Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Defense Advanced Research Projects Agency										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602304E: *COGNITIVE COMPUTING SYSTEMS*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	132.630	90.143	49.365	-	49.365	46.424	34.405	34.832	34.927	Continuing	Continuing
COG-02: *COGNITIVE COMPUTING*	84.601	42.143	11.674	-	11.674	13.542	12.578	12.840	12.840	Continuing	Continuing
COG-03: *COLLECTIVE COGNITIVE SYSTEMS AND INTERFACES*	48.029	48.000	37.691	-	37.691	32.882	21.827	21.992	22.087	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Cognitive Computing Systems program element is budgeted in the Applied Research budget activity because it is developing the next revolution in computing and information processing technology that will enable computational systems to have reasoning and learning capabilities and levels of autonomy far beyond those of today's systems. The ability to reason, learn and adapt will raise computing to new levels of capability and powerful new applications.

The Cognitive Computing project will develop core technologies that enable computing systems to learn, reason and apply knowledge gained through experience, and respond intelligently to things that have not been previously encountered. These technologies will lead to systems demonstrating increased self-reliance, self-adaptive reconfiguration, intelligent negotiation, cooperative behavior and survivability with reduced human intervention.

The Collective Cognitive Systems and Interfaces project will dramatically improve warfighter and commander effectiveness and productivity using advanced cognitive approaches that enable faster, better informed, and more highly coordinated actions than those of our enemies. This will be accomplished by developing revolutionary methods that increase our information processing capabilities, enhance our situational awareness, and enable more cohesive group action by our forces. Critical technical areas addressed in this project include automated coordinated decision support, information sharing, and ensured communications.

B. Program Change Summary ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**
Previous President's Budget	144.236	90.143	88.462	-	88.462
Current President's Budget	132.630	90.143	49.365	-	49.365
Total Adjustments	-11.606	-	-39.097	-	-39.097
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	-7.780	-			
• SBIR/STTR Transfer	-3.826	-			
• TotalOtherAdjustments	-	-	-39.097	-	-39.097

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Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2010	FY 2011
Project: COG-02: *COGNITIVE COMPUTING*		
Congressional Add: *BioButanol Production Research*	2.000	-
Congressional Add Subtotals for Project: COG-02	2.000	-
Congressional Add Totals for all Projects	2.000	-

Change Summary Explanation

FY 2010: Decrease reflects internal below threshold reprogrammings and SBIR/STTR transfer.

FY 2012: Decrease reflects transition of robotics efforts and completion of the Personalized Assistant that Learns (PAL) program and Defense Efficiencies for contractor staff support and studies.

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
COG-02: *COGNITIVE COMPUTING*	84.601	42.143	11.674	-	11.674	13.542	12.578	12.840	12.840	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Cognitive Computing project will develop core technologies that enable computing systems to learn, reason and apply knowledge gained through experience, and to respond intelligently to new and unforeseen events. These technologies will lead to systems with increased self reliance, cooperative behavior, and the capacity to reconfigure themselves and survive with reduced programmer intervention. These capabilities will make the difference between mission success and mission degradation or failure, even in the event of cyber-attack or component attrition resulting from kinetic warfare or accidental faults and errors. Systems that learn and reason will reduce the requirement for skilled system administrators and dramatically reduce the overall cost of system maintenance.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Autonomous Robotic Manipulation (ARM)*	16.490	20.500	11.674

Description: *Formerly Robust Robotics

The Autonomous Robotic Manipulation (ARM) program is developing advanced robotic technologies that will enable autonomous (unmanned) mobile platforms to manipulate objects without human control or intervention. A key objective is intelligent control of mobile manipulators to independently perform subtasks over a broad range of domains of interest to the warfighter, thereby reducing operator workload, time on target, training time, bandwidth, and hardware complexity. Current mobile manipulation systems have many limitations. For example, while they perform well in certain mission environments, they have yet to demonstrate proficiency and flexibility across multiple mission environments; they require burdensome human interaction and the full attention of the operator; and the time required to complete tasks generally exceeds military users' desires. ARM will create mobile manipulators with a high degree of autonomy capable of serving multiple military purposes across a wide variety of application domains, including but not limited to counter-improvised explosive device, countermine, search and rescue, weapons support, checkpoint and access control, explosive ordnance disposal, and combat casualty care (including battlefield extraction). ARM will enable autonomous mobile manipulation systems to surpass the performance level of remote manipulation systems that are controlled directly by a human operator.

