Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy											Date: May 2017	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602131M *I Marine Corps Lndg Force Tech*							
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	50.164	51.590	53.936	-	53.936	60.036	57.036	51.036	52.057	Continuing	Continuing
3001: *Marine Corps Landing Force Tech*	0.000	44.371	51.590	53.936	-	53.936	60.036	57.036	51.036	52.057	Continuing	Continuing
9999: *Congressional Adds*	0.000	5.793	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.793

A. Mission Description and Budget Item Justification

The efforts described in this Program Element(PE)are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps) to include specific Marine Corps objectives defined by the USMC S&T Strategic Plan. It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare. Expeditionary Force 21 (EF 21) is the Marine Corps' foundational Capstone Operating Concept that provides vision and context for developing future operating and functional concepts that in turn guide capability development and this PE. Using future concepts, science and technology (S&T) performers can focus less technologically mature applied research in areas where end state capabilities are not fully defined and on S&T opportunities where feasibility is not fully developed or known but is also potentially game changing. EF 21 aligns with national level strategic guidance including the National Security Strategy (NSS), National Military Strategy (NMS), Defense Strategic Guidance (DSG), Quadrennial Defense Review (QDR) and with Naval strategy in the Department of the Navy's Cooperative Strategy for 21st Century Seapower.

Expeditionary Force 21 describes a future Marine Corps ground force that will have cornerstone characteristics of being naval, expeditionary, agile, and lethal. This force will face security environments and threats driven by Complex Terrain (to include informational and human aspects), Technology Proliferation (including precision weapons), Information used as a Weapon, Battles of Electromagnetic (EM) Spectrum Signatures, and Increasingly Contested Maritime Domains. The future Marine Corps will be designed to meet those future security environments but needed force characteristics also impose constraints and challenges on future operating concepts and capabilities. EF 21 provides the context in which promising and innovative applied research is explored to determine scientific feasibility of potential solutions and opportunities to enhance, change, or invent future concepts with S&T. For example within the above naval force characteristics, amphibious operations against EM signature aware threats with advanced weapons systems will be part of future Marine operating concepts. Promising science opportunities in autonomy may enable new concepts and capabilities in agility, lethality, and signature management that have not even been defined. The EF 21 context brings constraints and challenges that stimulate unique science and technology (S&T) requirements and opportunities that define this PE.

S&T projects in this PE explore the feasibility of applied research to meet broad Marine Corps conceptual requirements within the unique constraints described above in the warfighting functional areas of: Command, Control, Communications, Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); maneuver and mobility; force protection; logistics and sustainment; human performance, training and education, firepower, and Expeditionary Cyber. This PE funds applied research, future

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technology assessment and road mapping, future technology concepts, and less technologically mature projects within the Future Naval Capability (FNC) process as means to inform, enhance, and invent future concepts and capabilities with new S&T.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	51.643	51.590	53.936	-	53.936
Current President's Budget	50.164	51.590	53.936	-	53.936
Total Adjustments	-1.479	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.479	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: 9999: *Congressional Adds*		
Congressional Add: *Cyber Research*	5.793	0.000
Congressional Add Subtotals for Project: 9999	5.793	0.000
Congressional Add Totals for all Projects	5.793	0.000

Change Summary Explanation

Technical: Not Applicable.

Schedule: Not Applicable.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy			Date: May 2017
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602131M / *Marine Corps Lndg Force Tech*	Project (Number/Name) 3001 / *Marine Corps Landing Force Tech*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
3001: *Marine Corps Landing Force Tech*	0.000	44.371	51.590	53.936	-	53.936	60.036	57.036	51.036	52.057	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is organized into ten activities, which are represented as eight Expeditionary Warfighting Capability Areas, as well as Future Concepts, Technology Assessment & Roadmapping, and the USMC Future Naval Capabilities(FNCs) Program. The eight Expeditionary Warfighting Areas support the Discovery and Invention (D&I) portfolio investment. The USMC FNCs support the Technology Maturation/Acquisition Enabler investment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Title: COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4)	4.180	4.730	4.419	0.000	4.419

