| Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification | | | | | | | | | DATE: May 2009 | |
|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | | | | | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | | | | | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 94.939 | 90.050 | 108.394 | | | | | | Continuing | Continuing |
| 2919: COMMUNICATIONS SECURITY | 92.426 | 90.050 | 108.394 | | | | | | Continuing | Continuing |
| 9999: CONGRESSIONAL PLUS-UPS | 2.513 | 0.000 | 0.000 | | | | | | Continuing | Continuing |

**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 S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). 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). 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.

Activities and efforts in this program address the advanced technology development, test, and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The promise of net-centricity and potential for persistent and pervasive sensing creates greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors, and tailored dissemination of information to support network centric operations. The focus of this program is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments. These missions include the Overseas Contingency Operations (OCO), urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, the Navy must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capabilities, this project demonstrates technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to rapid, accurate decision-making and result in decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.

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| **APPROPRIATION/BUDGET ACTIVITY**<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | **R-1 ITEM NOMENCLATURE**<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY |

The Common Picture Program supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Secure Collaboration; GIG Compliant Networking; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; GWOT Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; and Real-Time Long Range Air Defense Combat ID in Support of Early Engagements.

In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance; Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).

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 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| Previous President's Budget | 92.401 | 104.578 | 60.722 | |
| Current BES/President's Budget | 94.939 | 90.050 | 108.394 | |
| Total Adjustments | 2.538 | -14.528 | 47.672 | |
| Congressional Program Reductions | | -14.498 | | |
| Congressional Rescissions | | | | |
| Total Congressional Increases | | | | |
| Total Reprogrammings | 4.138 | | | |
| SBIR/STTR Transfer | -1.600 | | | |
| Program Adjustments | | | 47.636 | |
| Rate/Misc Adjustments | | -0.030 | 0.036 | |

**Congressional Increase Details ($ in Millions)**

| | FY 2008 | FY 2009 |
|---|---|---|
| **Project:** 9999, **COMPUTER FORENSICS FOR ENHANCED MARITIME DOMAIN AWARENESS** | 0.965 | 0.000 |
| **Project:** 9999, **MARITIME IDENTIFICATION SURVEILLANCE TECHNOLOGY (MIST)** | 1.548 | 0.000 |

**Change Summary Explanation**

Technical: Not applicable.

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| **APPROPRIATION/BUDGET ACTIVITY**<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | **R-1 ITEM NOMENCLATURE**<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY |

Schedule: Not applicable.

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|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | | | | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | | | | | PROJECT NUMBER<br>2919 | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| 2919: COMMUNICATIONS SECURITY | 92.426 | 90.050 | 108.394 | | | | | | Continuing | Continuing |

**A. Mission Description and Budget Item Justification**

Activities and efforts in this project address the advanced technology development, test, and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The promise of net-centricity and potential for persistent and pervasive sensing creates greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors, and tailored dissemination of information to support network centric operations. The focus of this program is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments. These missions include the OCO, urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, the Navy must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capabilities, this project demonstrates technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to rapid, accurate decision-making and result in decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.

The Communications Security project supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Secure Collaboration; GIG Compliant Networking; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; GWOT Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; and Real-Time Long Range Air Defense Combat ID in Support of Early Engagements.

In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance (ISR); Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).

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| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | PROJECT NUMBER<br>2919 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY | 4.211 | 4.870 | 0.000 | |

The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities, using either GPS systems, non-GPS navigation devices, or atomic clocks. This project will increase the operational effectiveness of U.S. Naval units. Emphasis is placed on (a) GPS Anti-Jam Technology, (b) Precision Time and Time Transfer Technology and (c) Non-GPS Navigation Technology (Inertial aviation system, bathymetry, gravity and magnetic navigation). The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS). The current specific objectives are:

a) GPS Anti-Jam Antennas and Receivers: Develop/demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; develop, demonstrate and transition anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats.

b) Precision Time and Time Transfer: Develop/evaluate/demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; Develop/demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time.

c) Non-GPS Navigation Technology: Develop/demonstrate an advanced inertial navigation system for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; Develop, demonstrate and transition a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals.

