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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE February 2008	
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 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total Program Element (PE) Cost	137.063	150.677	156.733	220.952	206.504	206.362	210.068
Joint Warfare Systems NET-01	46.792	75.093	69.133	54.954	56.124	58.105	61.076
Maritime Systems NET-02	25.853	25.706	30.471	61.083	63.238	61.511	62.247
Classified NET-CLS	64.418	49.878	57.129	104.915	87.142	86.746	86.745

(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 collocated, 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.

(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

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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 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Previous President's Budget	163.755	151.641	181.971
	Current Budget	137.063	150.677	156.733
	Total Adjustments	-26.692	-0.964	-25.238
	Congressional project reductions	-22.500	-0.964	
	Congressional increases	0.000		
	Reprogrammings	0.000		
	SBIR/STTR transfer	-4.192		

(U)	<u>Change Summary Explanation:</u>	
FY 2007	Decrease reflects the Section 8043 Recission and the SBIR/STTR transfer.	
FY 2008	Decrease reflects reductions for Section 8097 Contractor Efficiencies and Section 8104 Economic Assumptions.	
FY 2009	Decrease reflects program completion of Quarantine Toxic UAV Payloads, Confirmatory Hunter Killer System, and Urban Operations Hopper in Project NET-01 and rephasing of the Tango Bravo program to MOA requirements in Project NET-02.	

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COST (In Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Joint Warfare Systems NET-01	46.792	75.093	69.133	54.954	56.124	58.105	61.076

(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 co-located, 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 2007	FY 2008	FY 2009
Federated Object-level Exploitation (FOX)	7.000	11.000	18.456

(U) The Federated Object-level Exploitation (FOX) thrust will provide a new set of geospatial intelligence (GeoINT) products, continuously updated and maintained in a form that ensures their consistency across both product elements (digital elevation models, traditional maps, 3-D structure models, census summaries, and directories) and spatial nodes (coarse resolution country data for economic analysis to fine resolution

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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 (1) produced in a unified framework, and (2) sufficiently 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.

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(U) Program Plans:

- Auto Metadata Extractions
FY 2007 Accomplishments:
 - Demonstrated processing infrastructure to automatically index all-source imagery.FY 2008 Plans:
 - Demonstrate assimilation of location, shape and class data into unified representation.FY 2009 Plans:
 - Demonstrate temporal queries of geospatial data.
- Exploitation Language Technology for GeoINT
FY 2008 Plans:
 - Preliminary design review of prototype.FY 2009 Plans:
 - Demonstrate dynamic extraction of urban geospatial information from available documents.
- All Things Repository
FY 2007 Accomplishments:
 - Initiated concept development review.FY 2008 Plans:
 - Demonstrate Rapid Archive Geospatial Data.FY 2009 Plans:
 - Demonstrate integration with imaging intelligence products.

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		FY 2007	FY 2008
Network Command		9.197	9.393
			8.000

(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 builds on the paradigm established by the Command Post of the Future program, which demonstrated to commanders, working with voice-over-internet protocol (VOIP) 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

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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.

(U) Program Plans:

- Network-Centric Situation Assessment
FY 2007 Accomplishments:
 - Identified data fields available to a representative theater commander.
FY 2008 Plans:
 - Evaluate technologies using real-world data.
FY 2009 Plans:
 - Transition software components to U.S. Army Distributed Common Ground System.

- Joint Mission Rehearsal
FY 2007 Accomplishments:
 - Identified testbed and avatar requirements.
FY 2008 Plans:
 - Demonstrate insertion of moving avatars into Helmet Mounted Display.
FY 2009 Plans:
 - Demonstration of dynamic avatar simulation insertion in Army Training Exercise.

	FY 2007	FY 2008	FY 2009
Precision Urban Combat Systems (PUCS)	7.665	6.400	6.000

(U) The Precision Urban Combat Systems (PUCS), including the Remote Detection of Suspicious Vehicles (RDSV) programs are developing and validating advanced sensor, exploitation, networking, and battle management capabilities for joint dismounted forces in urban combat. These programs include 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 and RDSV will utilize technologies including: smart networks of distributed imaging and non-imaging sensors; sensors with the capability to detect

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hidden human targets; improved 3-Dimensional (3-D) 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 and the Marines.