Description: This activity supports S&T investment in Command and Control and is focused in three main areas: (1) Implementing the FORCEnet concept (2) Developing decision support systems that enable warfighters to take advantage of the FORCEnet and MAGTF C2, and tactically extend Net-Enabled Command and Control (NECC) for shared situational awareness; and (3) Providing effective combat identification of enemy combatants, friendly forces, and non-combatants. FORCEnet is the operational construct and architectural framework for naval warfare in the information age that integrates warriors, networks, command and control, and weapons into a networked, distributed, combat force that is scalable across all levels of conflict from the seabed to space, and from sea to land. The Marine Corps instantiation of FORCEnet is Marine Air Ground Task Force Command and Control (MAGTF C2), with technologies to exchange data and information with, and among, distributed tactical forces. Activities in this program area provide technologies for secure, robust, self-forming, mobile communications networks and distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of an appropriate common picture. Marine Corps specific efforts include power management, low detectability, size and weight constraints, and interoperability within the joint environment.

FY 2016 Accomplishments:
- Continued development of urban/restricted environment communications technologies.
- Continued Adaptable Antennas, Self-Adapting Radio Prototype and RF Technologies efforts.
- Continued Cognitive Networking and Trusted Computing Technology efforts.
- Continued an Electro-Magnetic Technologies effort.
- Continued a meta-material antennas effort.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Completed a limited distributed, Cyber Technology development effort. ***FY 2017 Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete a meta-material antennas effort. - Complete an Electro-Magnetic Technologies effort. - Initiate Advanced Expeditionary Cyber Technology efforts. ***FY 2018 Base Plans:*** - Continue all efforts of FY 2017, less those noted as completed above. - Complete Cognitive Networking and Trusted Computing Technology efforts. - Initiate Photonic Component Technologies - Initiate Full Duplex Technologies - Transfer all USMC 6.2 Cyber Technology to Expeditionary Cyber Activity. ***FY 2018 OCO Plans:*** N/A					
Title: FIREPOWER ***Description:*** This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: Fuze, fire control, launch/ propulsion, lethality, and accuracy. The FY2016 to FY2017 increase in the Firepower Activity is for the increased efforts in High Reliability Dual Purpose Improved Conventional Munitions (DPICM) Replacement (HRDR) to include projectile integration, lethality enhancement, fuze setting integration and aerodynamic and aerospace technologies. ***FY 2016 Accomplishments:*** - Continued investigation of the scalability of variable effects conventional munitions and gun technology for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare. - Continued development of precision fires engagement technologies, to include trajectory shaped 81mm mortars, 83mm missiles, and smaller precision munitions. - Continued design and development of lightweight technologies to provide individual Marines enhanced capabilities to detect and identify man-sized targets to the maximum effective ranges of their individual weapons,	4.854	6.550	6.131	0.000	6.131

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
during all conditions (daylight, limited visibility, & darkness), by integrating multiple optics capabilities into a single system. - Continued Semi-Autonomous Fires Technology. - Continued Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view. - Continued Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions. - Continued Caseless, Lightweight, Low-volume Round (CLLVR) to develop lightweight, small caliber ammunition for individual, crew served, and remotely mounted weapons. - Completed Disruptive Energetic Materials (DEM) to exploit nano-energetics developments for significant enhancement of explosive yield per warhead mass and volume. - Completed the development of a concept for an insensitive munitions propulsion system to enable firing a shoulder launched rocket from an enclosed space. This program will transition to the Future Naval Capabilities program. - Initiated High-Reliability Dual Purpose Improved Conventional Munitions (DPICM) Replacement (HRDR) to develop high-reliability sub-munitions fuzing technologies.					
FY 2017 Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions. - Initiate development of concept for thin film materials to thermally mask equipment and munitions and provide counter rocket, artillery, and mortars (C-RAM) capability for future munitions. - Initiate development of concepts for a 155mm mortar or self-propelled Howitzer that would utilize existing stockpiles of 155mm artillery ammunition.					
FY 2018 Base Plans: - Continue all efforts of FY 2017, less those noted as completed above. - Complete development of concepts for a 155mm mortar or self-propelled Howitzer that would utilize existing stockpiles of 155mm artillery ammunition.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Complete Caseless, Lightweight, Low-volume Round (CLLVR) to develop lightweight, small caliber ammunition for individual, crew served, and remotely mounted weapons. ***FY 2018 OCO Plans:*** N/A					
Title: FORCE PROTECTION ***Description:*** This activity supports the Force Protection Thrust's applied research program. Technologies are being developed that focus on the following: Explosive Hazard avoidance, detection, breaching/neutralization, marking and analysis; Air Defense/Counter Rocket, Artillery, and Mortars; Counter tactical surveillance and targeting, and technologies for improved protection for individuals including Marine Personnel Protective Equipment against blast, ballistic and blunt impact threats. ***FY 2016 Accomplishments:*** - Continued development of technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO). - Continued development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection. - Continued technology development programs to address force protection personal protective equipment capability gaps. - Continued Counter Rockets, Artillery, Mortars, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event. - Continued the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform due to an urgent operational need. - Continued a program to determine the feasibility to detect and neutralize anti-helicopter mine threat. - Continued the refinement and improve current suite of advanced biomechanical instrumentation to assess potential reductions of Warfighter mobility and functionality caused by PPE systems. - Continued the scientific investigation into an integrated PPE performance tool for assessing coordinated human and armor performance (mobility, back-face deformation, area of coverage, propensity for injury and mass). - Continued broad based material (ceramics, fiber and fiber re-enforced plastics) studies so that significant weight reductions (greater than 50%) can be achieved. - Continued studies to improve ballistic and blast armor material and systems models so that novel concepts can be evaluated and material property characteristics which provide the necessary improvements can be identified prior to significant monetary investments.	5.376	6.090	6.679	0.000	6.679

