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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 2007	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Network-Centric Warfare Technology PE 0603766E				
COST (In Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total Program Element (PE) Cost	120.486	163.755	151.641	181.971	229.066	222.904	228.322	200.066
Joint Warfare Systems NET-01	38.173	68.084	78.993	89.656	139.657	143.657	143.657	143.657
Maritime Systems NET-02	27.714	34.753	22.770	40.205	33.839	33.839	32.095	3.839
Classified NET-CLS	54.599	60.918	49.878	52.110	55.570	45.408	52.570	52.570

(U) Mission Description:

(U) The Network-Centric Warfare Technology program element is budgeted in the Advanced Technology Development budget activity because it addresses high payoff opportunities to develop and rapidly mature advanced technologies and systems required for today's network-centric warfare concepts. It is imperative for the future of the U.S. forces to operate flawlessly with each other, regardless of which Services and systems are involved in any particular mission. The overarching goal of this program element is to enable technologies at all levels, regardless of Service component, to operate as one system.

(U) The objective of the Joint Warfare Systems project is to create enabling technologies for seamless joint operations, from strategic planning to tactical and urban operations. Joint Warfare Systems leverage current and emerging network, robotic, and information technology and provide next generation U.S. forces with greatly expanded capability, lethality, and rapid responsiveness. Critical issues facing this project are: (1) U.S. opponents utilizing systems that are flexible, robust, and difficult to neutralize; and (2) U.S. doctrine that limits the use of firepower to lessen the impact of operations on noncombatants. These problems are magnified in urban and semi-urban areas where combatants and civilians are often colocated, and in peacekeeping operations where combatants and civilians are often indistinguishable. Meeting these challenges places a heavy burden on joint war planning. Understanding opponent networks is essential so that creative options can be developed to counter their strategies. Synchronization of air and ground operations to apply force only where needed and with specific effects is required.

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(U) The Maritime Systems project will identify, develop and rapidly mature critical advanced technologies and system concepts for the naval forces' role in today's network centric warfare concept. Naval forces play an ever-increasing role in network centric warfare because of their forward deployed nature, their unique capability to operate simultaneously in the air, on the sea and under the sea and their versatile ability to provide both rapid strike and project sustained force. The technologies developed under this project will capitalize on these attributes, improve them and enable them to operate with other network centric forces.

(U) <u>Program Change Summary:</u> <i>(In Millions)</i>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Previous President's Budget	134.944	174.276	178.032	170.066
Current Budget	120.486	163.755	151.641	181.971
Total Adjustments	-14.458	-10.521	-26.391	11.905
 Congressional project reductions	 -11.000	 -10.521		
Congressional increases	0.000			
Reprogrammings	0.000			
SBIR/STTR transfer	-3.458			

(U) Change Summary Explanation:

FY 2006	The decrease reflects the SBIR/STTR transfer and the Section 8040 rescission.
FY 2007	The decrease reflects congressional cuts to Network Command, Network Centric Logistics, FOX, PUCS, and a reduction for Section 8106 Economic Assumptions.
FY 2008	The decrease reflects program repricing in the Joint Warfare Systems project, repricing of various programs funded in the Mobile Undersea Distributed Systems program, and reductions to classified programs.

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FY 2009

Increase reflects additional support for the design and development of a large scale shaftless propulsion submarine demonstrator for the Tango Bravo Program.

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COST (In Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Joint Warfare Systems NET-01	38.173	68.084	78.993	89.656	139.657	143.657	143.657	143.657

(U) Mission Description:

(U) The objective of the Joint Warfare Systems project is to create enabling technologies for seamless joint operations, from strategic planning to tactical and urban operations. Joint Warfare Systems leverage current and emerging network, robotic, and information technology and provide next generation U.S. forces with greatly expanded capability, lethality, and rapid responsiveness. Critical issues facing this project are: (1) U.S. opponents using systems that are flexible, robust, and difficult to neutralize; and (2) U.S. doctrine that limits the use of firepower to lessen the impact of operations on noncombatants. These problems are magnified in urban and semi-urban areas where combatants and civilians are often colocated, and in peacekeeping operations where combatants and civilians are often indistinguishable. Meeting these challenges places a heavy burden on joint war planning. Understanding opponent networks is essential so that creative options can be developed to counter their strategies. Synchronization of air and ground operations to apply force only where needed and with specific effects is required. This project supports all levels of the force structure including: (1) the strategic/operational level by generating targeting options against opponents' centers of gravity that have complex networked relationships; (2) the tactical/operational level by managing highly automated forces with tight coupling between air and ground platforms; and (3) the focused tactical level by developing platforms, which acquire targets of opportunity, cuing network-based analysis of likely enemy operations and developing warfighter tools, thus maximizing the presence of ground forces in stability and support operational environments.