- The Smart Dust Sensor Networks Applied to Urban Area Operations program will provide persistent staring reconnaissance, surveillance, and target acquisition of the 3-D 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 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.

- (U) Program Plans:
- Smart Dust Sensor Networks Applied to Urban Area Operations
FY 2007 Accomplishments:
 - Prototyped miniaturized sensors based on dense ground sensor concept.
 - Developed self organizing network algorithms.
 - Estimated precise node locations and orientations.

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FY 2008 Plans:

- Complete algorithm evaluations and down select.
- Demonstrate key performance parameters in field tests.

- Exploiting Vibrations to Monitor Activities in Building

FY 2007 Accomplishments:

- Collected acoustic/seismic data from a set of sample buildings.

FY 2008 Plans:

- Develop and evaluate candidate algorithms and down select.

FY 2009 Plans:

- Develop and demonstrate technologies to separate targets from background.
- Demonstrate at a representative military base.

	FY 2007	FY 2008	FY 2009
Urban Ops Hopper*	3.000	4.200	0.000

*Previously this was part of PUCS.

(U) 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 Intelligence, Surveillance, and Reconnaissance (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 40x-60x their own size. Hopping will extend robot navigation to six degrees-of-freedom situational location and mapping. Hopping mobility can be shown to be five times more efficient than hovering for obstacles at heights less than or equal to ten 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. This program will transition to Special Operation Forces in FY 2009.

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- (U) Program Plans:
FY 2007 Accomplishments:
- Demonstrated required hop height and length to meet current urban combat obstacle clearance.
 - Demonstrated autonomous navigation in urban environment using baseline sensor suite.
- FY 2008 Plans:
- Develop 3-D ISR obstacle detection, classification, and mapping tools for an unknown environment.
 - Demonstrate autonomous navigation in urban environment using upgraded sensor suite.
 - Develop precision hopping through restricted pathways to include windows and stairwells.
 - Demonstrate precision hopping using upgraded mechanical articulated wheel design.
 - Evaluate technologies in various Military Operations on Urban Terrain (MOUT) facilities.

	FY 2007	FY 2008	FY 2009
Multipath Exploitation Radar (MER)*	0.000	4.000	8.000

*Previously funded as the Total RF Detection and Ranging (TORDAR) system as part of PUCS.

(U) The Multipath Exploitation Radar (MER) 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. Another key area that can be exploited is urban multipath. This program will exploit multipath bounces to detect and track moving targets within urban canyons, and extend the area coverage rate of airborne sensors by a factor of ten or more over physical line-of-sight limits. If successful, the urban coverage improvement will make it cost effective to consider airborne surveillance of an area the size of a large metropolitan area with a handful of airborne sensors. This capability will facilitate both manned and unmanned airborne Intelligence, Surveillance and Reconnaissance (ISR) and is planned to transition to the Air Force and Army in 2011.

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- (U) Program Plans:
- FY 2008 Plans:
- Develop improved tracking concepts to exploit multipath signatures in improving target localization and tracking.
 - Demonstrate vehicle detection using urban multipath to extend radar sensing range in urban environment by a factor of three beyond line of sight limitations.
- FY 2009 Plans:
- Perform passive bistatic measurements using common RF transmissions as radar signals of opportunity.
 - Demonstrate urban clutter nulling capabilities from both stationary and moving airborne collections.
 - Demonstrate factor of ten improvement in urban tracking using multipath radar.
 - Perform measurements using integrated passive/active radar architecture.
 - Develop urban tracking algorithms exploiting urban multipath.
- FY 2009 Plans:
- Develop persistent wide-area surveillance architecture for large metropolitan areas.

	FY 2007	FY 2008	FY 2009
Multi Dimensional Mobility Robot (MDMR)	5.240	5.000	1.000

(U) The Multi Dimensional Mobility Robot (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, climbing steep slopes, and optically sensing its immediate surroundings. 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 SOCOM.

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- (U) Program Plans:
FY 2007 Accomplishments:
– Demonstrated serpentine mobility from a base level approach.
FY 2008 Plans:
– Develop smaller, more maneuverable serpentine platform.
– Develop and test tele-operation control.
– Develop and test sensors for integration onto the serpentine platform.
– Perform rigorous testing to characterize system performance.
FY 2009 Plans:
– Demonstrate and transition system to search and rescue users.