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters. - Continued a program to develop modular mission packages for the detection, neutralization, marking and reporting of explosive hazards using multiple, existing vehicles in movement to contact and amphibious raid scenarios. - Continued a program to study the use of autonomous vehicles in the detection, neutralization, marking and reporting of explosive hazards using multiple, existing vehicles in movement to contact and amphibious raid scenarios. - Completed a program to study the fundamental sciences of homemade explosives due to urgent operational needs.					
FY 2017 Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete Counter Rockets, Artillery, Mortars, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event. - Complete the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc.) from a moving platform. - Complete the scientific investigation into an integrated PPE performance tool for assessing coordinated human and armor performance (mobility, back-face deformation, area of coverage, propensity for injury and mass). - Initiate the study of technologies to enable detection of explosive hazards and surveillance/targeting systems in complex environments such as jungles and the littoral environment.					
FY 2018 Base Plans: - Continue all efforts of FY 2017, less those noted as completed above. - Complete technology development programs to address force protection personal protective equipment capability gaps (Transitioned from Maneuver activity). - Complete the refinement and improve current suite of advanced biomechanical instrumentation to assess potential reductions of Warfighter mobility and functionality caused by PPE systems. - Complete modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters. - Complete the study of technologies to enable detection of explosive hazards and surveillance/targeting systems in complex environments such as jungles and the littoral environment.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
-Initiate projects that enable detection of explosive hazards and surveillance/targeting systems in challenging operational environments based on previous study. ***FY 2018 OCO Plans:*** N/A					
Title: HUMAN PERFORMANCE, TRAINING AND EDUCATION	4.904	4.920	3.153	0.000	3.153
Description: This activity addresses the applied research effort of the USMC Human Performance Training and Education area (HPT&E). The HPT&E thrust investment profile is directed at two technology investment areas, Warrior Resilience, and Decision Making and Expertise Development. The funding aligned to Warrior Resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Those funds aligned to Decision Making and Expertise Development refers to training and education technologies and methodologies that accelerate the development and improve the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields. The FY2017 to FY2018 decrease in the Human Performance Training and Education (HPT&E) activity is due to completion of all Small Unit Decision Making (SUDM) efforts. ***FY 2016 Accomplishments:*** - Continued studies into next generation physical performance enhancement methodologies and technologies (enhanced warfighter psycho-physical performance). - Continued research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems. - Continued the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert. - Continued research into the effects of glucose administration to mitigate stress reactions in trauma patients. - Continued design and development of an automated functional movement screening system to provide a low cost accurate solution for fit-for-duty evaluations and injury prevention training. - Continued development of statistical methods for measuring small unit decision making (SUDM), using previous work on developing assessments of small unit decision making (e.g., Levels of Mastery), and provide a series of training sessions on statistical modeling to enable ground work to be laid by SUDM projects to also use statistical modeling.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Initiated research into automated simulation content generation via a field worn sensor suite. - Initiated research for establishing optimal training intervals for improvement in physical performance and warrior mindset. ***FY 2017 Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert. - Complete development of statistical methods for measuring small unit decision making (SUDM), using previous work on developing assessments of small unit decision making (e.g., Levels of Mastery), and provide a series of training sessions on statistical modeling to enable ground work to be laid by SUDM projects to also use statistical modeling. - Initiate the use of augmented reality technologies into tactical decision making tools to support information dominance requirements. ***FY 2018 Base Plans:*** - Continue all efforts of FY 2017, less those noted as completed above. - Complete research into the effects of glucose administration to mitigate stress reactions in trauma patients. - Complete design and development of an automated functional movement screening system to provide a low cost accurate solution for fit-for-duty evaluations and injury prevention training. - Initiate research into developing artificial intelligence to support infantry simulation based training. ***FY 2018 OCO Plans:*** N/A					
Title: INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) ***Description:*** This activity develops ISR technologies for applications in future intelligence, surveillance, and reconnaissance. Technologies being pursued enhance situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes biometrics for expeditionary operations, complete future automation of options and persistent surveillance in support of distributed operations.	2.794	3.160	6.953	0.000	6.953

