Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Defense Advanced Research Projects Agency	Date: February 2015
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
Total Program Element	-	261.613	360.426	452.861	-	452.861	470.582	407.944	407.772	405.418	-	-
NET-01: *JOINT WARFARE SYSTEMS*	-	37.273	43.828	61.787	-	61.787	100.520	129.808	187.094	195.117	-	-
NET-02: *MARITIME SYSTEMS*	-	44.975	86.120	113.868	-	113.868	105.062	107.802	141.344	151.301	-	-
NET-06: *NETWORK-CENTRIC WARFARE TECHNOLOGY*	-	179.365	230.478	277.206	-	277.206	265.000	170.334	79.334	59.000	-	-

A. Mission Description and Budget Item Justification

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.

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.

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. 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Defense Advanced Research Projects Agency	Date: February 2015
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603766E *I NETWORK-CENTRIC WARFARE TECHNOLOGY*

B. Program Change Summary ($ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	259.006	386.926	390.744	-	390.744
Current President's Budget	261.613	360.426	452.861	-	452.861
Total Adjustments	2.607	-26.500	62.117	-	62.117
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-26.500			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	9.863	-			
• SBIR/STTR Transfer	-7.256	-			
• TotalOtherAdjustments	-	-	62.117	-	62.117

Change Summary Explanation

FY 2014: Increase reflects reprogrammings offset by the SBIR/STTR transfer.

FY 2015: Decrease reflects congressional reduction.

FY 2016: Increase reflects expanded maritime systems efforts and an increase in classified programs.

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency			Date: February 2015
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	Project (Number/Name) NET-01 / *JOINT WARFARE SYSTEMS*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
NET-01: *JOINT WARFARE SYSTEMS*	-	37.273	43.828	61.787	-	61.787	100.520	129.808	187.094	195.117	-	-