FY 2010 Accomplishments:

- Developed a manipulator platform--a base with arm and sensor heads, each with a multi-fingered hand--to serve as a common development platform.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Developed control algorithms that simultaneously manage the degrees of freedom in the arms and hands based on inputs from perception sensors. ***FY 2011 Plans:*** - Develop bi-manual manipulation primitives for handling deformable materials, such as opening a satchel with one hand holding a handle and the other zipping a zipper or opening a clasp. - Develop kinesthetic search techniques based on tactile and haptic sensing. ***FY 2012 Plans:*** - Develop a mobile manipulator platform--add a mobile base to existing manipulator system that can handle outdoor environments. - Develop algorithms to accomplish challenge tasks with mobile platform.			
Title: Personalized Assistant that Learns (PAL) ***Description:*** The Personalized Assistant that Learns (PAL) program enables intelligence in information processing systems so critical DoD systems can better support the warfighter. PAL systems will have embedded learning capabilities that will allow them to retain prior learned knowledge, apply this knowledge to new scenarios and ultimately provide faster and more effective assistance. Overall, the ability to learn will enable the performance of a PAL system to improve over time. Cognitive systems technologies developed in this program will be applied and demonstrated in ongoing and future Command and Control Systems programs. ***FY 2010 Accomplishments:*** - Fine tuned all algorithms for scale-up, response time and throughput. - Finalized human-computer interface and completed the debugging of all PAL software. - Extended the capability of PAL software to learn semantic representations from end users. - Assessed the military impact of enabling users to rapidly integrate and manipulate data, software services and web content. ***FY 2011 Plans:*** - Develop the ability for an integrated cognitive system such as PAL to model its own behavior. - Create the ability for cognitive systems to exchange locally-learned knowledge.	17.355	10.825	-
Title: Foundational Learning Technology ***Description:*** The Foundational Learning Technology program develops advanced machine learning techniques that enable cognitive systems to continuously learn, adapt and respond to new situations by drawing inferences from past experience and existing information stores. The techniques developed under Foundational Learning Technology address diverse machine	8.300	6.818	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
learning challenges in processing of sensory inputs, language acquisition, combinatorial algorithms, strategic analysis, planning, reasoning, and reflection. One very promising approach involves transfer learning techniques that transfer knowledge and skills learned for specific situations to novel, unanticipated situations and thereby enable learning systems to perform appropriately and effectively the first time a novel situation is encountered. This is essential because most military operations occur in ever-changing environments; U.S. forces and systems must be able to act appropriately and effectively the first time each novel situation is encountered. ***FY 2010 Accomplishments:*** - Formulated learning approaches applicable to processing of sensory inputs. - Developed techniques to enable generalization of knowledge across application areas such as language acquisition, strategic analysis, planning, reasoning, and reflection. ***FY 2011 Plans:*** - Implement and test machine learning approaches on selected problems in processing of sensory inputs, language acquisition, strategic analysis, planning, reasoning, and reflection. - Develop a platform for visual and tactile input to ground concepts such as objects and actions for language learning.			
Title: Biomimetic Computing ***Description:*** Biomimetic Computing's goal is to develop the critical technologies necessary for the realization of a cognitive artifact comprised of biologically derived simulations of the brain embodied in a mechanical (robotic) system, which is further embedded in a physical environment. These devices will be a new generation of autonomous flexible machines that are capable of pattern recognition and adaptive behavior and that demonstrate a level of learning and cognition. Key enabling technologies include simulation of brain-inspired neural systems and special purpose digital processing systems designed for this purpose. ***FY 2010 Accomplishments:*** - Developed the capability to simulate a system of one million thalamocortical neurons with spike time dependent plasticity connected to an ape-inspired robot. - Demonstrated the ability of the robot and simulated neural system to organize its visual system and associate sensory inputs and motor output. - Improved and extended neural system models to include capabilities to integrate visual cortex, motor cortex, thalamus, basal ganglion and neuromodulatory systems. ***FY 2011 Plans:***	5.300	4.000	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Demonstrate an autonomous robot with a simulated neural system capable of mentally rotating images in order to grasp complex three dimensional objects.			