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
The FY2017 to FY2018 increase in the Intelligence, Surveillance and Reconnaissance activity is due to strong demand signals from the Marine Corps to address Tactical Cloud Computing Challenges. Effort has focused work on two fronts: connecting tactical clouds to each other and connecting tactical clouds to traditional Marine Corps Tactical Service Oriented Architecture in a contested operational environment. ***FY 2016 Accomplishments:*** - Continued development of low power consumption urban sensing technologies. - Continued development of information on demand technologies to provide the warfighter with the right information at the right time. - Continued development of urban sensing technologies to detect weapons at distance. - Continued development of advanced tactical sensor technologies to improve unit awareness. - Continued development of distributed information architecture technologies. - Continued Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks. - Continued efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor. - Continued development of adaptable enemy course of action engine to manipulate adversary decisions. - Continued efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform. - Continued development of capabilities to integrate socio-cultural models of human behavior with the ability to forecast the processes of decision making through predictive forecasting models. - Continued efforts to derive high resolution models of human networks statistically, with associated behavior attributes. - Continued research on the automated deconfliction and fusion of multi-intelligence tracks on movers of interest, enabled by a rich maritime ontology and active wiki technology. - Continued work on specific nanomaterial triggers and receptors. - Continued work on new optical taggants with improved producibility.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued research in automated techniques to establish the reliability of data from human and machine sources. - Continued technology development efforts required to enable a lightweight hyperspectral sensor capable of material characterization. - Continued research to develop algorithms that can disambiguate complex network graphs containing millions of sparsely characterized nodes. - Continued development of advanced analytics (data disambiguation, conditioning, fusion and dissemination) as a set of map reduce tasks that can run across a highly distributed data architecture. - Continued research in deep machine understanding of information requirements relevant to amphibious warfare. - Continued research in characterizing patterns of life from persistent track data. - Continued research on technologies needed to enable multi-INT sensors to collaborate in real time on complex fusion tasks. - Continued a project to enable the synchronized planning and management and ISR assets given a set of disparate mission information requirements. - Continued effort to represent disparate data as a reduced feature vector. - Continued research in analytics for limited and isolated computational environments to enable advanced analytic capabilities to be available on expeditionary lightweight computing platforms. - Continued research on technologies needed to produce products from multi-modal information in response to information requirements by leveraging cloud data access capabilities. - Continued research in representing the content of large data stores in a way that allows remote and accurate searching against data indexes to be enabled. - Continued research on collapsing networks inferred from disparate data sources. - Completed development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data. - Completed development of tagging, tracking and locating technologies to monitor adversary movement. - Completed development of a single, integrated, battlespace picture with tactical and strategic injections that begins to close the gap between ISR and C2. - Completed research on the development of networked, ultra-low power, long life and smart ground sensors. - Completed research on technologies needed to tailor information delivery to warfighters based on mission context and user preferences.					
FY 2017 Plans:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continue all efforts of FY 2016, less those noted as completed above. - Complete work on specific nanomaterial triggers and receptors. - Complete development of urban sensing technologies to detect weapons at distance. - Complete work on new optical taggants with improved producibility. - Complete development of low power consumption urban sensing technologies. - Complete development of information on demand technologies to provide the warfighter with the right information at the right time. - Complete efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor. - Complete research in automated techniques to establish the reliability of data from human and machine sources. - Complete development of advanced analytics (data disambiguation, conditioning, fusion and dissemination) as a set of map reduce tasks that can run across highly distributed data architecture. - Complete research on the automated deconfliction and fusion of multi-intelligence tracks on movers of interest, enabled by a rich maritime ontology and active wiki technology. - Complete research in characterizing patterns of life from persistent track data. - Complete research on collapsing networks inferred from disparate data sources. - Complete research in representing the content of large data stores in a way that allows remote and accurate searching against data indexes to be enabled. - Initiate effort to mature machine vision classifiers to the detection of specific objects from airborne video. - Initiate effort to represent graph based representations of the information content of a cloud that can be shared over limited bandwidths between clouds. - Initiate effort to develop advanced query capabilities on no-SQL data bases. - Initiate effort to develop novel analysis capabilities applicable to open source data.					
FY 2018 Base Plans: - Continue all efforts of FY 2017, less those noted as completed above. - Complete development of distributed information architecture technologies.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Complete Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks. - Complete development of adaptable enemy course of action engine to manipulate adversary decisions. - Complete efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform. - Complete efforts to derive high resolution models of human networks statistically, with associated behavior attributes. - Complete technology development efforts required to enable a lightweight hyperspectral sensor capable of material characterization. - Complete research on technologies needed to produce products from multi-modal information in response to information requirements by leveraging cloud data access capabilities. - Complete effort to mature machine vision classifiers to the detection of specific objects from airborne video. - Initiate effort connecting tactical clouds to each other and connecting tactical clouds to traditional Marine Corps Tactical Service Oriented Architecture environments. The goal is that each cloud and non-cloud instance is able to replicate all (but only) mission critical data in a bandwidth efficient manner. - Initiate research on using machine learning to project Measures of Effectiveness Performance based on Common Tactical Picture and Common Intelligence Picture content and on autonomous tactical decision support tools informed by these projections. - Initiate research on using artificial intelligence to compose and trigger analytic workflows based on the content of big real-time data streams and research on training classifiers to predict links between insurgent groups and between insurgent groups and other entities over time. - Initiate research on computational accuracy throttling and power mitigation strategies for real-time processors operating under constrained and fluctuating power resources. ***FY 2018 OCO Plans:*** N/A					
Title: USMC FUTURE NAVAL CAPABILITIES ***Description:*** This R-2 Activity, formerly named Littoral Combat/Power Projection (LC/PP), addresses the applied research associated with the Marine Corps' participation in the Department of the Navy's (DoN) Future Naval Capabilities (FNC) Program. Investments in this activity are coordinated with similar and non-duplicative efforts in PE 0602750N, where the Navy's participation in the FNC Program is funded. The FNC Program represents the requirements-driven, delivery-oriented portion of the DoN Science and Technology (S&T)	8.613	10.825	4.730	0.000	4.730