A. Mission Description and Budget Item Justification

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 increased 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 and tools, which acquire targets of opportunity and cue network-based analysis of likely enemy operations thus maximizing the effectiveness of ground forces in stability and support operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: System of Systems Architecture, Technology Development, and Demonstration	-	15.000	34.986
Description: The System of Systems Architecture, Technology Development, and Demonstration program seeks to implement an architecture framework capable of assessing and demonstrating potential operational benefits of integrating various system capabilities to improve mission success in contested environments. Such assessments would optimize system-level trades of requirements and architectures to properly leverage an integrated set of system characteristics and capabilities. The demonstration assessment metrics will measure individual and combined system performance to further streamline resource allocation to maximize operational impact. In addition, providing a modeling and simulation (M&S) environment to assess complex systems will enable greater utility of emerging system technologies, since they can be assessed in near-real-world simulations without the real-world costs of testing fully integrated systems. The program will also develop system synthesis and integration technologies that enable rapid assimilation of new and off-the-shelf technologies into the system of systems architecture. These technologies will break down current barriers to entry that new technologies face in system of systems using formal methods, compositional reasoning, and automated design space exploration. Technologies from this program will be transitioned to the Services.			
FY 2015 Plans: - Develop reference objective system of systems architecture.			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-01 / *JOINT WARFARE SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Develop architecture demonstration plan, including range and platform options. - Implement M&S capabilities for architecture design analysis and validation. - Develop a System Integration Laboratory (SIL) to support government verification and validation of system of systems architectures. - Commence the development of system of systems synthesis and integration tools and protocols. - Commence development of engineering tools to validate system of system architecture designs. - Commence development of formal verification techniques to validate integration of constituent systems into a system of systems. - Investigate technologies to permit multi level security M&S. - Explore alternative systems architectures, designs, tools, and protocols for the maritime environment. ***FY 2016 Plans:*** - Complete the development of system of systems synthesis and integration tools and protocols. - Complete prototype architectures to implement the system of systems concept. - Initiate experimentation in constructive, virtual, and real-world environments to validate system of systems approach. - Assess in SIL the capability of new engineering tools to validate system of system architecture designs. - Assess in SIL the capability of new formal verification techniques to validate integration of constituent systems into a system of systems. - Verify prototype of system of systems architectures in the SIL. - Develop technologies to permit multi level security M&S. - Identify the most promising alternative systems architectures, designs, tools, and protocols for the maritime environment.			
Title: Resilient Synchronized Planning and Assessment for the Contested Environment (RSPACE)*	-	10.684	16.866
Description: *Formerly Integrated Planning for Strike, ISR, and Spectrum (IPSIS) Currently, Command and Control (C2) of air platforms is a highly centralized process operating largely independently across planning domains (intelligence, surveillance, and reconnaissance (ISR), strike, and spectrum management) and is optimized for a permissive environment. To address the challenges faced in today's increasingly contested environments, the Resilient Synchronized Planning and Assessment for the Contested Environment (RSPACE) program will develop tools to enable distribution of planning functions across the C2 hierarchy for resilience (e.g. loss of communications) while synchronizing strike, ISR, and spectrum planning to maximize the contribution of all assets through increased utilization and exploitation of synergies. The program will develop tools supporting a mixed initiative planning approach, maximizing automation according to operator's choice, and enabling human-in-the-loop intervention and modification. During execution, the tools will provide lifecycle tracking of targeting and information needs and support assessment of progress towards achieving the commander's intent. The tools will			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-01 / *JOINT WARFARE SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
dynamically respond as directed to ad hoc requests and significant plan deviations via a real-time dynamic replanning capability, and easily adapt to technology refreshes. The RSPACE tools will transition to the Air Force and the Navy. ***FY 2015 Plans:*** - Develop concept of operations (CONOPS) for an integrated strike, ISR, and spectrum management capability operating in an Air Operations Center (AOC). - Develop system architecture and software framework for integrated strike, ISR, and spectrum management to include planning, assessment, and dynamic replanning. - Develop models and simulation capability for testing, analysis, and validation of planning and assessment components. - Commence development of algorithms and prototypes for integrated planning and assessment components. ***FY 2016 Plans:*** - Complete development of algorithms and prototypes for integrated planning and assessment components. - Develop models and simulation capability for testing, analysis, and validation of integrated system. - Implement the framework designs into a software prototype. - Test and evaluate candidate software frameworks and components.			
Title: Retrodirective Arrays for Coherent Transmission (ReACT) ***Description:*** Worldwide advancements in signal processing and electronics have decreased the effectiveness of single-platform, power-based Electronic Warfare (EW) as a viable technique in the future. The goal of the Retrodirective Arrays for Coherent Transmission (ReACT) program is to develop and to demonstrate the capability to combine distributed mobile transmitters to provide high-power spatially resolved EW beams at frequencies utilized by adversary communications and radars. ReACT will achieve this capability by synchronizing multiple distributed transmitters to form a much larger effective array than a single platform could support. The key technical challenge is to synchronize distributed and moving transmitters while compensating for platform motion and vibration. Further, the ReACT system must sense the target's emissions and then optimally configure the ReACT transmitters to focus on the area to be jammed, as well as the minimum power required to sufficiently jam the target. The ReACT program builds upon technology developed under the Arrays at Commercial Timescales (ACT) program, which is budgeted in PE 0602716E, Project ELT-01, and will culminate with a flight demonstration of distributed EW beamforming. The ReACT technology is planned to transition to the Air Force and Navy. ***FY 2016 Plans:*** - Complete development of algorithms and hardware for coherent beamforming under mobile environments. - Design algorithms that target an adversary by their emissions. - Identify phenomenological barriers (frequency, motion, and vibration) and validate transition opportunities.	-	-	9.935