(U) Program Accomplishments/Planned Programs:

	FY 2006	FY 2007	FY 2008	FY 2009
Network Command	11.646	13.216	13.393	14.000

(U) The Network Command program leverages recent advances in network computing to dramatically improve collaboration among physically separate command posts. The program allows commanders and their staffs to share situation information, develop coordinated battle plans, generate and compare alternate courses of action, and assess likely outcomes, without conventional group briefings. Network Command

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builds on the paradigm established by the Command Post of the Future program, which demonstrated to commanders, working with voice-over IP and robust graphical collaboration software, a coherent understanding of a situation and operational plan without any face-to-face interactions.

- The Network-Centric Situation Assessment program develops and deploys technologies to assess military situations at levels of interest above individual targets. The program uses all-source data to reconstruct unit organizations, mission relationships, logistics connections, and communications connectivity and analyzes data over time to infer movement, communication, and supply patterns. Within this context, capability analyses are provided and future courses of action are hypothesized. The objective is to understand potential capabilities and intentions of opposing forces. This effort provides greater understanding of opponents' force structures, capabilities, and operational practices, and then enables commanders to sustain effects-based targeting rather than simple attrition strategies. The program provides a context for discovering vulnerabilities in opposing forces and provides cues for intelligence, surveillance, and reconnaissance planning, as it suggests areas of future enemy activity that merit intense scrutiny. Technologies are planned to transition to the U.S. Army Distributed Common Ground Station.
- The Joint Mission Rehearsal program integrates high-fidelity; mainframe-based combat simulations with situation assessment and planning tools. The objective is to allow rehearsal of joint missions, while participants are en route to operations or remain at their home stations. The program uses current situation data to: (1) provide initial conditions for the simulations, and (2) plan data to steer the dynamics of the simulations along the selected courses of action. The technology streams data from the simulations for display, then visualization systems are available to the prospective participants. The visualization permits the warfighter to interact with the simulation in a manner consistent with their anticipated role in the mission being rehearsed. The program delivers the capability to practice and fine-tune mission plans for joint military operations and enables commanders and staff to participate from their current location instead of a training facility, thereby reducing deployment needs while improving mission planning and effectiveness. Technologies are planned to transition to the U.S. Army Simulation, Training & Instrumentation Command.
- The Decision-Directed Design and Adaptive Management program will develop a set of tools to adjust information flows within a Command Post of the Future (CPoF) enterprise to match the evolving needs of its operational users. Tools will be developed to analyze, in real time, command structures for critical functions, relations and information flow. These will continually monitor, adjust and estimate performance of the command structure with respect to process allocation and relations, and information sharing. They will provide real

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time support to modify the responsibilities, relations, tasks priorities and information sharing to meet a dynamic set of command needs across multiple units, echelons, and organizations.

(U) Program Plans:

- Network-Centric Situation Assessment
 - Identify data fields available to a representative theater commander.
 - Apply advanced link-analysis and pattern-matching technology to tactical data.
 - Evaluate technologies using real-world data.
- Joint Mission Rehearsal
 - Enhance existing mission simulations to require “red cell and white cell” participants.
 - Develop tools to rapidly assemble new mission scenarios from existing data sources.
 - Develop techniques to infer data needed by the simulations.
- Decision-Directed Design and Adaptive Management
 - Extend and develop emerging computational techniques for analysis and estimation of quality of organizational performance as a function of task assignments and information flows.
 - Develop tools to predict performance based on current organizational structure and expected additional tasks.
 - Design and execute a series of realistic wargame-based experiments to exercise those tools and validate their technical assumptions.
 - Integrate tools into the CPoF infrastructure and transition to the Army.

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	FY 2006	FY 2007	FY 2008	FY 2009
Precision Urban Combat Systems (PUCS)	5.243	10.665	14.600	17.000

(U) The Precision Urban Combat Systems (PUCS) program is developing and validating advanced sensor, exploitation, networking, and battle management capabilities for joint dismounted forces in urban combat. The program includes detection and tracking of potential enemy targets, discrimination and identification of friendly versus enemy units, sorting of enemy from neutral and non-combatant personnel, coordination of sensing, maneuver, and fires, and continuous assessment of results. PUCS will utilize technologies including: smart networks of distributed imaging and non-imaging sensors; sensors with the capability to detect hidden human targets; improved 3D visualization systems, and multi-spectral discrimination systems that survey the battlefield for weapon activity and detect primary signatures. These capabilities will be developed within the framework of both legacy forces and expected future forces. The program will provide a set of prototype demonstrations of the capabilities in surrogate urban combat environments. Technologies are planned to transition to the U.S. Special Operations Command.