Title: Integrated Learning ***Description:*** The Integrated Learning program created a new computer learning paradigm in which systems learn complex workflows from warfighters while the warfighters perform their regular duties. The effort focused on military planning tasks such as air operations center planning and military medical logistics. With this learning technology, it will be possible to create many different types of military decision support systems that learn by watching experts rather than relying on expensive and error prone hand-encoded knowledge. The new learning paradigm differs from conventional machine learning in that it does not rely on large amounts of carefully crafted training data. Rather, in the new paradigm the learner works to "figure things out" by combining many different types of learning, reasoning, and knowledge. Such a cognitive system will ultimately need the capability to build and update its own internal model of the world and the objects in it without human input. ***FY 2010 Accomplishments:*** - Expanded the scope of the problems being learned so the systems learn multi-user task models. - Modified the integrated learning systems to be able to abstract the details of the process it is learning and learn general process or meta process knowledge. - Extended capabilities of the integrated learning systems so they can share information (low-level data, mid-level hypothesis, and high-level conclusions) with other learners. - Evaluated systems by having them compete against expert humans.	5.102	-	-
Title: Bootstrapped Learning ***Description:*** The Bootstrapped Learning program provided computers with the capability to learn complex concepts the same way people do: from a customized curriculum designed to teach a hierarchy of concepts at increasing levels of complexity. Learning each new level depends on having successfully mastered the previous level's learning. In addition, the learning program will be "reprogrammable" in the field using the same modes of natural instruction used to train people without the need for software developers to modify the software code. At each level, a rich set of knowledge sources (such as training manuals, examples, expert behaviors, simulators, and references and specifications that are typically used by people learning to perform complex tasks) will be combined and used to generate concepts and a similar set of knowledge sources for the next level. This will enable rapid learning of complex high-level concepts, a capability which is essential for autonomous military systems that will need to understand not only what to do but, why they are doing it, and when what they are doing may no longer be appropriate. ***FY 2010 Accomplishments:***	7.650	-	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Established system generality by demonstrating learning performance in a "surprise" domain that was completely unknown to the learning system developers. - Enhanced system capabilities to include instructible situational awareness. - Demonstrated end-to-end autonomous bootstrapped learning.			
Title: Machine Reading and Reasoning Technology ***Description:*** The Machine Reading and Reasoning Technology program is developing enabling technologies to acquire, integrate, and use high performance reasoning strategies in knowledge-rich domains. Such technologies will provide DoD decision makers with rapid, relevant knowledge from a broad spectrum of sources that may be dynamic and/or inconsistent. To address the significant challenges of context, temporal information, complex belief structures, and uncertainty, new capabilities are needed to extract key information and metadata, and to exploit these via context-capable search and inference (both deductive and inductive). Machine reading addresses the prohibitive cost of handcrafting information by replacing the expert, and associated knowledge engineer, with un-supervised or self-supervised learning systems that "read" natural text and insert it into AI knowledge bases especially encoded to support subsequent machine reasoning. Machine reading requires the integration of multiple technologies: natural language processing must be used to transform the text into candidate internal representations, and knowledge representation and reasoning techniques must be used to test this new information to determine how it is to be integrated into the system's evolving models so that it can be used for effective problem solving. These concepts and technology development efforts will continue in PE 0602305E, Project MCN-01 beginning in FY 2011. ***FY 2010 Accomplishments:*** - Demonstrated the ability of a system to acquire and organize factual information directly from unstructured narrative text in multiple domains. - Developed knowledge representation and reasoning capabilities to support simple temporal reasoning using ordered relationships in text. - Demonstrated the ability of machine reading systems to extract knowledge from texts that employ varied writing styles and require contextualization for proper interpretation. - Demonstrated human-level performance by machines at categorizing text quality preparatory to automatic knowledge extraction.	17.404	-	-
Title: Mind's Eye ***Description:*** The Mind's Eye program, previously part of the Machine Reading and Reasoning thrust, is developing in machines, a capability that currently exists only in animals: "visual intelligence." Machines enhanced by Mind's Eye technology will have the capability to learn generally applicable and generative representations of action between objects in a scene, directly from visual inputs, and be able to reason over those learned representations. While current research in machine vision has been	5.000	-	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
successful in developing techniques recognizing objects and their properties, Mind's Eye will add the perceptual and cognitive underpinnings for reasoning about the action in scenes, enabling the creation of a more complete narrative for the visual field. The technologies developed under Mind's Eye will have broad applicability in robotics and surveillance. These concepts and technology will continue in PE 0602305E, Project MCN-01 beginning in FY 2011. ***FY 2010 Accomplishments:*** - Developed enduring research corpus and library of thousands of video vignettes to support technical development and evaluation as well as future research. - Developed high-level system integration concept to support implementation of visual intelligence algorithms on smart camera platforms. - Developed first-generation visual intelligence algorithms for domain-independent event recognition, prediction, interpolation, and visualization.			
Accomplishments/Planned Programs Subtotals	82.601	42.143	11.674