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-01 / *JOINT WARFARE SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Demonstrate system performance over-the-air in mobile ground environments at extended ranges, under operationally representative motion and vibration. - Integrate tracking algorithms for target motion preparing for ground-to-air demonstration of capability.			
Title: High Energy Liquid Laser Area Defense System (HELLADS)	26.673	14.144	-
Description: The goal of the HELLADS program is to develop a high-energy laser weapon system that will provide an order of magnitude reduction in weight compared to existing laser systems. HELLADS will enable high-energy lasers (HELs) to be integrated onto tactical aircraft and will significantly increase engagement ranges compared to ground-based systems, in addition to enabling high precision/low collateral damage and rapid engagement of fleeting targets for both offensive and defensive missions. Advancements in beam control and other subsystems that are required for the practical integration of a laser weapon into existing tactical platforms will be explored. With the assistance of the Services, the HELLADS program will pursue the necessary analysis, coordination, and design activity for a prototype laser weapon system incorporating the HELLADS laser system and the ABC turret into air-, ground-, or sea-based tactical vehicles. While the prototype laser weapon system module is in design and development, the HELLADS 150 kilowatt (kW) laser will be made available for demonstration opportunities and transition to the Army, Navy, or Air Force. ***FY 2014 Accomplishments:*** - Completed laboratory checkout and government acceptance of 150 kW laser; packaged laser and shipped for integration into the high power laser demonstrator system. - Continued risk reduction test of tracking systems for dynamic targets, demonstrated aim point accuracy to support lethal power delivery to test targets in representative battlefield environments. - Completed high power optics insertion, safety system checkouts, range communications protocol check, and initial high power static operation of laser weapon demonstrator to verify the laser and its subsystems can safely demonstrate lethal effects on mortars and rockets. - Commenced live fire tests against rocket and mortar fly-outs to demonstrate lethal laser power at mission-relevant ranges. - Completed preliminary design and detailed design of laser weapon module prototype's subsystems for integration on a specific air-, ground-, or sea-based tactical vehicle. ***FY 2015 Plans:*** - Complete live fire tests against rocket and mortar fly-outs to demonstrate lethal laser power at mission-relevant ranges. - Transport demonstrator laser from Army mission (rocket/mortar) relevant ground test site to mountain peak test site to mimic Air Force missions for precision air-to-ground and airborne self-defense demonstrations.			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-01 / *JOINT WARFARE SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Complete live fire target prosecution from mountain peak test site to demonstrate performance of laser weapon system in airborne missions, to include targeting of ground vehicles and self-defense against surface-to-air missiles.			
Title: Robotics Challenge ***Description:*** Advancements are being made in land-capable, high degree-of-freedom unmanned platforms to enable mobility over complex terrain. Many current prototypes are inspired by biological systems and while proof-of-principle systems have or are demonstrating unprecedented mobility, limitations have emerged. Advanced capabilities in perception, control, and physical capability/coordination are needed to work autonomously in human environments. These are critical enablers for performing mission-relevant tasks in austere and remote regions, partially-destroyed roads, high-threat anti-access/area denied environments, rubble-filled areas, and providing greater range/endurance for soldiers, platforms, and personnel. The Robotics Challenge program will boost innovation in autonomous systems and expand platform utility through enhanced actuation, energy density, perception, locomotion, agile reconfiguration, and design efficiency. Program thrusts are centered on a progressive regimen of physical problem solving, real-time team oriented tasks, and dynamic adaptation designed to build "machine trust", especially when integrated with humans in a variety of operational environments. The Robotics Challenge program consists of a series of obstacle course style challenge events that will focus on technology solutions to demonstrate and test robot capabilities for disaster response. Robotics Challenge events will drive advances in power systems, agility and speed, precision in perception tied to platform coordination, dexterity, and impulsive power. Program objectives focus on technologies to expand mobility and extend endurance of unmanned platforms, advanced tactile and manipulation capabilities, and tools for cost effective design, validation, and construction of autonomous technology, and human-robot interaction. The 6.2 portion of this program is budgeted in PE 0602702E Project TT-04. Anticipated Service users include the Army, Marines, and Special Forces. ***FY 2014 Accomplishments:*** - Coordinated Service participation in Robotics Challenge and applied simulation system to Service areas of interest. - Conducted DARPA Robotics Challenge Trials. - Extrapolated on and conducted further modeling and simulation of techniques and approaches for authentic applications with higher complexity. ***FY 2015 Plans:*** - Conduct DARPA Robotics Challenge Finals.	8.100	4.000	-
Title: Legged Squad Support System (LS3) ***Description:*** The Legged Squad Support System (LS3) program explored the development of a mission-relevant quadruped platform scaled to unburden the infantry squad and hence unburden the soldier. In current operations, soldiers carry upwards of 50lbs of equipment, in some cases over 100lbs, over long distances in terrain not always accessible by wheeled platforms that	2.500	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-01 / *JOINT WARFARE SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
support infantry. As a result, the soldier's combat effectiveness can be compromised. The LS3 program designed and developed technology demonstrators capable of carrying 400lbs of payload for 20 miles in 24 hours, negotiating terrain at endurance levels expected of typical squad maneuvers. LS3 leveraged technical breakthroughs of prior biologically inspired legged platform development efforts. It developed system designs to the scale and performance adequate for infantry squad mission applications, focusing on platform, control, and human-machine interaction capabilities, as well as secondary design considerations, such as acoustic signature. Anticipated Service users include the Army, Marines, and Special Forces. ***FY 2014 Accomplishments:*** - Supported and refined system prototypes. - Designed additional LS3 technology demonstrator to address novel approaches to energy consumption, increased survivability and reduced noise. - Participated in final demonstration activities in coordination with the U.S. Marine Corps. - Conducted endurance and reliability testing of final LS3 system.			
Accomplishments/Planned Programs Subtotals	37.273	43.828	61.787