- The Smart Dust Sensor Networks Applied to Urban Area Operations program will provide persistent staring reconnaissance, surveillance, and target acquisition of the three-dimensional urban battlespace using a dense network of ground sensors. The system concept consists of ubiquitous and inconspicuous low-power, small and easily concealed ground sensors distributed throughout the urban landscape. The program includes the development of ultra small sensor nodes for easy deployment and concealment in a crowded urban environment and data fusion algorithms to exploit the abundance of new information provided by a dense urban spatial network. The program will create a self organizing system that will integrate and exploit reliable networks of low-cost, small, and long-lifetime sensor nodes providing the capability for monitoring secured areas (e.g., buildings) and providing situational awareness to warfighters (e.g., checkpoints and sniper fire), and intelligence applications such as wide-area persistent surveillance of roadways and major arteries (e.g., for Improvised Explosive Devices (IED) emplacement), perimeters, and even city wide areas. The program technologies will transition to the Army.
- The Networked Acoustic-Visual Imaging System (NAVIS) (formerly Head Mounted Alerting for Urban Operations) program will develop a networked weapon fire detection system using infrared sensor imagery fused with acoustic sensor information for precise localization of the source of weapon fire. The NAVIS system is a soldier-borne sensor array that moves with the dismounted unit, continually adapting to the dynamic threat situation in urban operations. The system exploits all available infrared and acoustic event data and correlates all

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observables from a multi-sensor, multi-node, networked array to minimize false alarms and maximize accuracy. The challenge of this initiative is to provide a moving networked sensor array, borne by dismounted warfighters, with near real-time visualization of the fused firing event data for immediate response and accurate pointing.

- The Exploiting Vibrations to Monitor Activities in Buildings program will develop procedures and sensors to characterize activity inside structures based on acoustic/seismic information. The types of information sought include number and location of personnel, foot traffic, operation of building mechanicals (ventilation, cooling, and heating; plumbing; etc.) as an indicator of human activity, operation of other machinery, door openings and closings, and speech. Algorithms that infer internal layout of the building from the pattern and location of these activities will be investigated along with the fusing of the information from other surveillance information gained by other sensing modalities.
- The Total RF Detection and Ranging (TORDAR) program will address radar deficiencies due to discontinuous bandwidth: reduced range coverage, denial in certain geographic regions, interoperability issues, and reduced range resolution. This will involve a system-wide redesign of radar optimized over the full RF spectrum, not individual stove-piped tasks. It will include the integration of sparse bandwidth returns (including passive signals of opportunity), adaptive transmitter and waveform diversity, and agile frequency diverse hardware. It will also use all RF and radar resources more intelligently to fill gaps in knowledge as opposed to re-deriving situational awareness with every new radar processing interval. This capability will facilitate both manned and unmanned airborne Intelligence, Surveillance and Reconnaissance (ISR).
- The Urban Ops Hopper program will develop a semi-autonomous hybrid hopping/articulated wheeled robotic platform that could adapt to the urban environment in real-time and provide both surgical lethality and/or ISR to any point of the urban jungle while remaining lightweight, small and expendable to minimize the burden on the soldier. In general, small robots or unmanned ground vehicles (UGV) are severely limited by obstacle negotiation capability. The demonstrated hopping capability allows small UGVs to overcome obstacles 40-60 times their own size. Hopping will extend robot navigation to six degree-of-freedom situational location and mapping. Hopping mobility can be shown to be 5 times more efficient than hovering for obstacles at heights less than or equal to 10 meters. The proposed hopping robot would be truly multi-functional in that it will negotiate all aspects of the urban battlefield to deliver ISR and/or lethal payloads to non-line-of-sight targets with precision. The articulated wheel design allows the robot to negotiate short range obstacles for precision placement in difficult terrain.

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(U) Program Plans:

- Smart Dust Sensor Networks Applied to Urban Area Operations
 - Develop miniaturized sensors based on Network Embedded Systems Technology (NEST) concept.
 - Develop and demonstrate technologies to separate targets from background.
 - Develop battlefield activity alert logic.
 - Conduct demonstration at a representative MOUT site.
- Networked, Acoustic-Visual Imaging Systems (NAVIS)
 - Develop dynamic network sensor processing algorithms.
 - Develop fusion emulator for post processing data analysis.
 - Conduct testing and data collection under controlled motion conditions and various conditions.
 - Develop brassboard processor with sensor and fusion processing algorithms.
 - Conduct live-fire testing under controlled motion conditions in realistic urban conditions.
 - Develop real-time fusion and visualization software.
 - Design and develop a man-wearable NAVIS prototype.
- Exploiting Vibrations to Monitor Activities in Building
 - Collect acoustic/seismic data from a set of sample buildings.
 - Develop and demonstrate technologies to separate targets from background and summarize activity.
 - Demonstrate at a representative MOUT site.
- Total RF Detection and Ranging (TORDAR)
 - Develop conceptual design and algorithm requirements of spectrum utilization approaches.
 - Demonstrate spectrum utilization approaches with ground based sensing architectures.
 - Develop airborne demonstration.

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- Urban Ops Hopper
 - Demonstrated required hop height and length to meet current urban combat obstacle clearance.
 - Develop 3D ISR obstacle detection, classification, and mapping tools for an unknown environment.
 - Develop precision hopping through restricted pathways to include windows and stair wells.
 - Evaluate technologies in a real-world environment.