	FY 2010	FY 2011
Congressional Add: BioButanol Production Research	2.000	-
FY 2010 Accomplishments: - Continue to investigate bio-butanol production capabilities.		
Congressional Adds Subtotals	2.000	-

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 2012 Defense Advanced Research Projects Agency			DATE: February 2011
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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
COG-03: *COLLECTIVE COGNITIVE SYSTEMS AND INTERFACES*	48.029	48.000	37.691	-	37.691	32.882	21.827	21.992	22.087	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Collective Cognitive Systems and Interfaces project will dramatically improve warfighter and commander effectiveness and productivity using advanced cognitive approaches that enable faster, better informed, and more highly coordinated actions than those of our enemies. This will be accomplished by developing revolutionary methods that increase our information processing capabilities, enhance our situational awareness, and enable more cohesive group action by our forces. Critical technical areas addressed in this project include automated decision support, information sharing, ensured communications, and advanced informatics. Cognitive decision support tools reason about tasks, timings, and interactions so that when plans change or the enemy does not respond as anticipated, U.S. forces can quickly adapt. The quality of such decisions and the effectiveness of our actions depend critically on our ability to take full advantage of all available information in a rapid and flexible manner. This requires the capability to share information and to automatically integrate distributed information bases for broad tactical battlespace awareness. Team cohesion requires effective and reliable communication in difficult environments such as urban settings where radio signal propagation is complex. Here the approach is to develop cognitive communications management and control algorithms that reason about channel conditions, higher-level application connectivity requirements and related factors, and decide what parameters each radio will use. Finally, the use of advanced informatics will help guide user's to information most relevant to them, assist caregivers with treatment, destigmatize the psychological health process, and help alert DoD to emerging psychological health trends and crises. The suite of programs under this project will significantly advance the military's ability to successfully deal with complex situations in operational environments.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Transformative Apps	9.400	15.500	16.502
Description: The goal of the Transformative Apps effort is to put mobile, tactical applications (apps) in the hands of warfighters and to create a new military apps marketplace with a vibrant apps development community. The effort will demonstrate a broad array of apps supporting command and control, situational awareness, collaboration, geo-spatial visualization, training, and language translation. Many of these applications will require ongoing network connectivity; others will require occasional data synchronization. While commercial networks benefit from robust cellular networks and the presence of large data centers, tactical networks are notorious for their limited bandwidth, frequent outages, and high-latency links. Specialized backend architecture and middleware will be developed to enable apps to run while providing engaging user experience and without over-burdening the network. Of particular importance is development of a new data synchronization architecture between the handhelds and the backend computing/storage nodes. Additionally, appropriate middleware services and libraries will be developed to facilitate shared capabilities such as map viewing, apps management, and collection of logs, usage statistics and user feedback. Apps, together with handhelds and networks, will be tested in different training environments as well as in deployed environments. Performance and usage will be carefully tracked and user feedback collected to guide rapid enhancement of apps. The effort			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
will create a military apps development community by reaching out to non-traditional performers and will explore new models for software acquisitions based on end-user empowerment. The effort will leverage the resources, experience, and lessons-learned derived from the Tactical Ground Reporting System (TIGR). ***FY 2010 Accomplishments:*** - Launched a series of user conferences. - Established innovation and collaboration tools. - Created application programming interfaces (APIs) and a development framework that will enable efficient creation of specialized military apps later in the program. ***FY 2011 Plans:*** - Develop initial set of middleware services and tools. - Develop initial apps suite available on BETA repository. - Perform operational evaluation testing with military and commercial networks. ***FY 2012 Plans:*** - Conduct evaluations with security infrastructure. - Enhance middleware and services for apps. - Develop tools for non-experts to create apps on smartphone platforms. - Test interoperability with Wireless Network After Next (WNAN) or other military tactical networks.			
Title: Healing Heroes - Medical ***Description:*** The Healing Heroes program will develop automated information systems that identify group and individual trends indicative of post-traumatic stress disorder (PTSD) and traumatic brain injury (TBI), anomaly detection algorithms to identify emerging physical and psychological crises, and provide guided access to information and educational materials. This will complement commercial on-line resources, interactive media, and social networks that supplement traditional healthcare options but have not focused on issues specific to the Warfighter. Healing Heroes will integrate social networking and medical informatics technologies in a secure web-based platform that provides both functionality and privacy to the user. The program will also provide tools for spouses, caregivers, and children, and will leverage related DoD family outreach efforts. Healing Heroes recognizes that security and privacy are critical to user acceptance and Health Insurance Portability and Accountability Act (HIPAA) compliance and so will incorporate strong authentication and other security mechanisms as needed to protect patient data. The program will also develop partnerships with key DoD organizations working in this area, including the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury, the Defense Medical Research and Development Program	6.000	14.948	9.079