The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.

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| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | PROJECT NUMBER<br>2919 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| This activity transfers to PE 0603271N in FY 2010.<br><br>*FY 2008 Accomplishments:*<br>GPS Anti-Jam Antennas and Receivers:<br>- Continued the Enhanced AJ GPS Receiver Technology (EAGRT) project.<br>- Continued the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project.<br>- Completed the demonstration project of nonlinearly constrained adaptive beam forming for defeating Binary Phase-Shift-Keying (BPSK) jammers. Developed an algorithm to mitigate the loss of Signal-to-Noise Ratio (SNR) through a combination of adaptive space-time-frequency signal processing techniques.<br>- Initiated the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system.<br>- Initiated the Adaptive Temporal Suppression of GPS Structured Interference project.<br><br>Precision Time and Time Transfer:<br>- Continued the development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO).<br>- Continued the Qualification of a Commercial-Off-the-Shelf (COTS) Miniature Atomic Clock project.<br>- Initiated the GPS Synchronization of a Chip-scale Atomic Clock project.<br><br>Non-GPS Navigation Technology:<br>- Continued the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer.<br>- Continued the Integrated Optically Transduced Gyro Assembly (IOTA) project.<br>- Continued the Scaleable Integrated Micro Optical Gyroscope (SIMOG) project.<br>- Continued the Navigation Grade Microfabricated Integrated Optical Gyro (MIOG) project.<br>- Continued the Navigation Grade Sub-Harmonic Lateral Mode Gyro (GSLMG) project. | | | | |

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| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | PROJECT NUMBER<br>2919 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| - Continued the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.<br>- Continued the MEMS Gyro-cluster INS for Tactical Platforms project.<br>- Continued the Precision Celestial Navigation System (PCNS) project.<br>- Continued the Dead Reckoning Advanced Tight Coupling (DRATC) project.<br>- Completed the development of the Sonar Aided Inertial Navigation Technology (SAINT).<br>- Initiated the navigation grade Inertial Navigation System (INS) using fiber optic/Micro-Electronic Mechanical System (MEMS) gyros and electro-optic accelerometers.<br>- Initiated the Simultaneous Localization and Mapping (SLAM) Inertial Measurement Unit (IMU) non-GPS Navigator (SINGN) project.<br><br>*FY 2009 Plans:*<br>GPS Anti-Jam Antennas and Receivers:<br>- Continue all efforts of FY 2008 less those noted as completed above.<br>- Complete the development of EAGRT.<br>- Complete the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project.<br><br>Precision Time and Time Transfer:<br>- Continue all efforts of FY 2008.<br>- Complete the GPS Synchronization of a Chip-scale Atomic Clock project.<br>- Complete the Qualification of a COTS Miniature Atomic Clock project.<br><br>Non-GPS Navigation Technology:<br>- Continue all efforts of FY 2008.<br>- Complete the development of IOTA.<br>- Complete the development of SIMOG.<br>- Complete the development of MIOG.<br>- Complete the development of GSLMG.<br>- Complete the SLAM IMU non-GPS Navigator (SINGN) project. | | | | |

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| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | PROJECT NUMBER<br>2919 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| In addition to being performed here in FY 2009, the following efforts transfer to PE 0603271N in FY 2010:<br><br>GPS Anti-Jam Antennas and Receivers:<br>- Continue the Adaptive Temporal Suppression of GPS Structured Interference project.<br>- Continue the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system.<br><br>Precision Time and Time Transfer:<br>- Continue the development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO).<br><br>Non-GPS Navigation Technology:<br>- Continue the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer.<br>- Continue the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.<br>- Continue the MEMS Gyro-cluster INS for Tactical Platforms project.<br>- Continue the Precision Celestial Navigation System (PCNS) project.<br>- Continue the Dead Reckoning Advanced Tight Coupling (DRATC) project.<br>- Continue the navigation grade Inertial Navigation System (INS) using fiber optic/Micro-Electronic Mechanical System (MEMS) gyros and electro-optic accelerometers.<br>- Initiate the development of the Sonar Aided Bathymetric Navigation Technology.<br>- Initiate the Optically Transduced MEMS Inertial Navigation System project.<br>- Initiate the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project.<br>- Initiate the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project. | | | | |
| HIGH-INTEGRITY GLOBAL POSITIONING SYSTEM (HIGPS) | 49.682 | 46.672 | 59.110 | |
| The High-Integrity Global Positioning System (HIGPS) activity is focused on developing the technology required to demonstrate the capability of using the existing Iridium satellite constellation to enhance current | | | | |

