilities, such as learning to anticipate users' information needs, pre-fetching needed information, learning users' interests, alerting users about the occurrence of events of interest, managing message traffic, and learning routine procedures and when to execute them. - Demonstrated, tested, and evaluated Personalized Assistant that Learns (PAL) program-enhanced information systems in military settings to validate that the PAL technologies are robust to the dynamics and uncertainties of the battlefield and dramatically compensate for end-user "cognitive overload." - Hardened and refined the PAL Learning Services Framework. *FY 2010 Plans:* - Extend PAL analyst support capabilities based on test and evaluation in exercises along with end-user feedback. - Integrate PAL-based prototypes with operational C2I information systems and data sources at end user facilities as integral subsystems. - Deploy a hardened capability for evaluation in an Army military readiness exercise. - Evolve and improve the PAL Learning Services Framework based on developer feedback and release for general use.					
ZETA	0.000	29.760	29.000	0.000	29.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) The ZETA program is exploring the unclassified aspects of novel physical devices, concepts, and techniques that leverage quantum physics for information technology. Research in this area has the ultimate goal of demonstrating information technology components with radical improvements in power efficiency and/or computational power relevant to military applications and opportunities. *FY 2010 Plans:* - Continue validation of key physical device assumptions. *FY 2011 Base Plans:* - Continue validation of key physical device assumptions. - Initial planning for small-scale demonstration of key physical devices.					
Predictive Analysis for Naval Deployment Activities (PANDA) (U) Predictive Analysis for Naval Deployment Activities (PANDA) developed technologies to automatically learn normal activity models of motion and emission for maritime surface vessels, automatically detect anomalous behavior, provide context modeling to resolve known categories of anomalies (e.g., due to weather and business rule changes), and generate alerts. The resulting technologies can be extended and applied to a wide range of applications including ground vehicles, troop movements, and individual targets of interest as the methods of tracking those targets improves. There is a Memorandum of Agreement in place with the Director of Naval Intelligence for technology transition. *FY 2009 Accomplishments:* - Enhanced initial system capability at operational naval site. - Commenced final phase III development in collaboration with the naval customer. - Obtained collaborative Navy funding to execute Phase III development in conjunction with DARPA funding.	6.000	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Urban Commander	0.916	0.000	0.000	0.000	0.000
(U) The Urban Commander program developed automated tools to help ground commanders construct detailed, realistic operational plans, particularly in nontraditional and urban environments. The primary effort in this thrust, the Multi-spectral Adaptive Networked Tactical Imaging System (MANTIS), developed, integrated, and demonstrated an advanced night vision visualization system. Prototype systems have been built. The system consists of a multispectral sensor suite with a high-resolution display and a high performance vision processor, along with a power supply and radio. The prototypes provide the soldier with digitally fused, multispectral video imagery in real-time from the Visible/Near Infrared (VNIR), the Short Wave Infrared (SWIR) and the Long Wave Infrared (LWIR) sensors via the high-resolution display. The processor adaptively fuses the digital imagery from the multispectral sensors providing the highest context, best nighttime imagery in real-time under varying battlefield conditions. There is a Memorandum of Agreement in place with the Program Executive Office-Soldier and Night Vision and Electronics Sensor Directorate for transition at the conclusion of Phase III in the first quarter of FY 2010. *FY 2009 Accomplishments:* - Completed test and integration of the MANTIS vision processor. - Fabricated and tested prototypes. - Transitioned MANTIS prototypes to the U.S. Army (PEO Soldier).					
Accomplishments/Planned Programs Subtotals	40.870	89.702	69.450	0.000	69.450

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

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E. Performance Metrics

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

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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
CCC-02: *INFORMATION INTEGRATION SYSTEMS*	163.681	91.301	64.376	0.000	64.376	64.155	63.412	63.442	64.730	Continuing	Continuing