	FY 2006	FY 2007	FY 2008	FY 2009
Effects Based Network Targeting	2.723	4.500	5.000	8.000

(U) The Effects Based Network Targeting program is developing technology to identify, determine vulnerabilities, target, and anticipate workarounds in enemy networks. These techniques use all-source information to continuously update models of urban networks. Using the models, operational objectives for urban interventions, expressed in terms of desired and undesired effects will be generated. The technology will then use these objectives to find vulnerabilities in the networks, nominating targets for prosecution to maximize desired effects while minimizing undesired effects. Further, the program will develop techniques for predicting those observables that will rapidly identify an opponent's response when several courses of action are available. In particular, the program will focus on radio frequency networks: identifying transmitters, receivers, and links between them. The program will apply advanced beam forming technologies to provide co-channel interference cancellation for densely deployed cellular telephone or WiFi services in an urban environment. From this understanding of the network topology, courses of action for precision jamming or flooding attacks can be assessed, including determination of effects on downstream components (subscribers to the network). Technologies are planned to transition to the U.S. Strategic Command.

(U) Program Plans:

- Develop tools to: (1) extract relevant information from source data (especially signals, text, and imagery); (2) correlate that information to existing models; (3) update the models while resolving conflicts among sources; and (4) analyze the overall effect of newly discovered changes.
- Conduct measurements of various signals of interest under a set of geometric conditions, which span the range of potential surveillance system employments.

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- Develop and evaluate algorithms for signal geolocation and copy over a range of interference conditions.
- Complete a Preliminary Design Review (PDR) for a demonstration sensor system.
- Develop concepts for operation and identify transition opportunities.
- Design tools to analyze networks, singly and in combination, in order to identify vulnerabilities to predict effects of candidate interdiction.
- Demonstrate selected tools on real-world cases, validating against historical and natural situations.

	FY 2006	FY 2007	FY 2008	FY 2009
Confirmatory Hunter Killer System - CCLR	5.928	6.481	7.000	6.000

(U) The Confirmatory Hunter-Killer System program is developing a low cost expendable loitering weapon/unmanned air vehicle for deployment in urban environments. The program is developing a hand-held, tube-launched, fiber-optic guided, loitering munition suitable for non-line-of-sight (NLOS) target prosecution by individual warfighters in urban environments. It will be an agile NLOS weapon that extends the warfighters' zone of engagement from 200 meters line-of-sight to 2000 meters NLOS. The guided munition will be capable of striking targets from significantly expanded avenues of approach, e.g. over the tops of buildings and around corners, at a distance of up to 10 blocks depending on the specific terrain and building features. A variant capability would include an ultra light designating and ranging system that could be mounted into an organic UAV and remotely piloted by ground crews. This system will develop a highly efficient prototype designating/ranging laser and advanced software needed to integrate into pointing and tracking equipment, and communication and control instrumentation. This program is planned for transition to the Army in 2012.

(U) Program Plans:

- Conduct concept feasibility though analysis and modeling of the designator laser.
- Design and build prototype designator laser with electronics board sufficient to drive laser.
- Develop and demonstrate tracking and communication and control instrumentation.
- Construct prototype vehicles and conduct field flight tests.

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	FY 2006	FY 2007	FY 2008	FY 2009
Sensing and Patrolling Enablers Yielding Enhanced Security (SPEYES)	4.633	7.010	10.000	10.000

(U) The Sensing and Patrolling Enablers Yielding Enhanced Security (SPEYES) program provides technologies for Stability and Support Operations (SASO) to enhance the capabilities of our current ground forces in Iraq and Afghanistan. The first program phase evaluates and inserts mature advanced ground-based C3I technologies for three problem areas (Fixed Site Security, Patrolling, and Cordon & Search), seeking to effect a significant force-multiplier improvement through transformational Tactics, Techniques, and Procedures (TTPs). Key Component Technologies include: 1) WASP Micro UAV, 2) Eye Ball R1 Throwable Camera, 3) Leave Behind Intrusion Detection Sensor, 4) SPEYES Handheld PDA Device, and 5) Vehicle Weight Analysis Software and Video/EOD Underbody Sniffers. Later program phases will develop technology to enable mobile HUMINT collection and real-time data analysis to support dismounted soldier patrolling urban areas. The program will include (1) networked mobile devices for collecting HUMINT, communicating new information to a local headquarters, and displaying analysis of the newly collected data; (2) headquarters-level automated real-time analysis of the current state of the observed network to identify gaps in the knowledge base, provide information on the individuals a patrol is interviewing, and generate additional information requests. The technology is planned for transition to the Army and Marine Corps.