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency			Date: February 2015
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	Project (Number/Name) NET-02 / *MARITIME SYSTEMS*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
NET-02: *MARITIME SYSTEMS*	-	44.975	86.120	113.868	-	113.868	105.062	107.802	141.344	151.301	-	-

A. Mission Description and Budget Item Justification

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Distributed Agile Submarine Hunting (DASH)	23.975	14.874	8.500

Description: The diesel-electric submarine is an asymmetric threat in terms of its cost and consequential growth in numbers relative to our legacy maritime platforms. In addition, these submarines have trended toward lower acoustic signature levels, and have grown in lethality. The Distributed Agile Submarine Hunting (DASH) program intends to reverse the asymmetric advantage of this threat through the development of advanced standoff sensing from unmanned systems. Deep-ocean sonar nodes will be developed to operate at significant depths in open ocean areas to achieve large fields of view to detect submarines overhead. Each deep node is the maritime equivalent of a satellite, and is referred to as a subullite. The significant field of view, along with the advantage of low-noise phenomena at extreme depths will permit a scalable number of collaborative sensor platforms to detect and track submarines over large areas. At-sea demonstrations have shown that the detection capability is achievable. The program will continue to develop prototype systems that will evolve through additional at-sea testing. These tests will demonstrate the ability to integrate into the Navy's undersea systems responsible for anti-submarine warfare (ASW). The program seeks to achieve breakthrough technology for long-range detection and classification, communications, energy management, sensor and platform integration, and robust semiautonomous processing and control for distributed sensing platforms. This program will transition to the Navy.

FY 2014 Accomplishments:
- Completed development of deep-sea prototypes system of distributed sonar nodes, both passive and active.
- Completed development of distributed multi-node communication network for connectivity between seafloor, surface, and shore or ship.
- Demonstrated extended remote monitoring capability of a passive sonar barrier network at sea.
- Demonstrated Unmanned Undersea Vehicle (UUV)-based active sonar in a deep-sea test showing target detection and tracking.

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-02 / *MARITIME SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Integrated technologies for autonomous, reliable, and secure undersea energy and data transfers to fixed and mobile undersea systems. ***FY 2015 Plans:*** - Design and develop longer-duration passive and active sonar nodes. - Conduct extended-duration sonar demonstrations at sea against a target. - Demonstrate connectivity from seafloor node to remote shore station. - Integrate distributed communications with Navy systems for data transfer and Command, Control, Communications, Computers, and Intelligence (C4I). - Initiate test planning for passive and active sonar sea test. - Explore alternative concepts of operations and modified architectures of DASH system for other applications. ***FY 2016 Plans:*** - Conduct at-sea demonstrations of a distributed deep-ocean passive sonar barrier using multiple nodes for extended duration. - Conduct at-sea demonstrations of a mobile active sonar node. - Perform data-driven signal processing development to improve automated sonar detection algorithms. - Provide analysis and data to support Navy utility assessments and studies to aid in transition.			
Title: Hydra ***Description:*** The Hydra program will develop and demonstrate advanced capabilities for the undersea deployment and employment of unique payloads. Hydra integrates existing and emerging technologies and the ability to be positioned in the littoral undersea battlespace to create a disruptive capability. The system consists of a modular enclosure with communications, command and control, energy storage, and standard interfaces for payload systems. The modular enclosures are deployed by various means, depending on the need for speed and stealth and remain deployed until awakened for employment. Hydra will develop critical enabling technologies for energy storage and recharging, communications, command and control, deployment, and autonomous operations. Technologies from this program will transition to the Navy. ***FY 2014 Accomplishments:*** - Conducted studies to refine the operational trade space, define limits of current technology, and develop new technical approaches. - Initiated concept designs for the modular enclosure and potential payloads. - Explored innovative approaches for key enabling technologies such as energy storage, communications, and deployment. - Conducted risk reduction of key enabling technologies. - Investigated deployment options and initiated system conceptual design. ***FY 2015 Plans:***	14.000	28.898	32.868