A. Mission Description and Budget Item Justification

(U) The goals of the Information Integration Systems project are to take diverse data inputs from a variety of sources, efficiently disseminate the information, and perform distributed and dynamic all-source correlation and fusion to produce an integrated, geo-spatially referenced, battlefield database and knowledge-base. Through the use of wideband dissemination and integrated sensor management, the project will also facilitate multi-site, real-time, collaborative situation assessment and course-of-action evaluations to enable true network centric warfare concepts.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Optical & RF Combined Link Experiment (ORCLE)	60.765	31.496	19.070	0.000	19.070
(U) The Optical & RF Combined Link Experiment (ORCLE) program seeks to develop combined radio frequency (RF) and free space optical (FSO) communications as well as networking technologies that exploit the benefits of complementary path diversity. This effort encompasses the extension of research into the FSO/RF Internet Protocol-based Gateway Network system for tactical reach-back applications called the Optical RF Communications Adjunct (ORCA). Using optical and RF communication techniques, ORCLE will demonstrate improved battlespace communications using a hybrid RF and FSO link in air-to-air-to-ground environments. The central challenge is to enable optical communications bandwidth without giving up RF reliability regardless of the weather. ORCLE will develop RF and FSO propagation channel analysis, coding techniques and modeling to include weather, atmospherics and aero-optics to provide the joint force commander assured high-data rate communications. The technical objective is to prototype and flight demonstrate hybrid FSO/RF air-to-air-to-ground links that combine the best attributes of both technologies and simulate hybrid network performance. The ORCLE technology is planned for transition to the Special Operations Forces and the Air Force in FY 2011.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Constructed and field tested a brassboard system incorporating the FSO/RF components and dynamic network communication and interface system. - Performed range and flight demonstrations of hybrid FSO/RF links in operational representative environment. - Integrated and tested the ORCLE terminals to verify performance and readiness for field experiments and demonstrations. - Developed, designed, and initiated building hardware and software of a prototype system for integration into military air and ground platforms. - Began coordinating field demonstrations of ORCA networking that supports multiple airborne platforms, a ground node with direct interface to the Global Information Grid, and a ground node with an interface to a tactical gateway supporting Internet Protocol (IP)-addressable nodes. *FY 2010 Plans:* - Demonstrate high availability, gigabit data flow network performance with air-to-ground nodes. - Execute a Critical Design Review that provides the information to build prototype system including FSO, RF, network, and related components for airborne to airborne to ground network use. - Perform a series of flight experiments and gather performance metrics and performance utilizing locations in the eastern and western U.S. - Complete design and build multiple ORCA nodes to be contained in aircraft wing pods for airborne hybrid FSO/RF and network link validation experiments and demonstrations. - Complete system upgrade of Optical Automatic Gain Control and Optical Modem. - Integrate improved adaptive optics, e.g., lighter deformable mirror, and faster steering mirrors, into an airborne optical link system that will be incorporated into the ORCA prototype to provide gigabits of data over long ranges with high reliability and quality. - Complete design and build of a router for integration into ORCA prototype. - Validate adaptive optics approaches and control methods during ground checkout and air-ground testing.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Develop and execute a test program to validate program design metrics, network performance, and high data rate reliability. - Validate the ability to provide the warfighter low latency information for command and control as well as ISR requirements. - Demonstrate network instantiation and user interfaces to command and control at multiple levels. - Complete ORCA prototype nodes and install on a minimum of three aircraft networked to ground terminals for global information grid interoperability and worldwide data distribution as well as battlefield command and control. - Design and execute a test plan to show ability to provide reliable high data rate information based on military needs and mission requirements are available for immediate decision making. - Demonstrate hybrid high data rate FSO/RF and advance network capabilities to validate the ability to operate over a large theater of operations. - Perform a series of flight experiments and gather performance metrics and demonstrate ORCA capability utilizing military ranges and locations in the eastern and western U.S. locations. - Complete transition of the technology.					
Disruption Tolerant Networking (DTN) (U) The Disruption Tolerant Networking (DTN) program is developing network protocols and interfaces to existing delivery mechanisms (“convergence layers”) that provide high reliability information delivery using communications media that are not available at all times, such as low earth satellites, Unmanned Aerial Vehicle (UAV) over-flights, orbital mechanics, etc. The program is developing a single model for bundling information and ensuring its delivery, through a series of episodic communications links, from generator to user. Mechanisms and protocols that reduce bandwidth consumption, reduce latency, and improve reliability of information delivered to tactical deployments will be explored. The program is also exploring a new security model which protects information held in portable devices. To maximize the applicability and commercial viability of these protocols, and develop the basic software in an open	7.135	1.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