(U) Program Plans:

- Develop/procure prototypes of selected SPEYES technologies.
- Plan, conduct, and evaluate appropriate training events with selected Marine and Army deploying units to determine employment CONOPS.
- Following ruggedization of selected prototypes, provide deployable technology for movement to theater.
- Develop new technologies and a system architecture to support real-time HUMINT collection and analysis.
- Develop simulation test bed to evaluate selected network algorithms.
- Design, conduct and analyze field experiments using test bed and National Training Center at Ft. Irwin.
- Evaluate system functions for both individual and staff level functions in culturally specific environments at the National Training Center.

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	FY 2006	FY 2007	FY 2008	FY 2009
Multi Dimensional Mobility Robot (MDMR)	8.000	10.240	5.000	2.000

(U) The MDMR program will investigate concepts using serpentine mobility to achieve new ground robot capabilities for search and rescue applications. The MDMR system will navigate complex urban terrain and provide the operator with real time images of its environment. Examples of the capability include: overcoming obstacles that are a significant fraction of its length, crossing slippery surfaces, ascending poles, and climbing steep slopes. The MDMR platform will be able to support a variety of search missions in hazardous environments such as urban rubble piles. To achieve such a degree of mobility, design concepts must address system challenges such as: on board power management; situational awareness; complex terrain navigation; and system controls. The technology is planned for transition to USSOCOM.

- (U) Program Plans:
- Demonstrate serpentine mobility from a base level approach.
 - Integrate the robotic system and user interface control.
 - Develop and test tele-operation control.
 - Perform rigorous testing to characterize system performance and spiral new technology developments into the existing platform.
 - Develop and test sensors suitable for integration onto the serpentine platform.
 - Transition platform to search and rescue users and demonstrate new capabilities.

	FY 2006	FY 2007	FY 2008	FY 2009
Human-carried Explosive Detection Stand-off System (HEDSS)	0.000	4.000	5.000	7.000

(U) Insurgent and terrorist elements are increasingly relying on human carried explosives because they are nearly impossible to visibly detect. The goal of the Human-carried Explosive Detection Stand-off System (HEDSS) program is to develop a system that can rapidly identify human-carried explosives (HCEs) at a stand-off range between 50 and 150 meters. While alternative technologies exist for HCE detection, they necessitate close-in sensing, are expensive and require extended processing times. Successful development of a HEDSS with detection ranges of

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50 – 150 m will provide reliable protection for deployed forces from suicide bombers by allowing enough time and space to interdict bombers before they cause maximum damage. The technology is planned for transition to the Army and Marine Corps.

(U) Program Plans:

- Conduct proof-of-concept experiments and perform system level analysis designed to validate key technical assumptions and identify major system design parameters.
- Design components and system.
- Build and integrate system and conduct lab experimentation.
- Conduct extensive field testing of the system under realistic threat conditions.

	FY 2006	FY 2007	FY 2008	FY 2009
Federated Object-level Exploitation (FOX)	0.000	7.000	11.000	12.656

(U) The Federated Object-level Exploitation (FOX) thrust will provide a new set of geospatial intelligence products, continuously updated and maintained in a form that ensures their consistency across both product elements (digital elevation models, traditional maps, 3D structure models, census summaries, and directories) and spatial nodes (coarse resolution country data for economic analysis to fine resolution building data for platoon-level combat operations). Included programs will combine techniques including model-based image analysis (both object recognizers and change detectors), symbolic correlators (both temporal and spatial), and emerging cognitive methods to identify changes to objects, addresses, names, and functions of natural and man-made structures. These algorithms will be scaled to operate on data streams including full-motion video, ladar, text, and tabular data, in addition to conventional geospatial imagery. Federated algorithm architectures will be explored to achieve scalability through spatial, temporal and ontological partitioning. FOX technologies are planned for transition to the National Geospatial-Intelligence Agency.

- The Auto Metadata Extractions effort will build a system to automatically (with no man-in-the-loop) extract metadata from terabytes of multi-sensor imagery and signals per day. Extracted metadata will include both platform generated information (classical metadata) and algorithmically extracted features and internals. The extracted metadata will be (a) produced in a unified framework, and (b) sufficiently

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semantically rich to support both semantic information fusion and development of multi-dimensional predictive models. The system will provide all of the fundamental extracted data required for advanced exploitation technology development.

- The Exploitation Language Technology for GeoINT program will build a system to extract and linguistically confirm terms and labels of geographic significance from graphical, textual and audio sources. The program will develop the technology to associate and verify the extracted information against features extracted from imagery. Both extraction and association will be performed against and across multiple languages. A major effort will be made to develop necessary database and query technology to support a wide range of GeoINT specific concepts, e.g., feature classes, complex distance calculations, and boundaries.
- The All Things Repository effort will develop a system capable of ingesting 400 terabytes of multi-sensor all-source imagery, Moving Target Indicator (MTI) and signals per day. The program will build a fully automated metadata and features extraction framework to process all incoming data, and develop the distributed very-large database technologies required to provide both the raw sensor data and extracted features data to a multi-level exploitation user community, both human users and automated agents. Work-flow aware data transformation, data aggregation and data caching technologies will be developed to rapidly provide the user with access to the correct subset of the data rapidly and at appropriate bandwidth.