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
(DMRDP), the Army Telemedicine & Advanced Technologies Research Center (TATRC), and the National Center for TeleHealth and Technology. ***FY 2010 Accomplishments:*** - Developed Healing Heroes system concept of operations and preliminary privacy framework. - Developed system security requirements and performed initial system engineering. ***FY 2011 Plans:*** - Develop the Healing Heroes functional and security services. - Implement and release initial prototype version of Healing Heroes on a DoD network. - Perform alpha test/user trial of the system. ***FY 2012 Plans:*** - Complete final modifications to the system based on the results of the alpha test/user trial. - Perform beta test/user trial of the system. - Operationalize system software and documentation, harden the system, and obtain certification and accreditation.			
Title: Graph Understanding and Analysis for Rapid Detection - Deployed On the Ground (GUARD DOG)* ***Description:*** *Previously in Advanced Soldier Sensor Information System and Technology. The Graph Understanding and Analysis for Rapid Detection - Deployed On the Ground (GUARD DOG) program will develop an integrated system to provide real-time data collection and analysis of patrol-based civilian interviews and field observations to facilitate understanding of the local and regional political, social, economic, and infrastructure situation in which U.S. forces are deployed. GUARD DOG will consist of two segments: a handheld/portable digital assistant to support dismounted soldiers patrolling neighborhoods and villages; and a laptop/desktop computer system that integrates data from multiple patrols and supports battalion/brigade-level analysts. GUARD DOG will provide automated support for the Collect-Update-Analyze-Prioritize process by supporting data collection and advanced analytics to evaluate the current local/regional situation, identify gaps in the knowledge base, and generate information requirements. ***FY 2011 Plans:*** - Develop fast, graph-based, information analysis algorithms that can handle large, complex data sets. - Develop new technologies and system architecture to support real-time data collection and analysis. - Develop simulation test bed to evaluate selected graph-based algorithms.	-	10.000	12.110