source mode, the military, commercial and Internet communities have been engaged. These protocols will be implemented in a typical military system to verify both the performance of the protocol and to validate the utility. The DTN technology is planned for transition to the USMC. *FY 2009 Accomplishments:* - Integrated DTN into USMC software interoperability environment and prepared for operational tests. - Initiated integration of DTN into USMC military tactics, techniques, and procedures. - Designed and initiated insertion into prototype DTN tactical networks. *FY 2010 Plans:* - Transition DTN to USMC.					
Retro-directive Ultra-Fast Acquisition Sensor (RUFAS) (U) The Retro-directive Ultra-Fast Acquisition Sensor (RUFAS) effort will design, construct, and demonstrate an X-band noise correlating radar with a retro-directive antenna. This effort will research and develop a new type of radar sensor based on the correlations of the Gaussian noise received by an antenna array from a small object located in the far field of the antennas and the retro-directive reradiation of the correlated noise. Combining and tailoring noise correlating interferometry and retro-directive antenna arrays into a retro-directive noise-correlating (RNC) radar will allow the radar to operate in omni-directional search mode. The result of this project will be a new type of search-mode radar having promising performance in terms of short acquisition time and low probability-of-intercept. The RUFAS technology is planned for transition to the Army and Marines. *FY 2009 Accomplishments:* - Conducted cost trade study and determined system design limitations to finalize RUFAS design capabilities. - Performed field evaluations of system design and performance at military locations. - Developed plan and executed military utility and system design assessment.	1.000	1.265	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2010 Plans: - Execute development of system design and manufacturing techniques to produce RUFAS prototype system for military utility. - Determine performer and government organizations to collaborate on experimentation and evaluation. - Perform brassboard experiments with components to determine performance. - Conduct field experiments in support of USMC end-user field evaluation.					
Network Enabled by WDM-Highly Integrated Photonics (NEW-HIP)	4.845	5.100	2.983	0.000	2.983
(U) The Network Enabled by WDM-Highly Integrated Photonics (NEW-HIP) program will facilitate building or upgrading military aircraft and other aerospace platforms with a wavelength division multiplexed (WDM) single-mode fiber-optic networking infrastructure. This will have many capabilities that are well beyond those of currently used copper- and multi-mode-fiber-based technologies. Originally, the program focused on specific technologies for application on the Navy's EA-6B Prowler aircraft; however, the program has been broadened to focus on technologies that will provide advanced capabilities to a multitude of military aircraft, such as the Joint Strike Fighter (JSF). The NEW-HIP technologies and associated architecture will provide: scalability in the bandwidth and the number of connected devices; immunity to electromagnetic interference (EMI) and cable cross-talk; reduced cable and overall system weight and volume; increased reliability without an associated weight or volume penalty; ease of integration and future upgradeability; and the ability to carry mixed analog and digital signal formats. This will be accomplished by taking full advantage of single-mode fiber-optic WDM technology and leveraging optoelectronic and photonic integration techniques developed in DARPA photonics components program. To reduce the size, weight and power and to increase the reliability and the flexibility of interconnecting arbitrarily placed client devices with various signal formats, the NEW-HIP program will use passive, transparent and wavelength-routing technology at the core of the network, and tunable optical transmitters and receivers (transceivers) to inter-connect the client devices at the edge of the network. The technologies developed under this program are planned for transition					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to the Services for eventual incorporation into military aircraft, including tactical aircraft, UAVs, wide-bodied aircraft and rotorcraft. *FY 2009 Accomplishments:* - Developed preliminary architectures of the avionics optical network that satisfies the requirements for networking analog and digital signals. - Developed the preliminary performance specification for NEW-HIP circuits to satisfy the performance and environmental requirements of military aircraft. - Designed and prototyped the following key optoelectronic components: tunable digital transmitters, tunable digital receivers, and passive wavelength broadcasting and routing components with focus on digital performance metrics. - Developed the preliminary designs for analog transmitters and receivers. *FY 2010 Plans:* - Develop the final architecture of the avionics optical network that satisfies the requirements for networking analog and digital signals. - Develop the final performance specification for NEW-HIP circuits to satisfy the performance and environmental requirements of military aircraft including the Joint Strike Fighter (JSF). - Continue the development and prototyping of the digital optoelectronic components including environmental testing. - Begin development of analog optoelectronic components. - Conduct developmental performance testing of the digital links using prototype network components. *FY 2011 Base Plans:* - Continue development of the key optoelectronic digital and analog networking components with respect to performance, size, weight, power and environmental requirements.					
Military Networking Protocol	5.793	9.000	9.750	0.000	9.750