	FY 2007	FY 2008	FY 2009
Seismic/Acoustic Vibration Imaging (SAVI)	4.972	12.000	12.206

(U) The Seismic/Acoustic Vibration Imaging (SAVI) 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:
- FY 2007 Accomplishments:
- Completed analysis of potential system requirements suited to meet the objectives of the mobile landmine and tunnel detection missions from a sensitivity and area search rate perspective.
 - Initiated development of active acoustic sources for landmines, active seismic sources for tunnels, and multi-pixel laser vibrometer with variable field-of-regard used to make measurements.
- FY 2008 Plans:
- Complete the preliminary reviews for the scalable system meeting the initial sensitivity and search rate objectives.
 - 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.
 - Complete the operationally relevant test scenario for scalable system demonstration.
 - Determine location for outdoor-scaled system demonstration and initiation of site preparation.
- FY 2009 Plans:
- Complete the development of the component technologies required by the scalable system demonstration.
 - Complete an outdoor demonstration of the active acoustic landmine detection and active seismic tunnel detection coupled with the scalable multi-pixel laser vibrometer system.
 - Initiate the development of the scalable brassboard system for mobile operations.
 - Scale the system to form-factored prototype and verify performance at suitable outdoor ranges.

	FY 2007	FY 2008	FY 2009
Human-carried Explosive Detection Stand-off System (HEDSS)	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 (m). 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 Marines.

- (U) Program Plans:
- FY 2007 Accomplishments:
- Conducted proof-of-concept experiments and performed system level analysis designed to validate key technical assumptions and identify major system design parameters.
- FY 2008 Plans:
- Design prototype system.
 - Build and integrate system and conduct lab experimentation.
- FY 2009 Plans:
- Conduct extensive field-testing of the system under expanded threat conditions.

	FY 2007	FY 2008	FY 2009
Sensing and Patrolling Enablers Yielding Enhanced Security (SPEYES)	1.237	4.100	0.000

(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 and real-time data analysis to support dismounted soldier patrolling urban areas. The program will include (1) networked mobile devices, 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, and generate additional information requests. Elements of the technology are under consideration for transition to the Army and Marines.

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- (U) Program Plans:
- FY 2007 Accomplishments:
- Integrated three devices on a common wireless network.
 - Selected and demonstrated handheld computing device as an integration platform.
 - Completed extensive training and deployment to Afghanistan.
- FY 2008 Plans:
- Define system requirements.
 - Develop and test system components.

	FY 2007	FY 2008	FY 2009
Effects Based Network Targeting	3.500	5.000	5.471

(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:
- FY 2007 Accomplishments:
- Demonstrated feasibility in naval tactical wargame.

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FY 2008 Plans:

- Demonstrate tools to analyze single networks.

FY 2009 Plans:

- Demonstrate tools to analyze combinations of networks, simulated inputs.

	FY 2007	FY 2008	FY 2009
Confirmatory Hunter Killer System - CCLR	0.981	7.000	1.000

(U) The Confirmatory Hunter Killer System - CCLR 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 ten blocks depending on the specific terrain and building features. This program is planned for transition to the Army in 2008.

(U) Program Plans:

FY 2007 Accomplishments:

- Developed a tube-launched, compact, precision munition with warfighter-in-loop targeting and control via fiber optic link.
- Conducted risk reduction component tests.
- Verified launch, cruise and terminal mode performance.
- Conducted integrated system flight tests.

FY 2008 Plans:

- Perform risk reduction flight test.

FY 2009 Plans:

- Transition program to the Army.

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	FY 2007	FY 2008	FY 2009
Legged Squad Support System (LS3)	0.000	0.000	2.000

(U) The Legged Squad Support System (LS³) program will explore the development of a mission-relevant tetrapod platform scaled to unburden the infantry squad and hence unburden the soldier. Soldiers in current operations carry upwards of 50lbs of equipment and in some cases 100lbs, over long distances and in terrain not always accessible by wheeled platforms that support infantry. As a result, the soldier's combat effectiveness can be compromised. LS³ will leverage technical breakthroughs of prior biologically inspired legged platform development efforts. It will develop system designs to the scale and performance adequate for infantry squad mission applications, focusing on endurance, payload, terrain negotiation, and human-machine interaction capabilities, as well as secondary design considerations, such as acoustic signature. Multiple technical approaches will be explored, including electromechanical and hydraulic methods of legged actuation. Anticipated service users include the Army, Marines and Special Forces.