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-02 / *MARITIME SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Complete concept designs for the modular enclosure and potential payloads. - Begin development of a prototype modular enclosure. - Begin development of undersea and air vehicle payloads. - Demonstrate enabling technologies and subsystems. ***FY 2016 Plans:*** - Build and test prototype modular enclosure. - Complete critical design review for undersea payload. - Complete critical design review for air vehicle payload. - Conduct initial flight test of the air vehicle. - Demonstrate submerged payload launch capability.			
Title: Hybrid Multi Material Rotor Full Scale Demonstration	-	14.500	14.000
Description: The goal of the Hybrid Multi Material Rotor Full-Scale Demonstration (HyDem) program is to dramatically improve U.S. Navy submarine superiority. HyDem will apply breakthroughs in materials and material system technologies developed under the Hybrid Multi Material Rotor (HMMR) program budgeted in PE 0602715E, Project MBT-01, and multi-disciplinary design methods to a Virginia Class Submarine propulsor, a critical component in submarine performance. The U.S. Navy's ability to operate their submarine fleet with improved capability allows for the creation of strategic surprise. Submarines could exploit expanded areas which were previously unattainable for the purpose of submarine warfare, including antisubmarine warfare (ASW), antisurface warfare (ASuW), intelligence, surveillance and reconnaissance (ISR) gathering, strike, Special Forces operations, and strategic deterrence missions. The HyDem program will design, manufacture, and supply the Navy with a novel component for integration into a new construction Virginia Class Submarine. The Navy will evaluate this component in sea trials. It is envisioned that the Navy will integrate this design change into the future development of the Virginia Class and Ohio Replacement Submarines, and back-fit previously constructed Virginia Class Submarines. This program will transition to the Navy. ***FY 2015 Plans:*** - Conduct a Preliminary Design Review. - Complete manufacturing drawings and tooling. - Conduct a Critical Design Review. - Complete structural building block testing. - Complete shock building block testing. - Initiate manufacturing of the full-scale propulsor component to be installed on a Virginia Class submarine.			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-02 / *MARITIME SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Conduct a shock test of a large-scale model. ***FY 2016 Plans:*** - Complete manufacturing of the full-scale propulsor component. - Deliver full-scale propulsor component to the Navy for integration into a Virginia Class submarine. - Assess structural and shock qualification of the propulsor component. - Provide integration support for the propulsor component.			
Title: Tactical Undersea Network Architecture*	-	14.300	19.500
Description: *Formerly Undersea Architecture: Adaptive Infrastructure Systems fighting as a network are vulnerable to a loss of connectivity in a contested environment. This connectivity is important for synchronizing forces, establishing and maintaining situation awareness and control of remotely operated vehicles and systems. Additionally, undersea systems are challenged to maintain connectivity and must carry their own energy and operate over their design lifetime with little to no maintenance and repair. These factors inhibit their use in collaborative networks and prevent the full exploitation of the potential of undersea systems. By leveraging techniques explored under the Distributed Agile Submarine Hunting (DASH) program within Project NET-02, the Tactical Undersea Network Architecture program will overcome these limitations by developing the technologies necessary for autonomous, reliable, and secure undersea energy and data transfers; true plug, play, and operating standards; and rapid, cost effective deployment and sustainment technologies. The program will develop and demonstrate novel technology options and designs to temporarily restore connectivity for existing tactical data networks in contested environments using small diameter optical fiber and buoy relay nodes. The program will focus on innovative system architecture designs, lightweight optical fiber technologies, and rapidly deployable buoy node designs and component technologies. The Tactical Undersea Network Architecture program will emphasize early risk reduction with future scaled at-sea integrated demonstrations of increasing complexity. Program technologies will transition to the Navy. ***FY 2015 Plans:*** - Commence system architecture design trade studies, modeling and simulation. - Commence small lightweight optical fiber development and fiber performance testing. - Assess system deployment and sustainment options; develop cost model. - Develop system component-level technologies and commence scaled component-level testing. ***FY 2016 Plans:*** - Complete system architecture design trade studies and preliminary design reviews. - Continue fiber performance testing; demonstrate fiber survivability under at-sea conditions. - Complete component-level testing.			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-02 / *MARITIME SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Commence prototype system design and sea test planning.			