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| GPS navigation and timing capabilities. Enhancements include improved anti-jam performance, improved accuracy of navigation and positioning, increased availability of satellite navigation signals, improved accuracy in time stability transfer, and faster acquisition times.<br><br>This activity focuses on integrating a HIGPS Enabling Technology Development (ETD) prototype. This effort is planned to transition to a HIGPS Technology Concept Demonstration (TCD) program under Navy program management at Office of Naval Research.<br><br>The increase from FY 2009 to FY 2010 is required for procurement of prototype user equipment and completion of HIGPS technology demonstrations in FY 2009.<br><br>*FY 2008 Accomplishments:*<br>- Initiated and completed the HIGPS Enabling Technology Development (ETD) prototype development which includes development of a HIGPS user receiver (UR) prototype design, development and implementation of prototype HIGPS base station equipment, demonstrations of long baseline precision time transfer, and Iridium ephemeris store and broadcast, and completion of various trade studies required to determine the optimum way forward in implementing the system concept demonstration.<br><br>- Initiated the HIGPS Technology Concept Demonstration (TCD) project. The HIGPS project continued using the HI GPS ETD as a foundation to assemble a system that will demonstrate the GPS augmentation concept. In FY 2008 the activity was concerned with the system demonstration using Iridium ephemeris store and broadcast, precision time and differential GPS aiding from a base station, an enhanced narrowband Iridium signal, and brassboard user equipment.<br><br>*FY 2009 Plans:*<br>- Continue the HIGPS TCD project.<br><br>*FY 2010 Plans:*<br>- Continue the HIGPS TCD project. | | | | |
| INFORMATION SECURITY RESEARCH | 1.737 | 1.940 | 1.821 | |

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| The overarching objective of this activity is to protect the Navy and the Joint information infrastructure from hostile exploitation and attack. The current specific objectives are:<br><br>a) Network Situation Awareness & Security: Develop tools, techniques and methodologies to improve network resistance to denial of service attacks and improve indications and warnings of suspect activities.<br><br>b) Network Traffic Analysis and Assessment: Develop methods for conducting network traffic analysis; monitoring and assessing network status and health; identifying new capabilities to analyze network vulnerabilities and attacks; and providing situational awareness of network assets and operations.<br><br>c) Information Assurance: Develop and measure the effectiveness of Information Assurance (IA) protective solutions and improve the quality and level of certification of information assurance software.<br><br>The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>*FY 2008 Accomplishments:*<br>Network Situation Awareness & Security:<br>Develop tools, techniques and methodologies to improve network resistance to denial of service attacks and improve indications and warnings of suspect activities:<br>- Continued development of a tool for the development of agents that integrates unified modeling language (UML) and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers.<br><br>Network Traffic Analysis and Assessment:<br>- Continued development of the security management tool that provides a common picture of the networked environment with respect to IA and security, with emphasis on visualization capabilities to support active computer network defense. | | | | |

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| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |

- Initiated the development of capabilities and an infrastructure that will support the management of high assurance devices/components used within Navy networks. Ensured the approach was supported by the Navy's network centric architecture.

Information Assurance:
- Continued development of integrated capabilities that support battle damage assessment and infrastructure and asset protection based on information provided by the common picture of the networked environment with respect to IA and security. Evaluated and demonstrated the capabilities in an operationally representative environment and used the results to improve the capabilities.
- Initiated the development of a tool suite that will provide evidence of assurance for security products based on the foundations of formal methods. The tool will provide the automated analysis of the implementation based on the security policy, the architecture and/or the software security critical functions.

*FY 2009 Plans:*
Network Situation Awareness & Security:
- Continue all efforts of FY 2008.