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
portfolio. FNC investments respond to Naval Technology Gaps generated by IPTs that are co-managed by Navy and the Marine Corps flag/general officers with representation across the naval research enterprise. FNC funding is aligned to naval challenges that may be associated with any of the FNC focus areas (i.e., Pillars). FNCs contain both 6.2 Applied Research and 6.3 Advanced Technology Development Budget Activity (BA) components as technology is matured from a Technology Readiness Level (TRL) of 3 or 4 to a TRL of 6. The FY2016 to FY2017 increase was due to a rephasing of the Tactical Edge Enabling Capability products of Actionable Information Tactical Applications, Data Condition, and Network Adaptive Communication Services. The FY2017 to FY2018 decrease in the USMC Future Naval Capabilities activity is due to a realignment of funds to the Expeditionary Cyber Activity. Additional funding realignment within PE 0603640M Marine Corps Advanced Technology Demonstration ensures that the Future FNC funding will remain constant in USMC program elements. ***FY 2016 Accomplishments:*** - Continued Automated Processing for Spectral Exploitation and Dissemination (APSED) - Develop autonomous cueing algorithms. - Continued Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Research and assess compact processing and storage hardware for sensor management, image refinement and storage, and dissemination. - Continued Radar / Context Fusion - Research and design software algorithms to summarize Human Intelligence (HUMINT) data as a spatial threat surface. - Continued Radar Fusion and False Track Mitigation - Improve real-time algorithm effectiveness within the relevant environment. - Continued Data Conditioning - Research and design machine content extraction algorithms and algorithms capable of formatting a structured report. - Continued Network Adaptive Communication Services - Research and design a software policy specification that uses inputs from mission priorities, users and data conditioning that is based on Dynamic Tactical Communications Network (DTCN) prioritization. - Continued development of the Ground Based Air Defense On-the-move high energy laser demonstrator (GBAD). - Completed development of technologies to enable the exchange of actionable information at the tactical edge.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Completed development of the Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM). - Completed development and transition of Expeditionary Fighting Vehicle (EFV) obstacle detection capability to EFV Direct Reporting Program Manager (Expeditionary Fighting Vehicle Obstacle Avoidance System (EFVODS)). - Completed EMW-FY12-03 Wide Area Surgical And Persistent Surveillance (WASPS). ***FY 2017 Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. This includes EMW-FY16-01 Densified Propellant Fire From Enclosure - Confined Space(FFE/CS) Propulsion Technologies that was previously funded by PE 0602750N Future Naval Capabilities Applied Research in FY 2016. - Complete SHD-FY13-02 Ground Based Air Defense On-The-Move (GBAD). - Complete Radar Fusion and False Track Mitigation - Improve real-time algorithm effectiveness within the relevant environment. - Initiate EMW-FY17-01 High Reliability DPICM Replacement (HRDR). This effort will increase the legacy 155mm Dual Purpose Improved Conventional Munition (DPICM) projectile cannon fired sub-munition reliability to at least 99% and allow the Marine Corps to retain an anti-personnel/anti-armor, artillery-based Area Effect Munition (AEM) capability. - Initiate EPE-FY16-01 Advanced Topcoat Systems for Ground Vehicle (ATS-GV) - Continue development of isocyanate free topcoat resin systems for the ground vehicle. ***FY 2018 Base Plans:*** - Continue all efforts of FY 2017, less those noted as completed above. - Complete EMW-FY16-01 Densified Propellant Fire From Enclosure - Confined Space(FFE/CS) Propulsion Technologies. - Initiate EMW-FY18-01 ACV 1.X Fuel Efficient Technology Suite - Research and analyze initial requirements to develop a suite of technologies that will significantly increase platform reach and range, and reduce the logistical footprint. - Initiate Marine Corps portion of EMW-FY18-01 ACV 1.X Water Speed Enhancement (this effort is co-funded in PE 0602750N Future Naval Capabilities Applied Research) - Conduct Modeling and Simulation studies to design an optimal hull form and various propulsor concepts. ***FY 2018 OCO Plans:***					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
N/A					
Title: LOGISTICS	5.528	5.833	5.789	0.000	5.789