Title: Blue Wolf ***Description:*** Undersea platforms have inherent operational and tactical advantages such as stealth and surprise. Platform drag due to fluid viscosity and platform powering requirements varies with the speed through the water. Platform energy and power density limitations create two distinct operational usage profiles: one for unmanned undersea vehicles (low speed, long endurance) and another for undersea weapons (high speed, short endurance). Designers have historically solved this with hybrid systems such as the Navy's Vertical Launch Anti-Submarine Rocket, or by increasing the size of undersea systems. However, hybrid systems can be vulnerable to air and undersea defensive systems and larger undersea systems can result in significant launch platform modifications. The Blue Wolf program seeks to provide a radically different solution by leveraging the powering and performance results from the previously funded Super-Fast Submerged Transport program, PE 0602702E, Project TT-03, to develop and demonstrate an undersea demonstrator vehicle with endurance and speed capabilities beyond conventional undersea systems within the weight and volume envelopes of current Navy undersea systems. Significant technical challenges to be addressed include: integration of reliable undersea connectivity, autonomy, guidance, and navigation; obstacle avoidance; and propulsion and energy systems compatible with existing manned platform safety requirements. The program will culminate in a series of at-sea demonstrations and will transition to the Navy. ***FY 2015 Plans:*** - Commence platform and module design and technology assessments and system safety and effectiveness modeling. - Establish baseline test platform architecture and conduct initial check-out testing. - Conduct system performance modeling and simulation and small scale laboratory trials. - Commence design safety certification test planning. ***FY 2016 Plans:*** - Commence sub-system hardware and software testing and module integration. - Update system performance models and conduct initial at-sea testing. - Commence safety certifications and testing.	-	13.548	16.000
Title: Long-Range Undersea Navigation ***Description:*** The Long-Range Undersea Navigation program will provide continuous, GPS-level positioning accuracy to submarines and autonomous undersea vehicles (AUVs) in long-range ocean basins over extended periods of time. Undersea navigation cannot use GPS because the water blocks its signals. At shallower depths, masts can be raised to receive GPS signals, but masts present a detection risk. Typically, the alternative to GPS for undersea navigation has been inertial navigation	-	-	12.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-02 / *MARITIME SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
systems (INS), but INS accuracy can degrade unacceptably over time. Building upon concepts explored under the Distributed Agile Submarine Hunting (DASH) program within Project NET-02 and the Upward Falling Payloads program, PE 0602702E, Project TT-03 the Long-Range Undersea Navigation program will distribute a small number of acoustic sources, analogous to GPS satellites, around the ocean basin. A submarine or AUV will be equipped with an acoustic receiver and appropriate software in order to obtain, maintain, and re-acquire, if lost, an initial location. By transmitting specific acoustic waveforms and developing accurate acoustic propagation models to predict and interpret the complex arrival structure of the acoustic sources, the submarine or AUV can determine its range from each source and thus triangulate its position. Technologies developed under this program will transition to the Navy. ***FY 2016 Plans:*** - Develop signal waveforms and preliminary designs for signal transmitters and receivers. - Develop the system concept of operations. - Conduct at-sea experiments to validate analysis using a single source/receiver pair at basin-scale range to measure signal tracking accuracy and stability as well as signal acquisition techniques.			
Title: Multi-Axis Protection of Surface Ships ***Description:*** The anti-ship cruise missile (ASCM) is a growing asymmetric threat to U.S. naval combatants, force projection, and defense of the sea lanes of communications missions. Threat ASCM capabilities and lethality are rapidly improving with extended range, higher speeds, and advancing sophistication in navigation and targeting subsystems. In addition, these weapon systems are being proliferated in greater numbers to adversarial nations with options for submarine deployment. Submarine-launched ASCMs pose an even greater challenge to our Anti-Submarine Warfare (ASW) systems as they expand search area requirement proportional to the square of the cruise missile range. The Multi-Axis Protection of Surface Ships program intends to reverse the asymmetric advantage of these threats through the development of advanced offboard sensing from unmanned systems. These multi-spectral mobile and autonomous sensor systems will operate at significant offboard ranges from maritime battle groups to provide tactically significant early warning of cruise missile attacks. The effort is focused on achieving new detection modalities with sufficient low power, weight, and size (SWaP), to enable unmanned vessel implementations. Initial efforts will focus on identifying the best detection methods and sensor modalities leveraged from state-of-the-art sensors and new physical and operational insights. Provided compelling detection capability is achievable, prototype systems will evolve through at-sea testing and sensor integration. The program seeks to further explore ASW and networked maritime system concepts explored within PE 0603766E, Project NET-02, and PE 0602702E, Project TT-03, to develop breakthrough technology for long-range detection and classification, communications, energy management, sensor and platform integration, and robust autonomous processing and control for distributed sensing platforms. This program will transition to the Navy. ***FY 2016 Plans:***	-	-	11.000