Network Traffic Analysis and Assessment:
- Continue all efforts of FY 2008.

Information Assurance:
- Continue all efforts of FY 2008.
- Complete the development of integrated capabilities that support battle damage assessment and infrastructure and asset protection based on information provided by the common picture of the networked environment with respect to IA and security.

*FY 2010 Plans:*
Network Situation Awareness & Security:
- Continue all efforts of FY 2009.

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| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | | | PROJECT NUMBER<br>2919 | |
| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| - Complete a tool for the development of agents that integrates unified modeling language (UML) and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers.<br>- Initiate new high assurance security protocols for networks and communications infrastructure with particular emphasis on attack resistance and security management.<br><br>Network Traffic Analysis and Assessment:<br>- Continue all efforts of FY 2009.<br><br>Information Assurance:<br>- Continue all efforts of FY 2009 less those noted as completed above.<br>- Complete a tool suite that will provide evidence of assurance for security products based on the foundations of formal methods that will provide the automated analysis of the implementation based on the security policy. | | | | | |
| KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA)<br><br>A portion of this activity is devoted to mid-term technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition programs of record. This activity area also appears in PE 0602235N. The aspects of a given Enabling Capability (EC) in PE 0602235N focus on component technology, while this PE focuses on the integration of the components and on demonstrations. Warfighter Capability Gaps are being addressed by EC's. Each EC delivers capability-level products to acquisition in a three to five-year effort, and allocates a sufficient investment to ensure a capability is provided.<br><br>The Future Naval Enabling Capabilities in this activity span across the Information Infrastructure, Applications/Tools/Decision Aids, Command and Control, Apertures and Radios, and Tactical Networks and Network Control/Management technology areas. Technologies being developed will integrate sensors, networks, decision aids, weapons and supporting systems into a highly adaptive, human-centric, comprehensive maritime system. This system will operate from the sea bed to space in a Service Oriented Architecture (SOA) that can be used in a Joint Environment. To accomplish this information | | 33.972 | 36.568 | 47.463 | |

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| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |

integration, efforts are underway to develop rapid, accurate decision making and dynamic, efficient, mission-responsive communications and networks. Objectives of the current EC's are:

a) COCOM to Marine Combat ID: Develop technologies that enable all Naval forces to quickly obtain and exchange Blue Force information and provide global synchronization tools in an SOA.

b) Secure Collaboration: Develop technologies that support a Multi-Level Secure (MLS) web server which facilitates Joint/Coalition collaboration in a trusted environment. The payoff for the warfighter is the ability to share data objects quickly, securely, and cost-effectively across security domains. The technology will eliminate cross-domain content synchronization problems, reduce the cost of joint/coalition collaboration and require no changes/additions to existing networks or user workstations.

c) GIG Compliant Networking: Develop technologies that support Global Information Grid (GIG) compliant networking. Specifically, a high altitude, high data rate relay and router for ship-to-ship and ship-to-shore operations will be developed. Other efforts will use an approach to reduce Line of Sight (LOS) antennas on Large Decks and increase performance through an advanced multi-function, RF distribution for VHF-UHF radios. This technical development will use an architecture which allows for integrated elements into superstructure.

d) Combat ID Information Management of Coordinated Electronic Surveillance: Develop capability to dynamically re-task organic sensors in conjunction with f

*FY 2008 Accomplishments:*
COCOM to Marine Combat ID:
- Continued efforts on Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide Global Information Grid (GIG)-compliant core enterprise Services and Community of Interest (COI) Services which ensured warfighting COIs access to information required from any source for rapid situation awareness assessment.