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B. Accomplishments/Planned Program ($ in Millions)

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(U) The Military Networking Protocol program seeks to develop networks with full military organizational unit attribution and prioritization. The program will develop an authenticated and trusted version of Transmission Control Protocol/User Datagram Protocol/Internet Protocol (TCP/UDP/IP). By providing full attribution of every device and tracking each device's network flows, the system will know who owns each data flow. Based upon this knowledge, Military Networking Protocol will be able to provide a prioritization scheme of up to thirty-two levels. Military Networking Protocol will allow the network infrastructure to provide prioritization levels, reallocate bandwidth between different users or different military units, and automatically make quality of service decisions. Military Networking Protocol traffic will be compatible with existing Internet infrastructure and may allow or deny entry or transit of unauthenticated data and transmit data as fast as (or faster than) existing network protocols. Hardware developed in this program will be self-configuring and will greatly reduce the need for trained network personnel and overall network's maintenance cost. This program is planned for transition to the military Services. *FY 2009 Accomplishments:* - Developed technical scheme to allow for inserting attribution data into existing TCP/IP packets with a minimal amount of overhead. *FY 2010 Plans:* - Develop tactical router replacements that work with existing computers/routers and require no new configuration and enable self-forming networks that will result in at least an order-of-magnitude reduction in training, configuration, and installation time. - Develop changes to TCP/UDP/IP to accommodate Military Networking Protocol functionality. *FY 2011 Base Plans:* - Conduct demonstrations in operationally relevant environments.					
Scalable Millimeter-wave (MMW) Architectures for Reconfigurable Transceivers (SMART)	5.922	10.540	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) The Scalable Millimeter-wave (MMW) Architectures for Reconfigurable Transceivers (SMART) program is developing a new technology for producing very thin millimeterwave array apertures and transceivers. The technology development will culminate in the demonstration of a large-sized coherent, active electronically steerable array (AESA) with an output power density of 5W per square cm and a total layer thickness of less than 1cm. The SMART technology approach will result in a breakthrough in performance over conventional millimeterwave approaches. The 3-dimensional (3-D) multi-layer assembles that are being developed will greatly reduce AESA packaging complexity and will enable very compact, low-cost, millimeterwave and radio frequency circuit "building blocks" to combine to form arbitrarily large arrays. New capabilities, such as the ability to construct reconfigurable and/or multi-band AESAs and other MMW circuits, will be enabled by this architectural approach. This program will transition through industrial producers of MMW radar systems for DoD applications. *FY 2009 Accomplishments:* - Incorporated receive capability into the AESA while maintaining the thin dimension. - Demonstrated high isolation between transmit and receive functions. - Conducted evaluations and demonstrations of prototype components. - Initiated development of design automation algorithms and tools. *FY 2010 Plans:* - Complete initial testing of integrated components at high frequencies. - Demonstration of a large-size integrated transceiver array of 400 active elements with high output power, low losses, and low noise. - Complete final demonstrations of transceiver technology.					
Analog Logic* *Previously a part of Scalable Millimeter-wave (MMW) Architectures for Reconfigurable Transceivers (SMART).	6.625	6.486	7.650	0.000	7.650