Description: This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into four pillars: efficient and responsive force sustainment, planning and directing logistics operations, logistics demand reduction, and fleet maintenance. These pillars are thoroughly integrated and perpetually related in execution.

FY 2016 Accomplishments:
- Continued development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices.
- Continued applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems (Note: This also includes development of alternative human load carrying concepts to lighten the load carried by the Marine and reduce structural damage to the human body).
- Continued applied research toward materials that will reduce, or prevent, wear and corrosion on systems and equipment.
- Continued the development of advanced water location, harvesting, packaging, distribution, and quality monitoring systems to enable Marines to be fully self-sufficient for water resources on the battlefield.
- Continued operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies.
- Continued development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain.
- Continued the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices.
- Continued the development of energy scavenging technologies to minimize wasted thermal, RF, kinetic, and other energy on the battlefield.
- Continued development of high efficiency, high specific power, rugged, and inexpensive solar photovoltaic energy harvesting technologies.

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Completed the development of logistics C2 systems for optimizing the transportation of materiel across multiple intra and inter-theater connector vehicles (aka: Transportation Exploitation Tool). - Completed development technologies to facilitate cargo transfer across intra-theater logistics connector vehicles, to include advanced material handling equipment as well as asset tracking and reporting technologies.					
FY 2017 Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Complete development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices. - Complete applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems - Complete the development of advanced water location, harvesting, packaging, distribution, and quality monitoring systems to enable Marines to be fully self-sufficient for water resources on the battlefield. - Complete operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies. - Complete development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain. - Complete the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices. - Complete the development of energy scavenging technologies to minimize wasted thermal, RF, kinetic, and other energy on the battlefield. - Initiate the development of stochastic studies to model and insert Additive Manufacturing into the Naval Supply Chain. - Initiate the development of a project to investigate the complex physical processes occurring associated with complex geometries when using laser directed energy metal deposition processes with titanium alloys. - Initiate the development of a project to investigate the feasibility and attributes of the wireless transfer of power technologies for dismounted Marines.					
FY 2018 Base Plans: - Continue all efforts of FY 2017, less those noted as completed above. - Complete the development of stochastic studies to model and insert Additive Manufacturing into the Naval Supply Chain.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Complete the development of a project to investigate the feasibility and attributes of the wireless transfer of power technologies for dismounted Marines. ***FY 2018 OCO Plans:*** N/A					
Title: MANEUVER ***Description:*** The Maneuver thrust area focuses on the development of technologies that will increase the warfighting capabilities and effectiveness of the Marine Air-Ground Task Force (MAGTF). This thrust aims at capturing emerging technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Emphasis on survivability technologies includes defeat of small arms, IEDs, mine blast, and RPGs. Efforts also continue in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system's performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the program manager insight and guidance into pursuing future technologies. The Thrust is also providing the USMC with affordable technologies that enable manned-unmanned teaming, autonomous vehicle collaboration, and ground vehicle mobility technologies for enhanced expeditionary maneuver. The FY2016 to FY2017 increase in funding is due the re-phasing of the initiation of technology development programs to address expeditionary maneuver capability gaps. ***FY 2016 Accomplishments:*** - Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor. - Continued mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs. - Continued efforts addressing technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants. - Continued efforts addressing advanced suspension systems with ride height adjustment capabilities, adjustable ride quality capabilities, rollover prevention, and load equalizing systems to enhance tactical mobility and survivability. - Continued efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility.	6.745	7.950	7.837	0.000	7.837