Secure Collaboration:

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| - Completed development of Secure, Distributed Collaboration effort. Transitioned to the PEO for C4I and Space for the Combined Enterprise Regional Information Exchange System (CENTRIXS) for secure collaboration across multiple coalition boundaries and security levels in the maritime environment.<br><br>GIG Compliant Networking:<br>- Completed Ultra High Frequency (UHF)/L-Band phased array antennas for carriers.<br>- Completed the High Altitude Airborne Relay and Router Package to deliver relay/router packages for high and medium altitude platforms across UHF/VHF and Ku-Bands.<br><br>Combat ID in the Maritime Domain to Reveal Combat Intent:<br>- Continued the development of algorithms and software that will provide an automated capability to understand and interpret relationships among objects in the context of the maritime environment to include threat prediction and intent as well as event outcome assessment.<br>- Continued the development and demonstration of software that provides the capability to extract anomalies and provide basic reasoning techniques to separate false alarms from true anomalies. Tests will be conducted in both Limited Technology Experiments and Sea Trials.<br>- Continued the development and demonstration of smart algorithms for each sensor type that enables the translation of signals to information at the node; tactical multi-INT fusion algorithms; enhancements allowing for the fusion of tactical and higher sourced data and for the combined translation of information to actionable intelligence; and a tactical service oriented architecture.<br><br>Automated Control of Large Sensor Networks:<br>- Continued the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications and warnings based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node.<br><br>Focused Tactical Persistent Surveillance:<br>- Initiated the development of a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to the global war on terror. This includes organic sensors | | | | |

| Exhibit R-2a, PB 2010 Navy RDT&E Project Justification | | DATE: May 2009 |
|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | PROJECT NUMBER<br>2919 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| for small tactical expeditionary units, technical development of Quantum dot, Electro-Optic (EO) phase shifted and optical tags for use against vehicles and high priority entities, and technical development to enhance tactical sensor communications for a two-way high data rate radio.<br><br>Globally Netted Joint/Coalition Force Maritime Component Commander:<br>- Initiated development of technology to enable the coordinated Global Joint and Coalition Force Maritime Component Commander (J/CFMCC) capture and share information from sources and processes; with the intended result of managing at least 10,000 tracks per day in a consistent manner to support user awareness and control (current capability is approximately 200 tracks per day globally).<br><br>*FY 2009 Plans:*<br>COCOM to Marine Combat ID:<br>- Complete the Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide GIG-compliant core enterprise Services and COI Services which will ensure warfighting COIs access to information required from any source for rapid situation awareness assessment.<br><br>Combat ID Information Management of Coordinated Electronic Surveillance:<br>- Initiate the development of software that will provide the capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems.<br>- Initiate the development and demonstration of the service oriented network-centric architecture for adapting multi-sensor fusion and adaptive resource management across a network of intelligence sensors in an operational (Sea Trial) environment.<br><br>Combat ID in the Maritime Domain to Reveal Contact Intent:<br>- Continue all efforts of FY 2008. | | | | |

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| Automated Control of Large Sensor Networks:<br>- Continue all efforts of FY 2008.<br>- Initiate the development, integration and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload, tactical RF sensors, sensors to sense the state of a person and smart tactical imagers and acoustic sensors; of novel high bandwidth communications links for tactical UAVs and battery powered high information content tactical sensors; and airborne readers of optical tags.<br><br>Focused Tactical Persistent Surveillance:<br>- Continue all efforts of FY 2008.<br><br>Globally Netted Joint/Coalition Force Maritime Component Commander:<br>- Continue all efforts of FY 2008.<br>- Initiate the development, integration, and demonstration in Sea Trials the near real time ability to access all relevant databases and collect, analyze and disseminate relevant information to Maritime Component Commanders.<br><br>Dynamic Tactical Communications Networks:<br>- Initiate effort to develop and apply emerging technologies that support self-organizing networking and assured communications exchange in tactical communications networks.<br>- Initiate development, integration and demonstration of wireless network auto-configuration and self-organization (including dynamic partitions and merge) algorithms and protocols; distributed and dynamic policy based network management and secure mobility management solutions; network service discovery mechanisms and network-aware middleware-enabled applications; inter-domain (security and routing) protocols for fully-connected domains; and robust and bandwidth efficient group communication protocols for the tactical environment, including disruption tolerance.<br><br>Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC):<br>- Initiate effort to mature, demonstrate and apply emerging technologies that support dynamic and response management and control of net-centric enterprise theater and tactical ASW operations. This | | | | |