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) The Analog Logic program will develop and demonstrate architectures, designs, and development tools for implementing computational functions in analog circuitry to overcome performance limitations inherent in digital designs. This program will apply the technologies to signal processing functions typically performed in digital form, which experience design complexity, high power consumption, thermal loads, limits to computational speeds, loss in dynamic range, and susceptibility to manufacturing variances. The Analog Logic program will build and demonstrate an analog-only signal processing capability with no local oscillator, down conversion, or analog-to-digital conversion. The Analog Logic program will also develop the algorithm libraries and automated development tools needed for developing algorithms in a low-cost fashion similar to Very-High-Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL). (U) The Analog Logic program has the potential to reduce complexity and power requirements for signal processing functions while improving performance relative to digital implementations in field programmable gate arrays (FPGA), digital signal processors (DSP), and general purpose processors (GPP). The result is a significant reduction in system cost, increase in battery life, and higher system reliability and performance for critical wireless military communications system components. As a consequence of this effort, there will be a great saving in cost, power, and volume to many modern military systems implementing wideband signal spreading, spectrum utilization, multiple input multiple output channels and radar applications. This program is planned for transition to the Army. *FY 2009 Accomplishments:* - Demonstrated initial analog logic signal processing prototypes. - Developed integrated analog logic circuitry for insertion into prototype radio receiver. - Designed concepts and tools for integrated design flow of analog logic circuitry. *FY 2010 Plans:* - Demonstrate end-to-end capability of a receiver prototype using integrated analog logic components.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Develop and demonstrate an initial capability for automated design and synthesis of analog logic circuitry using the Hardware Description Language (HDL). - Produce designs for ultra high-speed analog logic components. - Establish technology transition planning for use of the analog logic capability for DoD applications. *FY 2011 Base Plans:* - Develop and demonstrate an all analog logic receiver prototype with no frequency conversion or digital components. - Demonstrate the automated design and synthesis of advanced high-speed analog logic circuitry using the HDL, to include design verification capabilities. - Complete technology transition of the analog logic capability for DoD applications.					
Wireless Network after Next (WNaN) (U) The Wireless Network after Next (WNaN) program goal is to develop and demonstrate technologies and system concepts enabling densely deployed networks in which distributed and adaptive network operations compensate for limitations of the physical layer of the low-cost wireless nodes that comprise these networks. WNaN networks will manage node configurations and the topology of the network to reduce the demands on the physical and link layers of the nodes. The technology created by the WNaN network effort will provide reliable and highly available battlefield communications at low system cost. (U) The WNaN program will develop a low-cost handheld/body wearable wireless node that can be used to form high-density ad-hoc networks and gateways to the Global Information Grid. This program will also develop robust networking architecture(s) and network technologies/processes that will exploit high-density node configurations. A MOA is in place between DARPA and the Army that will culminate in a large-scale network demonstration using the multichannel nodes to establish viability for the Army to transition to a program of record and procure WNaN devices. Transition of the WNaN technology to the Army is planned to begin in 2010 and complete in 2011.	32.295	14.414	6.923	0.000	6.923

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Conducted a demonstration of six prototype WNaN radios with low risk networking technology to include Combat Net Radio through packetized voice, transmitting/receiving situational awareness data, IP layer services through Ethernet connection, interoperable with legacy tactical radios and Position Location Information (PLI). - Initiated development, integration, test and simulation of the additional network technologies that exploit diverse paths and frequencies to support network scalability and network formation of tens of thousands of operational nodes. - Initiated development of advanced prototype WNaN radios in a producible form factor for the Army to conduct field experimentation in support of a decision to transition the WNaN technology. - Began working with the Army to develop a network simulation model that can show ad-hoc wireless network performance for >1000 nodes. *FY 2010 Plans:* - Conduct field demonstrations of prototype WNaN radios with enhanced networking technology to include Disruption Tolerant Networking (DTN) and Dynamic Spectrum Access (DSA) capability with spectrum policy reasoning engine. - Simulate WNaN mobile ad-hoc wireless network performance for networks of >1000 WNaN nodes. - Demonstrate a communication system where the network layers can mitigate shortfalls in the radio physical layer. - In conjunction with the Army, conduct experimentation of advanced prototype WNaN radios with enhanced network technologies that improve mobile ad-hoc wireless network operation and scalability. - Initiate development, integration, test and simulation of the full function network technologies that exploit diverse paths and frequencies to support network scalability and network formation of tens of thousands of operational nodes.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2011 Base Plans: - Investigate the integration of the DARPA Interference Multiple Access (DIMA) waveform onto the WNaN system. - Build, integrate and test pre-production WNaN radios with final version of advanced full function network technologies. - Conduct demonstration of pre-production WNaN radios in a field test that forms a highly adaptive, dynamic, self-forming, self-healing WNaN military tactical network. - Transition WNaN program to the Army.					
Networked Bionic Sensors for Threat Detection (U) The Networked Bionic Sensors for Threat Detection program will develop and demonstrate low power micro-sensor devices and networks for multiple missions including, language/speech detection and recognition processing, and shooter localization. The system will use ultra-low power signal conditioning/processing front-end processors with advanced algorithms for distributed sensor network applications. This program will provide the ability to discretely monitor buildings, human presence detection/tracking in other sensitive areas, enable force protection, and provide battle damage information. Intelligence, surveillance, and reconnaissance (ISR) capabilities will be enhanced with this technology by allowing detection and tracking of high-value targets with hand emplaced or air deployed sensor networks. The technology developed is planned for transition to the U.S. Marine Corps. *FY 2009 Accomplishments:* - Developed a system architecture to exploit network of low-power micro-sensor devices. - Developed algorithms for acoustic micro-sensor network exploitation for threat detection. *FY 2010 Plans:* - Conduct system design trades of power vs. performance sensitivity and accuracy. - Design a brassboard system for field environments. - Build prototype systems for operational evaluation.	1.000	2.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Mobile Networked Multiple-Input/Multiple-Output (MIMO) (MNM)	3.000	4.000	5.000	0.000	5.000