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued technology development programs to address maneuver capability gaps in survivability such as an advanced seat technology effort to improve/increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover. - Continued technology development programs to address maneuver capability gaps in Mobility such as a Vehicle Stability effort to improve/increase vehicle performance characteristics such as reducing vehicle rollover tendencies. - Continued efforts in advanced perception and context-based reasoning aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO). - Continued the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles. - Continued lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms. - Continued survivability technologies that enable defeat of all unitary and tandem RPG and select Anti-Tank Guided Missile (ATGM) threats, and the demonstration of survivable vehicles. - Continued non-GPS localization technologies such that autonomous vehicles can navigate in areas where satellite data is inaccessible. - Continued the development of technologies that enable vehicle component modularity and reduce life cycle costs. - Continued mobility technologies that enable improved vehicle agility and stability. - Continued Advanced Mobility efforts in Future Fuel Alternatives and Advanced Propulsion and Suspension Technologies to improve vehicle fuel efficiency through improvements in drive train and engine efficiencies and alternative fuels capabilities to enhance tactical mobility. - Continued the development of technologies that sustain vehicle components longer and reduce life cycle costs. - Continued the development of autonomous technologies automating behavior generation and enabling adaptive behavior using virtual environments. - Continued technology development programs to address expeditionary maneuver capability gaps. - Continued the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies. - Continued the development of autonomous technologies by enhanced human machine interface (HMI) through gestures and natural language understood by unmanned ground systems (UGS). - Continued survivability technologies to provide reduction in the probability of detection in a given background.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Completed the development of autonomous technologies transcribing vision-based perception data in order to be understood by a context-based reasoning system enabling adaptive behavior. - Completed development of Advanced Electro-Magnetic Armor (AEMA) for ground vehicle survivability. ***FY 2017 Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Initiate technology development programs to address expeditionary High Water Speed capability gaps. ***FY 2018 Base Plans:*** - Continue all efforts of FY 2017, less those noted as completed above. - Complete advanced seat technology effort to improve/increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover. - Initiate development of cognitive reasoning systems that enable manned-unmanned teaming with high levels of autonomy. ***FY 2018 OCO Plans:*** N/A					
Title: EXPEDITIONARY CYBER ***Description:*** This activity supports the Cyber Applied Research program which is intended to provide freedom of maneuver and influence in the Cyber-Electronic Warfare domain while simultaneously denying the same to the adversary and protecting critical command systems. Technologies are being developed using a multi-disciplinary approach that combines RF electronics, digital signal processing, computer engineering, software engineering, machine learning and data science to support Naval Expeditionary warfighters operating with size, weight and power constrained equipment in disrupted, intermittent, low bandwidth environments (DIL). Areas of applied research include distributed precision time, predictive software defined radio architectures, coordinated Cyber and Spectrum maneuver to mitigate detection and exploitation, tactical Cyber visualization, discovering and mapping networks in dense urban environments, contextual awareness and blind channel characterization. Effective 2018 all USMC 6.2 Cyber Technology was transferred from C4 to Expeditionary Cyber. ***FY 2016 Accomplishments:*** N/A ***FY 2017 Plans:***	0.000	0.000	6.790	0.000	6.790