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| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| includes automation support for synchronized planning of resources and multi-mission execution, and access and shared awareness of data, activities and status among Maritime Operation Centers and tactical forces in a tactical netted service-oriented architecture (SOA) environment.<br>- Initiate the development, integration and demonstration of SOA tactical services that support C2 by providing decision-quality information to the commander much more rapidly than in the past, and in response to unanticipated changes in operational requirements using data management with disconnected, intermittent, or limited communications paths; shared awareness of track data; adaptation to network conditions; and automated and real-time composition of existing tactical enterprise services to accomplish a new C2 function.<br>- Initiate the development and demonstration of automated techniques for force planning and allocation of resources based on information as it is passed from the Operational Level MOC to the local-tactical level and from local-tactical centers to adjacent local-tactical centers.<br><br>*FY 2010 Plans:*<br>Combat ID Information Management of Coordinated Electronic Surveillance:<br>- Complete the development of software that will provide the capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems.<br>- Complete the development and demonstration of the service oriented network-centric architecture for adapting multi-sensor fusion and adaptive resource management across a network of intelligence sensors in an operational (Sea Trial) environment.<br><br>Combat ID in the Maritime Domain to Reveal Contact Intent:<br>- Continue all efforts of FY 2009.<br><br>Automated Control of Large Sensor Networks:<br>- Continue all efforts of FY 2009. | | | | |

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| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | PROJECT NUMBER<br>2919 |

| B. Accomplishments/Planned Program ($ in Millions) | FY 2008 | FY 2009 | FY 2010 | FY 2011 |
|---|---|---|---|---|
| - Continue the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications and warnings based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node. Tests will be conducted in an Advanced Warfighting Experiment.<br><br>Focused Tactical Persistent Surveillance:<br>- Continue all efforts of FY 2009.<br>- Initiate development, integration, and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload and an RF payload for a tier-2 UAV.<br>- Initiate development, integration, and demonstration of a distributed architecture of smart metadata and analysis tools.<br><br>Globally Netted Joint/Coalition Force Maritime Component Commander:<br>- Continue all efforts of FY 2009.<br><br>Dynamic Tactical Communications Networks:<br>- Continue all efforts of FY 2009.<br><br>Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC):<br>- Continue all efforts of FY 2009.<br><br>High-bandwidth Free-Space Lasercomm:<br>- Initiate the development of software/hardware for mitigation techniques for laser beam propagation through atmospheric turbulence and aerosol obscuration; fast acquisition and fine beam steering/ tracking algorithms; characterization of performance/affordability of mechanical steering to not-so-mature electronic steering approaches under the Adaptive Photonic Phase-Locked Elements (APPLE) program.<br>- Initiate the development of wide-area avalanche photo-diode receive array techniques; high bandwidth wide field-of-view retro-reflector optics; and adaptive bit rate and transmit power control. | | | | |

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| **B. Accomplishments/Planned Program ($ in Millions)** | | **FY 2008** | **FY 2009** | **FY 2010** | **FY 2011** |
| - Initiate the development and integration of turbulence mitigation techniques to dual-mode free-space optical terminal electronics/optics.<br>- Initiate the development and demonstration of adaptive bit rate (10 Mbps-1 Gbps) and transmit power control; wide-area avalanche photo-diode receive array technique; high bandwidth wide field-of-view retro-reflector optics.<br>- Initiate the development of platform specific (e.g., P3/E2-C or ship or sub periscope mount) terminal configuration and 'disadvantaged platform' specific retro-reflector configuration.<br><br>Actionable Intelligence Enabled by Persistent Surveillance:<br>- Initiate development, integration and demonstration of an active liquid crystal lens for a very high resolution focal plane array, a distributed architecture of smart meta data and analysis tools, and control laws that allow a tier-2 UAV to satisfy flight safety standards required in manned airspace. | | | | | |
| MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID)<br>Multi-Source Integration (MSI), Advanced Sensor Netting Technology (ASNT), and Composite Combat Identification (CCID) technology address theater air and missile defense (TAMD) needs for data fusion, correlation of and reasoning over attributes leading to target Identification, and sensor fusion/management. This effort develops algorithms for use by air defense combat systems which will then be able to fuse, filter, and correlate on-board sensor and off-board battlespace information from all sources to achieve one common Combat Identification (CID) solution using Theater-wide information. This activity supports the Sea Shield Enabling Capability for Real Time Long Range Air Defense CID in Support of Early Engagements and related CID Science & Technology to be worked under FORCEnet.<br><br>Decrease from FY 2008 reflects the completion of efforts within this activity in FY 2008.<br><br>*FY 2008 Accomplishments:*<br>Real-Time Long Range Air Defense Combat ID in Support of Early Engagements:<br>- Completed technology transition to the E-2C/D Program Management Office (PMA-231), Intelligence, Surveillance, Reconnaissance, and Information Operations Program Office (PMW-180), and PEO-IWS. | | 2.824 | 0.000 | 0.000 | |