(U) The Mobile Networked Multiple-Input/Multiple-Output (MIMO) (MNM) program will pursue MIMO communication systems, which have the potential to increase data rates by 10-20 times above current systems. MIMO will use multipath to create parallel channels in the same frequency band thereby increasing spectral efficiency. This effort will demonstrate the MNM capability under dynamic urban Non-Line-of-Sight multipath channel conditions where conventional techniques are degraded. This effort will undertake advanced MIMO technology development and perform field demonstrations of mobile ad hoc networks (MANETs). This effort will culminate in the development of a wideband form-factor system for use in tactical edge devices including troops, vehicles, and robotics. The MNM technology is planned for transition to the Army in FY 2011.

FY 2009 Accomplishments:
- Developed, integrated, and tested high risk enhanced network technologies that exploit diverse paths and frequencies to support network scalability and network formation to support large numbers of tactical nodes.
- Developed, integrated, tested and demonstrated MNM wideband interference mitigation technology.
- Performed demonstrations at military locations demonstrating mobile, airborne, urban, and rural capabilities and improvements over current single input, single output (SISO) systems.

FY 2010 Plans:
- Design nodes that will be able to be employed in various devices, including robotics, mobile, and/or advantaged devices.
- Show the ability to scale to a large number of network nodes while providing an order of magnitude improvement in reliability over related SISO systems.
- Demonstrate a communication system where the network layer can mitigate shortfalls in the physical layer in a live many-node demonstration.

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Design, build, test, and demonstrate MIMO capabilities into a handheld/body wearable multi-channel radio that utilizes high volume, low cost COTS RF circuits, narrowband tuning filters and dual-core Digital Signal Processing baseband processing. *FY 2011 Base Plans:* - Perform a transition demonstration in an operational environment.					
Mobile Ad Hoc Interoperability Networking GATEway (MAINGATE) (U) Building upon gateway technology developed under the WNaN and Future Combat Systems (FCS) Communications program, the Mobile Ad hoc Interoperability Networking GATEway (MAINGATE) program seeks to develop the next generation Network Centric Radio System (NCRS) with additional capabilities and an assured affordable unit price to the user. MAINGATE will enable heterogeneous groups of radios to be integrated into a heterogeneous network tolerant to high latency and packet loss. The technologies developed for the program will permit affordable, tactical, real-time, high fidelity video, data, and voice services to be deployed in a networked environment to support tactical operations in maneuver or dismounted operations for line-of-site and beyond-line-of-site communications on the move and at the halt. Two critical technologies for achieving these goals: 1) a backbone radio architecture that enables a versatile IP Mobile Ad hoc Network (MANET) and 2) a radio gateway that enables legacy analog and digital communications systems to be interconnected through a network. The MAINGATE program will use an iterative build-test-build approach that will culminate with limited user testing by U.S. and Allied Experimental Forces evaluating the affect of MAINGATE on new tactics, techniques and procedures designed for the networked maneuver and dismounted forces. The resulting MAINGATE system and capability is planned for transition in 2011 to the U.S. Army and Marine Corps with a focus on Special Operations Forces. *FY 2009 Accomplishments:* - Completed demonstrations of an initial, interoperable gateway capability.	22.652	6.000	7.000	0.000	7.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiated development of the wireless MANET capability and demonstrated an adaptive IP backbone network among gateways. - Conducted basic gateway and MANET performance in fielded environment. - Completed design of prototype MAINGATE units for field experimentation and testing. - Conducted two capability demonstrations to Army personnel. Demonstrations included up to 10 MAINGATE nodes (air and ground) providing interoperability among 15 radio types. - Began integrating dynamic spectrum access (DSA) and disruption tolerant networking (DTN) technologies into the MAINGATE system. *FY 2010 Plans:* - Develop and demonstrate the final gateway capability for interoperability between all targeted legacy networks. - Develop and demonstrate the final wireless MANET capability to create an adaptive IP backbone network among gateways and for connection to the Global Information Grid (GIG). *FY 2011 Base Plans:* - Perform limited user testing of the MAINGATE units in a realistic tactical scenario. - Transition the MAINGATE capability to the Military Services.					
Next Generation Communications (U) The Next Generation Communications program will develop detection and "reasoner" technology that will allow cognitive radios to recognize jamming attacks and then adapt to maintain communications in the presence of cognitive jammer attacks and dynamic interference of multiple cognitive network interactions. The program will develop models of adversary, commercial, and friendly cognitive radios and implement those models in a "reasoner" that assesses, in real time, the current and future dynamics of the communications network. Based on the predictions of the level of communication success vs. mission communication requirements, the "reasoner" within the cognitive radio will choose waveform selections/configurations that best achieve mission objectives.	0.000	0.000	6.000	0.000	6.000