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
N/A ***FY 2018 Base Plans:*** - Initiate a USMC Expeditionary Cyber Applied Research Technology Activity addressing Cyber at the tactical edge. - Initiate cognitive blind channel characterization. - Initiate predictive software defined radio architecture. ***FY 2018 OCO Plans:*** N/A					
Title: FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING ***Description:*** This activity supports the planning and integration of technology development efforts across the entire PE. In conjunction with the Concepts Based Capabilities System and the Marine Corps Warfighting Laboratory, unique and novel concepts for advanced warfighting are developed and validated. Effectiveness analyses are conducted to identify the synergistic effects that can be achieved through the integration of emerging technology with innovative tactics, doctrine, and techniques. Technology assessments are conducted to determine the supporting technologies that have the highest impact across the warfare areas, and warrant further investment within this PE. Technology Roadmapping is conducted to help identify opportunities to leverage technology development within the Department of the Navy and the Department of Defense, as well as, with the commercial sector and university communities. The resultant technology investment strategy is developed and used to guide out-year technology development efforts. ***FY 2016 Accomplishments:*** - Continued planning and integration of technology development efforts to meet imposing security threats that challenge our Nation. - Continued a review and assess the Marine Corps' required surface connector capabilities specifically exploring promising and relevant research, technologies, capabilities and opportunities by which the Marine Corps can anticipate and identify potential solutions that meet the service's surface connector requirements. - Continued a technology assessment for a Cyber/Electronic Warfare Coordination Cell (CEWCC) to enable seamless integration of kinetic and non-kinetic fires during expeditionary operations. - Completed a careful analysis of trends that can identify emerging changes in the security environment that are likely to have significant implications for U.S. ground forces. The output will be used to reduce risk and hedge against the surprises that will inevitably occur.	1.377	1.532	1.455	0.000	1.455

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Initiated a review and assessment of Expeditionary Force 21. This new USMC concept describes how the Marine Corps must deploy and operate, and what force attributes will be required. This study will describe Expeditionary Force 21 implications for S&T. Nested directly under Cooperative Strategy 21 (Naval Strategy), Expeditionary Force 21 covers a 10-year planning horizon that informs, and is informed by, other USMC concepts and documents. ***FY 2017 Plans:*** - Continue all efforts of FY 2016, less those noted as completed above. - Complete a technology assessment for a Cyber/Electronic Warfare Coordination Cell (CEWCC) to enable seamless integration of kinetic and non-kinetic fires during expeditionary operations. ***FY 2018 Base Plans:*** - Continue all efforts of FY 2017, less those noted as completed above. - Complete a review and assessment of Expeditionary Force 21 (including revisions). This new USMC concept describes how the Marine Corps must deploy and operate, and what force attributes will be required. This study will describe Expeditionary Force 21 implications for S&T. Nested directly under Cooperative Strategy 21 (Naval Strategy), Expeditionary Force 21 covers a 10-year planning horizon that informs, and is informed by, other USMC concepts and documents. ***FY 2018 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	44.371	51.590	53.936	0.000	53.936

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare and Combating Terrorism. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with

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other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

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COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	5.793	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.793

A. Mission Description and Budget Item Justification

These Congressional Cyber funds were provided to develop a multi-disciplinary science and technology strategy addressing dynamic cyber defense and Expeditionary cyberspace operations in support of distributed Naval Expeditionary Warfighters. This was accomplished through examination of prototyping and developing technology capabilities for Expeditionary Cyberspace Operations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Cyber Research	5.793	0.000
FY 2016 Accomplishments: - Initiate a multi-disciplinary science and technology effort addressing dynamic cyber defense and tactical cyberspace operations.		
FY 2017 Plans: N/A		
Congressional Adds Subtotals	5.793	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Deliverables include a multi-disciplinary science and technology strategy addressing dynamic cyber defense and Expeditionary Cyberspace Operations.