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**C. Other Program Funding Summary ($ in Millions)**

| | FY 2008 | FY 2009 | FY 2010 | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| PE 0204152N/E-2 Squadrons | | | | | | | | | Continuing | Continuing |
| PE 0205601N/HARM Improvement | | | | | | | | | Continuing | Continuing |
| PE 0206313M/Marine Corps Communications Systems | | | | | | | | | Continuing | Continuing |
| PE 0303140N/Information Systems Security Program | | | | | | | | | Continuing | Continuing |
| PE 0308601N/Modeling and Simulation Support | | | | | | | | | Continuing | Continuing |
| PE 0601153N/Defense Research Sciences | | | | | | | | | Continuing | Continuing |
| PE 0602114N/Power Projection Applied Research | | | | | | | | | Continuing | Continuing |
| PE 0602123N/Force Protection Applied Research | | | | | | | | | Continuing | Continuing |
| PE 0602131M/Marine Corps Landing Force Technology | | | | | | | | | Continuing | Continuing |
| PE 0602235N/Common Picture Applied Research | | | | | | | | | Continuing | Continuing |
| PE 0602236N/Warfighter Sustainment Applied Research | | | | | | | | | Continuing | Continuing |

| Exhibit R-2a, PB 2010 Navy RDT&E Project Justification | | DATE: May 2009 |
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| | | |
|---|---|---|
| PE 0602271N/ Electromagnetic Systems Applied Research | | |
| PE 0603114N/Power Projection Advanced Technology | Continuing | Continuing |
| PE 0603123N/Force Protection Advanced Technology | Continuing | Continuing |
| PE 0603236N/Warfighter Sustainment Advanced Technology | Continuing | Continuing |
| PE 0603271N/ Electromagnetic Systems Advanced Technology | Continuing | Continuing |
| PE 0603609N/ Conventional Munitions | Continuing | Continuing |
| PE 0603640M/USMC Advanced Technology Demonstration (ATD) | Continuing | Continuing |
| PE 0603658N/Cooperative Engagement | Continuing | Continuing |
| PE 0603750D8Z/ Advanced Concept Technology Demonstrations | Continuing | Continuing |
| PE 0604307N/Surface Combatant Combat System Engineering | Continuing | Continuing |
| PE 0604518N/Combat Information Center Conversion | Continuing | Continuing |

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**D. Acquisition Strategy**

Not applicable.

**E. Performance Metrics**

Performance metrics are discussed within the project (R2a).

| Exhibit R-2a, PB 2010 Navy RDT&E Project Justification | | | | | | | | DATE: May 2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| APPROPRIATION/BUDGET ACTIVITY<br>1319 - Research, Development, Test & Evaluation, Navy/BA 3 - Advanced Technology Development (ATD) | | | | R-1 ITEM NOMENCLATURE<br>PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY | | | | | PROJECT NUMBER<br>9999 | |
| **COST ($ in Millions)** | **FY 2008 Actual** | **FY 2009 Estimate** | **FY 2010 Estimate** | **FY 2011 Estimate** | **FY 2012 Estimate** | **FY 2013 Estimate** | **FY 2014 Estimate** | **FY 2015 Estimate** | **Cost To Complete** | **Total Cost** |
| 9999: CONGRESSIONAL PLUS-UPS | 2.513 | 0.000 | 0.000 | | | | | | Continuing | Continuing |

**A. Mission Description and Budget Item Justification**

N/A

**C. Other Program Funding Summary ($ in Millions)**

N/A

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

N/A

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