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	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The "reasoner" will include the capability to analyze and select optimum waveform configurations during all aspects of a mission, to include initial alert, ingress, mission, and infiltration. The design effort will lead to new radio communication architectures, more robust radio communication networking and better understanding of selection amongst interference avoidance and interference suppression strategies based on the predicted outcome. (U) The Next Generation Communications will result in an original capability to predict communications performance in a complex electromagnetic environment that includes large numbers of emitters and various types of Red/Blue/White communication systems. These predictions will enable cognitive radios to select the optimum communications configuration for achieving success given the mission phase and objective. This program will also develop and construct a network of radios that implement interference alignment, solving practical design issues such as distributed synchronization. *FY 2011 Base Plans:* - Develop and demonstrate algorithms to measure cognitive radio network behaviors that sufficiently characterize state space and behavior. - Establish baseline sensor performance requirements. - Analyze/develop efficient model structure, essential metrics, and transforms. - Initiate development of attack library to include interface specifications, and baseline attack detectors. - Conduct concept design studies and perform feasibility analysis for moderate and large networks. - Develop efficient distributed algorithms and implement hardware prototypes for carrier frequency offset and frame synchronization. - Develop efficient algorithms for channel estimation and computation and distribution of alignment information; design the associated protocols.					
Polarized Rotation Modulation (PZRM) Communications	1.000	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