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Design, conduct and analyze field experiments using test bed and National Training Center at Ft. Irwin. ***FY 2012 Plans:*** - Optimize algorithms to run on handheld devices in the field. - Enhance algorithms to address uncertain and dynamic data. - Expand architecture to support multiple, distributed users. - Design, conduct and analyze field experiments using test bed and National Training Center at Ft. Irwin and/or Joint Readiness Training Center at Ft. Polk, LA.			
Title: Cognitive Networking ***Description:*** The Cognitive Networking program will develop technologies that provide information systems and communication networks with the ability to maintain and self-optimize their own functionality, reliability and survivability. These technologies will allow the military to focus its critical manpower resources on the mission rather than on the maintenance of its information systems and network infrastructure. Cognitive information processing will be used to optimize networked communications based on current conditions, past experience and high-level user guidance. The Cognitive Networking program is also addressing the warfighter's need for actionable situational awareness in complex radio frequency (RF) environments. This work leverages advances in software-defined radio technology to achieve specific military goals. Cognitive Networking funds three programs: SAPIENT, LANDroids, and BOSS. The Situation-Aware Protocols in Edge Network Technologies (SAPIENT) effort will develop a new generation of cognitive protocol architectures to replace conventional protocols that fare poorly in extreme network conditions and do not provide adequate service for key applications. Technology developed in SAPIENT will have military utility wherever tactical communications are deployed. SAPIENT architectures will represent awareness with a knowledge base that is updated based on specification and observation. SAPIENT technology enables the automatic adaptation of protocols to the operational environment to dramatically reduce the effect of network impairments on applications while demonstrating a positive trend in capability as new situations are encountered and learned. The Local Area Network droids (LANdroids) effort will give warfighters reliable communications in urban settings. LANdroids will accomplish this by creating robotic radio relay nodes that move autonomously to configure and maintain a communications mesh by reasoning about their positions relative to one another and relative to the warfighters. LANdroids will move as the warfighters move with the goal of maintaining warfighter connectivity throughout their operations. LANdroids will be pocket-sized so warfighters can carry several and drop or deploy them as they move through an area. The effort is creating both the intelligent	16.459	5.552	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012

radio control software and the small radio platform on which it runs. The technologies will be tested in a physical setting and at an operationally relevant scale.

The Brood of Spectrum Supremacy (BOSS) effort will provide actionable situational awareness to the warfighter in complex radio frequency (RF) environments. BOSS adds collaborative processing capabilities to tactical software-defined radios to achieve specific military goals. BOSS exploits cooperative use of computational, communication and sensory capabilities in a software radio to generate breakthrough capabilities in the warfighter knowledge of their surroundings, with a particular focus on RF-rich urban operations. Ultimately this effort will develop Software Communications Architecture (SCA)-compliant waveforms suitable for implementation on a tactical software radio system.

FY 2010 Accomplishments:

Situation-Aware Protocols in Edge Network Technologies (SAPIENT)

- Demonstrated an adaptive cognitive prototype for a tactical environment using mobile, airborne, and stationary nodes.

Local Area Network droids (LANdroids)

- Evaluated tethering, power management and load-balancing algorithms using a 15-node LANdroids network that spans two indoor floors of a building.
- Developed control algorithms for LANdroids that enable them to tether the network to warfighters so the network moves as the warfighters move.
- Developed intelligent power management algorithms for LANdroids so they make intelligent decisions about whether or not to move based on current conditions and expected power expenditures and savings.
- Developed network load-balancing protocols for LANdroids that dovetail with the power management algorithms to enable the network to last as long as possible.

Brood of Spectrum Supremacy (BOSS)

- Collected RF data with Wireless Network after Next (WNaN) radio to evaluate BOSS algorithms with these radios.
- Performed minor modifications on the WNaN radio to extend the frequency range for BOSS applications and enable BOSS to be used with a wider range of signals of interest.
- Optimized BOSS software as necessary for use with WNaN radios.
- Began embedding the BOSS algorithms into radios for real-time testing and evaluation.
- Evaluated network understanding algorithms with collected RF data.