- (U) Program Plans:
FY 2009 Plans:
– Develop, analyze and assess initial Legged Squad Support System preliminary designs.

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

(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. Potential transition targets include SOCOM, Army, and Marines.

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- (U) Program Plans:
FY 2008 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.

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

- Not Applicable.

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COST (In Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Maritime Systems NET-02	25.853	25.706	30.471	61.083	63.238	61.511	62.247

(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.

(U) Program Accomplishments/Planned Programs:

	FY 2007	FY 2008	FY 2009
Persistent Ocean Surveillance (includes Surface Wave Harvesting)*	5.904	3.463	2.250

*Previously funded under Mobile Undersea Distributed Systems (MUDS).

(U) The Persistent Ocean Surveillance program combines 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, will result in a floating field of smart sensors capable of observing the undersea 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 in late FY 2009.

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- (U) Program Plans:
- FY 2007 Accomplishments:
- Completed design concepts for harvesting energy from the local environment and assessed buoy performance using simulation.
 - Completed design for packaged configuration and deployment sequence.
 - Developed energy harvesting technologies and conducted engineering tests.
 - Demonstrated feasibility of using nanofluidic technology with moving magnets in a linear generator to harvest wave energy.
 - Characterized ferrofluidic material and developed electromagnetic models.
- FY 2008 Plans:
- Integrate energy harvesting technologies with station keeping technologies and conduct demonstration/test at sea.
 - Perform trade-off analysis to determine buoy sensor payload for persistent ocean surveillance demonstration in fleet exercise.
 - Conduct at-sea testing to demonstrate persistence and survivability.
 - Identify payload package of high utility to the Navy and commence integration into the station keeping buoy.
- FY 2009 Plans:
- Conduct demonstration of persistent ocean surveillance with a sensor payload package of high utility to the Navy.

	FY 2007	FY 2008	FY 2009
Aluminum Combuster*	2.392	1.359	2.500

*Previously funded under Mobile Undersea Distributed Systems (MUDS).

(U) The Aluminum Combustor program seeks to develop an energy-dense air-independent underwater power source as a propulsion system for future naval undersea warfare systems. This program will optimize the design for a small aluminum combustor, silane fuel treatment process, 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 integrated with a turbine in order to successfully demonstrate a power system in a laboratory environment. Upon successful completion of the laboratory tests, DARPA will investigate novel naval applications for an energy dense air independent propulsion system. The power system will then be integrated into a Navy submersible and tested at sea. The Aluminum Combustor technology is anticipated to transition to the Navy in FY 2011.

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- (U) Program Plans:
- FY 2007 Accomplishments:
- 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.
 - Designed a long endurance aluminum fuel feed subsystem.
- FY 2008 Plans:
- Develop and optimize silane fuel treatment protocol to improve operating characteristics of the aluminum combustor.
 - Investigate novel naval applications.
- FY 2009 Plans:
- Modify or redesign the components from the laboratory Aluminum Combustor Power System for use in a UUV.
 - Integrate and test the components as a system in the laboratory.

	FY 2007	FY 2008	FY 2009
River Eye*	4.557	2.950	2.000

*Previously funded under Mobile Undersea Distributed Systems (MUDS).

(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 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.

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- (U) Program Plans:
- FY 2007 Accomplishments:
- Conducted airborne and satellite data collections in well-mixed, instrumented estuary.
 - Developed image-processing algorithms for extracting circulation currents.
- FY 2008 Plans:
- Develop a simulation/model inputting simple idealized bathymetries to generate a circulation field and an inverse model that used the circulation field as an input parameter and calculated the bathymetry.
 - Conduct instrumented data collections in a new environment and evaluate performance.
 - Conduct additional instrumented data collections to evaluate the performance of an initial inverse model.
- FY 2009 Plans:
- Continue development of the inverse model for extracting bathymetry from indirectly sensed currents.
 - Refine and tune algorithms for extracting circulation currents and bathymetry in more complex environments.