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency		Date: February 2015
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	**Project (Number/Name)** NET-02 / *MARITIME SYSTEMS*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Define/develop system objectives and requirements. - Develop concept of operation for outer- and mid-zone defense. - Characterize tactical communications interface requirements. - Develop candidate systems concepts. - Analyze and evaluate candidate systems performance.			
Title: Structural Logic	7.000	-	-
Description: The Structural Logic program developed platform structures and frames that can adapt to varying loads and simultaneously exhibit both high stiffness and high damping. This program demonstrated the utility of negative stiffness structural elements developed under the Multifunctional Materials and Structures program, budgeted in PE 0602715E, Project MBT-01, in the ridged support frames of real world DoD platforms. As the demands on military platforms increase, so does the need for structures to mitigate the shock and vibrations applied by dynamic environments. Today's structures exhibit limited adaptability and typically achieve either extreme stiffness or damping. In military platforms, extremely stiff structures provide high strength, but readily transfer loads to passengers often resulting in serious injury. Conversely, existing damping structures can reduce the load transferred to passengers, but only at the expense of structural strength and integrity. By demonstrating the ability to combine stiffness, damping, and dynamic range in a single structure, the Structural Logic program enabled the design of military platforms with the ability to continually adapt their properties to match the demands of a dynamic environment. Technology from this program transitioned to the Navy. ***FY 2014 Accomplishments:*** - Completed construction of sub-scale high-speed planing boat incorporating negative stiffness elements; performed system testing and evaluation with Navy partners, demonstrating the technology in a realistic environment.			
Accomplishments/Planned Programs Subtotals	44.975	86.120	113.868

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2016 Defense Advanced Research Projects Agency			Date: February 2015
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603766E / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	Project (Number/Name) NET-06 / *NETWORK-CENTRIC WARFARE TECHNOLOGY*	

COST ($ in Millions)	Prior Years	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
NET-06: *NETWORK-CENTRIC WARFARE TECHNOLOGY*	-	179.365	230.478	277.206	-	277.206	265.000	170.334	79.334	59.000	-	-

A. Mission Description and Budget Item Justification

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Classified DARPA Program	179.365	230.478	277.206
Description: This project funds Classified DARPA Programs. Details of this submission are classified. ***FY 2014 Accomplishments:*** Details will be provided under separate cover. ***FY 2015 Plans:*** Details will be provided under separate cover. ***FY 2016 Plans:*** Details will be provided under separate cover.			
Accomplishments/Planned Programs Subtotals	179.365	230.478	277.206

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Details will be provided under separate cover.