(U) Program Plans:

- Auto Metadata Extractions
 - Develop a unified processing infrastructure for the generation of metadata from all-source data.
 - Demonstrate a unified semantic representation of metadata generated from all-source data.
 - Demonstrate the collection/conversion of platform generated metadata into the unified representation.
 - Demonstrate generation of metadata from all-source imagery and signals into unified representation.
 - Demonstrate generation of metadata from fusion of prior metadata into unified representation.
- Exploitation Language Technology for GeoINT
 - Demonstrate extraction of geographic terms, (e.g., city names, and their association with geolocations from textual and graphical sources).
 - Develop a multi-lingual ontology of geographic language.

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- Demonstration extraction of geographic language from graphical, textual and audio sources.
- Demonstrate multi-lingual queries of geographic language from a large collection of extracted terms.
- All Things Repository
 - Demonstrate a multi-source co-registered database over a village sized site.
 - Demonstrate unified access in a single query to multiple spatial and temporal data types.
 - Demonstrate incorporation of automated feature extraction into high volume data flow.
 - Experimentally determine where data volume causes system failures.
 - Demonstrate solutions to very large data volume induced failures.
 - Demonstrate data selection and summarization based on prior work-flows and access.

	FY 2006	FY 2007	FY 2008	FY 2009
Seismic/Acoustic Vibration Imaging (SAVI)	0.000	4.972	6.000	8.000

(U) The Seismic/Acoustic Vibration Imaging program will develop the capability to locate both near-surface tunnels and landmines with active seismic and acoustic sources. These systems will employ well characterized seismic and acoustic sources to stimulate the targets of interest from a remote platform. The interaction of the near surface seismic waves with tunnels and other objects will be observed with a multi-pixel laser interferometer system and used to assess the depth and extent of the targets in the midst of natural and man-made clutter. Similarly, focused acoustic sources will be employed to remotely stimulate plastic or metal antipersonnel and antitank mines. A laser interferometer system will be used to detect the resonant characteristics of the mines to discriminate against natural sources of clutter. The systems developed under this effort will be tested against a wide variety of soil types and environments to support operations under a wide range of conditions. Upon successful development of the initial and objective systems, the capabilities will be transitioned to the Army and Marine ground forces for the development and employment of operational systems starting in FY 2011.

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- (U) Program Plans:
- Develop conceptual system designs meeting objective system performance.
 - Initiate and demonstrate the technologies required for the laser interferometer system, including the sources and sensors, as well as the mobile seismic and directional acoustic sources.
 - Develop and demonstrate a scalable brassboard system for mobile operations.
 - Scale the system to form-factored prototype and verify performance.
 - Transition systems technology to Army and Marines for incorporation into future force structures.

	FY 2006	FY 2007	FY 2008	FY 2009
Quarantine Toxic UAV Payloads	0.000	0.000	2.000	5.000

(U) The Quarantine Toxic UAV Payloads program will develop a system which can safely and effectively sequester (entomb) toxic chemical and biological agent payloads located on hostile force unmanned aerial vehicles. While technology for detection, tracking, and destruction of these platforms exists, the destruction step is problematic since the process can inadvertently disperse the toxic agent over the intended (or other) targets. A means for safely, effectively, and inexpensively sequestering chemical payloads, and transporting these payloads to the ground, is a critical need. This program focuses on the development of a system, which integrates the tracking and detection capabilities with gentle methods of entombment (i.e., quarantine) of the active agent. Such methods include use of rapidly expanding polymer foams or rheology-changing fluids, which form a rugged, impermeable cocoon that effectively isolates the agent (or the entire vehicle) from the environment. Alternative methods, including collecting the agent into a trap, are also possible. Significant technical obstacles include achieving rapid and complete encapsulation (or entrapment), robustness toward countermeasures (including on-board explosives), and the gentle transport of the encapsulated package to the ground. Potential transition targets include SOCOM, Army, and Marines.

- (U) Program Plans:
- Develop strategies and system architecture for entombment of UAV-borne chemical and biological agents.
 - Develop materials and delivery techniques.
 - Perform laboratory and field tests to demonstrate system capabilities.

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(U) **Other Program Funding Summary Cost:**

- Not Applicable.

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COST (In Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Maritime Systems NET-02	27.714	34.753	22.770	40.205	33.839	33.839	32.095	3.839

(U) Mission Description:

(U) The objective of the Maritime Systems project is to identify, develop and rapidly mature critical advanced technologies and system concepts for the naval forces' role in today's network centric warfare concept. Improvements in communications between and among submarines, surface ships and naval aircraft have allowed these forces to operate seamlessly with each other and with other Service's network centric systems. Naval forces will play an ever-increasing role in network centric warfare because of their forward deployed nature, their unique capability to operate simultaneously in the air, on the sea and under the sea and their versatile ability to provide both rapid strike and project-sustained force. The technologies developed under this project will capitalize on these attributes, improve them and enable them to operate with other network centric forces. This project funds the Mobile Undersea Distributed System (MUDS) program, the Jet Blast Deflector program, the Non-Linear Dynamics for Anti-Submarine Warfare (ASW), and the Tango Bravo technology demonstration program.