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(U) The goal of the Polarized Rotation Modulation (PZRM) Communications program was to develop new extremely high data rate, point-to-point, or point-to-multipoint wireless communications waveform using the PZRM/Orthogonal Signal Spectrum Overlay (OSSO) communications concept to exploit the presently unused polarization and rotation dimensions of radiation. The PZRM Communications program investigated the use of polarization, including OSSO, modulation and the ability for conventional radios to carry all information over the transmitted signal amplitude, phase and frequency. The program demonstrated as an enhancement to an otherwise state-of-the-art communications system. Technologies developed under this program are available for transition to the Services in FY 2009. *FY 2009 Accomplishments:* - Completed final assessment of technology.					
Next Generation (XG) (U) The Next Generation (XG) program developed both the enabling technologies and system concepts to provide dramatic improvements in assured military communications in support of a full range of worldwide deployments through dynamic spectrum access. U.S. Forces face unique spectrum access issues in each country in which they operate due to competing civilian or government users of national spectrum. These constraints must be reflected in all force planning and may preclude operation of critical systems. Coalition and allied operations are even more complex to manage, and may severely limit the U.S. ability to fully exploit its superiority and investment in information technology. The XG program developed the theoretical underpinnings for dynamic access to the spectrum, the technologies and subsystems that enable dynamic access, and the system prototypes to demonstrate applicability to legacy and future DoD radio frequency emitters. The program investigated methods to leverage the technology base in microelectronics with new waveform and medium access and control protocol technologies to construct an integrated system. The program developed, integrated, and evaluated the technology to enable equipment to automatically select spectrum and operating modes to both	2.250	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
minimize disruption of existing users, and to ensure operation of U.S. systems. The XG program also developed and demonstrated a set of standard dynamic spectrum adaptation technologies for legacy and future emitter systems for joint service utility. The XG communications technology transitioned to the Army for implementation in a range of current and future communication systems including the Joint Tactical Radio Systems clusters and the Enhanced Position Location and Reporting System - Extended Frequency (EPLRS-XF) radio systems. *FY 2009 Accomplishments:* - Initiated effort with the U.S. Army to integrate XG software into the EPLRS-XF military networking radio. - Conducted assessment of EPLRS-XF processing and memory requirements for hosting the XG software. - Developed the software architecture of XG algorithms in the EPLRS-XF system. - Conducted modeling and simulation to verify changes to networking protocols.					
Advanced Speech Encoding (ASE) (U) The Advanced Speech Encoding (ASE) program achieved an order of magnitude reduction of voice communication bit rates over current state-of-the-art voice encoders (VOCODER) in noisy military environments. Such a reduction significantly decreased the probability of detection of transmitted signals and also decreased the required transmit energy, thereby increasing battery lifetime. The program pursued two novel approaches toward achieving its goal. Multiple noise-immune sensors combined with traditional coding algorithms; and communication without acoustic information achieved by extracting laryngeal and sublingual muscle signals that are produced when a person generates sub-vocal speech. The ASE technology is transitioning to the Special Operations Command and the Communications and Electronics Command of the U.S. Army.	4.350	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 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603760E: *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	PROJECT CCC-02: *INFORMATION INTEGRATION SYSTEMS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
FY 2009 Accomplishments: - Collected two large-scale libraries ("corpora") of mouth and neck electromyographic (EMG) signals for sub-vocal speech and signal models that relate the EMG signals to the mouthed but unspoken words. - Developed an ASE prototype, conducted tests, and demonstrated EMG-based sub-vocal word recognition. - Established that five EMG sensors can be used with negligible loss (vice eleven sensors) in system performance.					
Conflict Modeling, Planning, and Outcomes Experimentation (COMPOEX) (U) The Conflict Modeling, Planning, and Outcomes Experimentation (COMPOEX) research effort developed technologies that enhance the capability of leaders to plan and conduct complex campaigns. This includes a comprehensive suite of decision support tools that help leaders with: visualizing and understanding the situation and the complex operational environment they must operate in; constructing and managing plans that enable the commander to synchronize and integrate interdependent effects over a long period of time; employing the best sequence of unified actions to produce the desired effects; and generating and exploring options and courses of action to understand the range of outcomes and appreciate the side effects that may occur. Technologies developed in the program are transitioning to the U.S. Pacific Command (PACOM) and the Office of the Secretary of Defense Cost Analysis and Program Evaluation (OSD CAPE). *FY 2009 Accomplishments:* - Completed final PACOM demonstration. - Completed the transition to OSD CAPE as one of their analytical tools.	1.000	0.000	0.000	0.000	0.000
DARPA Interference Multiple Access (DIMA) Communications	4.049	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
(U) The DARPA Interference Multiple Access (DIMA) Communications program developed a networked radio system that supports voice, video and data. The program developed a network that is dynamically controllable using techniques such as reconfiguration, optimum resource allocations based on mission priorities, and dynamic policies, as opposed to relatively passive reactions to changes by the commercial infrastructure. This program initially developed direct sequence spread spectrum (DSSS) communications technologies as a building block to enable robust, mobile, tactical wireless networks, which are the foundation for network centric warfare concepts. The fundamental technical challenges are scalability, multi-user detection processing, low probability of detection/low probability of interception (LPD/LPI), robustness and platform size, weight and power (SWAP) requirements. The DIMA Communications program then developed and demonstrated a system based on multi-user detection (MUD) concepts that take advantage of overloaded channels while operating in an environment absent of infrastructure (ad-hoc networked). The technologies developed under this program are transitioning to the Army and USMC. *FY 2009 Accomplishments:* - Reduced complexity of DIMA system. - Developed and demonstrated real-time DIMA in a mobile ad hoc network using a radio handheld platform. - Tested the network in scenarios relevant to tactical users. - Transitioned DIMA technologies to the Army and USMC.					
Accomplishments/Planned Programs Subtotals	163.681	91.301	64.376	0.000	64.376

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2011 Defense Advanced Research Projects Agency		DATE: February 2010
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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 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603760E: *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	PROJECT CCC-CLS: *CLASSIFIED*	

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
CCC-CLS: *CLASSIFIED*	93.092	88.195	85.983	0.000	85.983	68.575	99.978	132.458	137.283	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds classified DARPA programs that are reported in accordance with Title 10, United States Code, Section 119(a)(1) in the Special Access Program Annual Report to Congress.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Classified DARPA Program	93.092	88.195	85.983	0.000	85.983
This project funds Classified DARPA Programs. Details of this submission are classified. *FY 2009 Accomplishments:* Details will be provided under separate cover. *FY 2010 Plans:* Details will be provided under separate cover. *FY 2011 Base Plans:* Details will be provided under separate cover.					
Accomplishments/Planned Programs Subtotals	93.092	88.195	85.983	0.000	85.983

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

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 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603760E: *COMMAND, CONTROL AND COMMUNICATIONS SYSTEMS*	**PROJECT** CCC-CLS: *CLASSIFIED*

E. Performance Metrics

Details will be provided under separate cover.