	FY 2007	FY 2008	FY 2009
Jet Blast Deflector (JBD)	1.000	0.000	0.000

(U) The Jet Blast Deflector (JBD) program used multifunctional materials developed under the DARPA Structural Material Program (PE 0602715E) to construct a passively cooled jet blast deflection that increased reliability and met weight reduction requirements for current and future classes of aircraft carriers.

- (U) Program Plans:
- FY 2007 Accomplishments:
- Demonstrated operation under damaged conditions.
 - Proved that the passively cooled JBD could exploit the flow from the aircraft engines to induce sufficient ambient air-flow to remove all heat and to return the JBD to the Navy-specified maximum temperature.
 - Proved that structurally the passive JBD could withstand the loads from an aircraft landing on a single wheel with a flat tire (worst case scenario).

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		FY 2007	FY 2008
Tango Bravo		12.000	17.934
		FY 2009	20.721

(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 and infrastructure cost. DARPA and the Navy, under a 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.

(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 Submarine Shaftless Stern 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 large-scale submarines.

(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 Submarine Shaftless Stern Demonstration in FY 2013.

(U) Program Plans:

FY 2007 Accomplishments:

- Completed detail design review and final design review of the medium-scale Integrated Motor Propulsor and Drive (IMPd) shaftless propulsion concept.
- Completed 1/12 full scale (model scale) hydrodynamic and hydro-acoustic testing of the shaftless propulsion propulsor in the forty-eight inch water tunnel.
- Completed the shaftless propulsion motor drive breadboard testing and initiated fabrication of the medium scale drive and controller.

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- Completed design, fabrication, and land-based testing of the External Weapons Stowage and Launch full-scale system.
 - Completed the Radical Ship Infrastructure Reduction project (Electric Actuation of Stern Planes and Rudder), including satisfactory demonstration of criteria (static load performance, range of motion, rate of motion, and bearing shock tests).
 - Completed fabrication of the full-scale electric actuator and controller/drive in preparation for actuator dynamic testing.
- FY 2008 Plans:
- Complete shaftless propulsion component fabrication (motor propulsor, duct, and structure.).
 - Complete the propulsion plant cost model to demonstrate the Shaftless Propulsion concept reduces submarine construction costs.
 - Evaluate Shaftless Propulsion criteria for continuation with the program, an eighteen-month effort that includes demonstrator assembly and integration followed by thorough in-water system testing.
 - Conduct concept studies for the Submarine Shaftless Stern Demonstration.
 - Assess programmatic and technical trade-offs to determine the optimum platform for the Submarine Shaftless Stern Demonstration.
 - Complete the External Weapons Stowage and Launch project by conducting full-scale, test depth, weapons launch testing.
 - Conduct weapon load/reload demonstration.
 - Complete the Radical Ship Infrastructure Reduction project by conducting testing of the electric actuator, including approximately one million full cycles of the actuator under representative at-sea dynamic loadings and pressures.
- FY 2009 Plans:
- Complete Shaftless Propulsion integrated system testing.
 - Perform design studies and computational analysis to establish critical design parameters for the Submarine Shaftless Stern Demonstration.

	FY 2007	FY 2008	FY 2009
Sea Shield	0.000	0.000	3.000

(U) The Sea Shield program will develop an extensible automated battle management (ABM) capability to provide persistent surveillance and targeting coverage to protect naval battle groups against overwhelming threats. Sea Shield will extend area protection 50-fold using layered and distributed sensing and targeting, through developing and implementing air, sea and subsurface autonomous, collaborative and self-healing sensor networks. The ABM system will enable timely and coordinated decision-making information and situational awareness for the commander. Sea

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Shield will enable intelligent deployment of shield sensors and network infrastructures, to protect Sea-Base assets, through effective cross-platform and multi-mission resource management, and distributed weapons coordination for increased raid size and heterogeneous threat types. Sea Shield will also enable the Sea-Base to decouple intelligence, surveillance, and reconnaissance/defense missions from offensive missions improving the power projection capability of the deployed force.

- (U) Program Plans:
FY 2009 Plans:
- Develop ABM technologies for detection, classification, localization, tracking and optimized engagement of sea-skimming cruise missiles.
 - Develop ABM for antisubmarine warfare.
 - Assess effectiveness of ABM component technologies through modeling and simulation.
 - Begin integration of mature components for subsystem test and evaluation.

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

- Not Applicable.

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