FY 2011 Plans:

Brood of Spectrum Supremacy (BOSS)

Exhibit R-2A, RDT&E Project Justification: PB 2012 Defense Advanced Research Projects Agency		DATE: February 2011
APPROPRIATION/BUDGET ACTIVITY 0400: *Research, Development, Test & Evaluation, Defense-Wide* BA 2: *Applied Research*	R-1 ITEM NOMENCLATURE PE 0602304E: *COGNITIVE COMPUTING SYSTEMS*	PROJECT COG-03: *COLLECTIVE COGNITIVE SYSTEMS AND INTERFACES*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
- Complete implementation of BOSS capabilities utilizing WNaN radios with BOSS frequencies. - Test and evaluate BOSS in "real-world" scenarios including test and evaluation of real-time RF geolocation and network understanding performance.			
Title: Advanced Soldier Sensor Information System and Technology (ASSIST) ***Description:*** The Advanced Soldier Sensor Information System and Technology (ASSIST) effort will develop an integrated information system that exploits soldier-worn sensors to augment the soldier's ability to capture, report, and share information in the field. This includes an integrated system using advanced technologies for processing, digitizing and analyzing information captured and collected by soldier-worn sensors. ASSIST draws heavily on the experiences and lessons learned from previous Operation Iraqi Freedom (OIF) missions and other surveillance and reconnaissance missions. A baseline system will demonstrate the capture of video/still images together with voice annotations and location-stamping. The advanced system will demonstrate automatic identification and extraction of key objects, events, activities and scenes from soldier-collected data. The system will create knowledge representations that will serve as an input to an array of warfighter products including augmented maps, situational analysis tools, and query and answer capabilities. ***FY 2010 Accomplishments:*** - Developed the means for efficient transfer of ASSIST information across Army tactical networks. - Integrated with Army battlefield command systems by addressing system latencies and data exchange formats and modalities. - Demonstrated an accelerated capability for recognizing new classes of events, objects and activities. - Integrated biometric feature extraction and comparison capabilities into Tactical Ground Reporting System (TIGR). ***FY 2011 Plans:*** - Automate the extraction of relevant portions of feeds for indexing into the TIGR database. - Integrate multiple, real-time sensor feeds including high-bandwidth sensor feeds such as video streams. - Implement robust operation over wireless networks of very limited bandwidth. - Develop real-time collaboration tools for dismounted soldiers.	9.450	2.000	-
Title: Cloud Computing ***Description:*** Cloud Computing explored techniques to enable information, applications, services, storage, and other resources that reside on military networks to be used by web-based clients to perform critical mission functions. The Cloud Computing program created architectures to automatically integrate distributed information bases for broad tactical battlespace awareness and produced the infrastructure and application technologies needed to automate the integration of multiple media (text, video, and digital photographs) as well as its analysis, indexing, and storage.	6.720	-	-

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
The Digital Object Storage and Retrieval (DOSR) effort pursued a network-based approach to information storage and management that will enable a network-based repository to hold all digital information. DOSR technology enables and facilitates controlled access to information by approved and authenticated users across administrative domains, and in this fashion it will enable transparent sharing of information across the enterprise. The Data Integration and Exploitation SystEm that Learns (DIESEL) effort addressed a significant problem facing the warfighter: the lack of interoperability of stovepiped information systems. DIESEL created a new suite of intelligent information integration tools that automatically understand heterogeneous information systems and integrate them into the existing information environment. The result is more complete and reliable information for better decision-making by warfighters. ***FY 2010 Accomplishments:*** Digital Object Storage and Retrieval (DOSR) - Completed final assessment of architectural approaches to secure controlled access. Data Integration and Exploitation SystEm that Learns (DIESEL) - Completed study to identify and understand user models based on the task to be performed (aided by the Army's Tactics, Techniques, and Procedures manuals), which will provide semantic context to refine search results. - Prototyped techniques to integrate with existing automated visualization services to provide 'at a glance' understanding of relevant content, customized to the user and task. - Designed an automated data integration technology through tests with realistic military information systems and a variety of new data sources of increasing complexity.			
Accomplishments/Planned Programs Subtotals	48.029	48.000	37.691

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.