(U) Program Accomplishments/Planned Programs:

	FY 2006	FY 2007	FY 2008	FY 2009
Mobile Undersea Distributed Systems (MUDS) Program	13.714	16.753	4.365	4.000

(U) The Mobile Undersea Distributed System (MUDS) program goal is to enhance operations in the littorals to counter asymmetric threats posed by diesel submarines and other forces operating in the littorals, by distributing countering capabilities throughout a complimentary and networked system of sensors and platforms. The network-centric MUDS program includes the Persistent Ocean Surveillance effort, Warfighting in the Littoral effort, the Aluminum Combustor effort, and the River Eye effort.

(U) The Persistent Ocean Surveillance program combined geolocation techniques such as the global positioning system with station keeping and intra-sensor communication technologies to provide long-term station keeping ocean environment sensing buoys. These technologies, when applied with state-of-the-art undersea warfare sensors, have resulted in a floating field of smart sensors capable of observing the undersea

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environment in an area, including the presence of submarines and other undersea vehicles. A range of technologies have been considered including those that rely on the local environment (such as wind, ocean waves, solar energy, temperature differentials, etc.) for their power, miniature geolocation technologies, and technologies for sensor data storage, transmission, and intra-field communications. Persistent Ocean Surveillance-Station Keeping technology is planned for transition to the Navy.

(U) The Aluminum Combustor program seeks to develop an energy-dense air-independent underwater power source as a potential propulsion system for underwater vehicles. This program will optimize the design for a small combustor and develop the auxiliary power system components needed to control and sustain operations. In addition to the combustor, the aluminum fuel feed subsystem, aluminum-steam separator subsystem; and closed loop control subsystem will be designed, built, and tested and integrated with a turbine in order to successfully demonstrate a power system in a laboratory environment. The Aluminum Combustor technology is anticipated to transition to the Navy.

(U) Early entry maritime forces need maps of morphology, water depths, and currents in complex riverine/estuarine environments for mission planning and execution. This information is critical for route planning, sensor placement, rendezvous determination, vulnerability assessments, and for determining objective assault engagement/disengagement strategies. For uncharted and/or denied areas, present methods are inadequate for obtaining the necessary information. Reliable remote sensing methods do not exist that produce bathymetry and water current data in waters that are sediment laden (bottom is not visible) and/or sheltered (swell and significant wind waves are not likely). The River Eye effort will provide a new capability to predict or assess, in real time, river and estuary conditions to enable special operations mission planning and execution. New techniques will be developed to indirectly determine current speed and direction by remotely sensing advection of scene features. Using advanced modeling techniques, indirectly sensed current data will be used to extract bathymetry data. Forward circulation models will use the bathymetry data to predict future currents and water heights in a mission planning decision support tool. The River Eye effort is anticipated to transition to the Navy and National Geospatial-Intelligence Agency in FY 2010.

(U) Program Plans:

- Mobile Undersea Distributed Systems
 - Continue investigation into novel communications and networking concepts.
 - Explore concepts to reduce platform infrastructure and, ultimately, the cost of future design and production of submarines.

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- Persistent Ocean Surveillance
 - Completed initial 24-hour sea test successfully demonstrating station keeping technologies in two system configurations.
 - Completed design concepts for harvesting energy from the local environment and assessed buoy performance using simulation.
 - Explored the scientific/engineering issues associated with station keeping.
 - Develop energy harvesting technologies and test in laboratory.
 - Integrate energy harvesting technologies with station keeping technologies and demonstrate at sea.
 - Demonstrated feasibility of using nanofluidic technology with moving magnets in linear generated configuration to harvest wave energy.
 - Characterized ferrofluidic material and developed electromagnetic models.
 - Develop a long endurance tactical sized ocean surveillance buoy using exploitable local environmental effects for station keeping.
 - Demonstrate performance at sea.
 - Develop wave energy harvesting applications and test at sea.
- Aluminum Combustor
 - Designed and fabricated the low Hp combustor, aluminum fuel feed subsystem, aluminum-steam separator subsystem; and closed loop control subsystem.
 - Commenced integration of the power system in the laboratory.
 - Design a long endurance aluminum fuel feed subsystem.
- River Eye
 - Completed analysis on existing circulation models to determine model sensitivity to bathymetry, winds, and fresh water inflow.
 - Revised the Concept of Operations for data collection.
 - Conduct airborne data collections in well-mixed, instrumented estuary.
 - Develop image processing algorithms for extracting circulation currents.
 - Develop inverse model for extracting bathymetry from indirectly sensed currents.
 - Conduct instrumented data collections in a new environment and evaluate performance.
 - Refine and tune algorithms for extracting circulation currents and bathymetry in more complex environments.

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- Conduct real time at sea demonstration.

	FY 2006	FY 2007	FY 2008	FY 2009
Jet Blast Deflector	1.000	1.000	1.000	1.000

(U) The Jet Blast Deflector program is an outgrowth of the DARPA structural materials program funded in PE 0602715E. The program will use multifunctional materials to construct a passively cooled jet blast deflection that increases reliability and meets weight reduction requirements for current and future classes of aircraft carriers. A Memorandum of Agreement was signed (January 2004) with the Navy's PEO (Aircraft Carriers) that agreed to, based on a successful sub-scale concept demonstration during FY 2005, full scale demonstration of prototype panel performance at Naval Air Warfare Center, Aircraft Division Lakehurst and a use decision for CVN21.

(U) Program Plans:

- Demonstrate that multifunctional materials can reduce weight by over 50% and will save operations and support costs by 26%.
- Test and validate performance and savings.

	FY 2006	FY 2007	FY 2008	FY 2009
Tango Bravo	10.500	17.000	17.405	35.205

(U) Based on the results of the DARPA/Navy Submarine Design Study, the Tango Bravo technology demonstration program is exploring design options for a reduced-size submarine with equivalent capability of the VIRGINIA Class submarine. The implicit goal of this program is to reduce platform infrastructure and, ultimately, the cost of future design and production of submarines. The program is a collaborative effort to overcome selected technological barriers that are judged to have a significant impact on submarine platform infrastructure cost. DARPA and the Navy, under Memorandum of Agreement, jointly formulated technical objectives for critical technology demonstrations in: (1) shaftless propulsion, (2) external weapons stowage and launch, (3) conformal alternatives to the existing spherical sonar array, (4) radical ship infrastructure reduction technologies that eliminate or substantially simplify hull, mechanical and electrical systems, and, (5) automated attack center technologies to reduce crew manning.

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(U) Following success of shaftless propulsion technologies demonstrated in the Tango Bravo program, DARPA and the U.S. Navy will design, build, and test a large scale Shaftless Propulsion Submarine Demonstrator to characterize and mitigate risks associated with ship integration into a next generation submarine propulsion option. The Demonstrator will be built to the minimum scale necessary to extrapolate hydrodynamics, powering, and acoustics to full-scale performance. The most cost effective technical approach to developing the demonstrator design will be considered, including the modification of existing sub-scale submarines, while preserving the technical validity of the design features.

(U) Elements of the Tango Bravo program will begin transition to the Navy in FY 2009, with full transition anticipated at the conclusion of the Shaftless Propulsion Submarine Demonstration in FY 2011.

(U) Program Plans:

- Tango Bravo
 - Develop shaftless propulsion concepts and demonstrate required technologies at an appropriate scale to validate key aspects such as system size and weight, propulsive efficiency, and acoustic and electromagnetic signatures, including predictive capability.
 - Develop external weapons stowage and launch concepts and conduct an integrated demonstration of the critical technologies required to meet launch hydrodynamics requirements while providing a safe stowage environment for a Mk48 ADCAP torpedo outside the pressure hull.
 - Investigate maintenance and health issues associated with prolonged weapon stowage away from manned access.
 - Analyze modeling to evaluate acoustic and shock performance requirements.
 - Develop and demonstrate a radical ship infrastructure reduction concept that relies on electric actuation of the rudder and stern planes instead of traditional hydraulic- mechanical movement of the ship's control surfaces.
- Shaftless Propulsion Submarine Demonstrator
 - Perform design studies and computational analysis to establish critical design parameters.
 - Develop demonstrator designs and assess build alternatives; select demonstrator design.
 - Perform subsystem testing and analysis.
 - Build demonstrator.
 - Demonstrate hydrodynamic and powering performance.
 - Demonstrate acoustic performance.

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	FY 2006	FY 2007	FY 2008	FY 2009
Non-Linear Dynamics for ASW	2.500	0.000	0.000	0.000

(U) The field of nonlinear dynamics has matured sufficiently to allow applications to nonlinear and non-stationary signal processing problems. Nonlinear beamforming approaches will be applied to the Navy's Advanced Extended Echo Ranging (AEER) airborne Anti Submarine Warfare (ASW) concept to enhance the effectiveness of active acoustics in the littoral ASW environment by improving the ability to detect weak signals in the presence of noise, interference, and reverberation.

- (U) Program Plans:
- Developed system requirements for the nonlinear Air Deployable Active Receiver (ADAR) beamformer.
 - Developed analytical formulation of the nonlinear ADAR beamformer array dynamics.
 - Developed high fidelity time series simulation data for evaluating nonlinear beamformer performance.
 - Developed quantitative assessment of potential improvement for realistic environments.

(U) **Other Program Funding Summary Cost:**

- Not Applicable.

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