Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*				R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**FY 2011 Base Estimate**	**FY 2011 OCO Estimate**	**FY 2011 Total Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	86.583	104.531	96.720	0.000	96.720	55.951	47.983	49.036	40.404	Continuing	Continuing
2919: *Communications Security*	86.583	102.938	96.720	0.000	96.720	55.951	47.983	49.036	40.404	Continuing	Continuing
9999: *Congressional Adds*	0.000	1.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.970

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 (Feb 2009). 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.

The Common Picture Program supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Combatant Commanders (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 Command and Control (C2) for Tactical Forces and Maritime Operations

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603235N: *Common Picture Advanced Technology*

Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; OCO Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; Pro-Active Computer Network Defense and Information Assurance; Fast Magic; and Naval Rearch Laboratory (NRL) Space.

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 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	90.050	108.394	0.000	0.000	0.000
Current President's Budget	86.583	104.531	96.720	0.000	96.720
Total Adjustments	-3.467	-3.863	96.720	0.000	96.720
• Congressional General Reductions		-0.457			
• Congressional Directed Reductions		0.000			
• Congressional Rescissions	0.000	-0.106			
• Congressional Adds		1.600			
• Congressional Directed Transfers		0.000			
• Reprogrammings	-1.323	0.000			
• SBIR/STTR Transfer	-2.144	0.000			
• Program Adjustments	0.000	0.000	96.720	0.000	96.720
• Rate/Misc Adjustments	0.000	-4.900	0.000	0.000	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 9999: *Congressional Adds*		
Congressional Add: *4D Data Fusion Visualization*	0.000	1.593
Congressional Add Subtotals for Project: 9999	0.000	1.593
Congressional Add Totals for all Projects	0.000	1.593

Exhibit R-2, RDT&E Budget Item Justification: PB 2011 Navy	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	**R-1 ITEM NOMENCLATURE** PE 0603235N: *Common Picture Advanced Technology*

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

FY11 from previous President's Budget is shown as zero because no FY11-15 data was presented in President's Budget 2010.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
2919: *Communications Security*	86.583	102.938	96.720	0.000	96.720	55.951	47.983	49.036	40.404	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): 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; OCO Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; Pro-Active Computer Network Defense and Information Assurance; Fast Magic; and NRL Space.

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).

B. Accomplishments/Planned Program ($ in Millions)

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	3.886	0.000	0.000	0.000	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.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity. This activity transfers to PE 0603271N in FY 2010. *FY 2009 Accomplishments:* GPS Anti-Jam (AJ) Antennas and Receivers: - Completed the development of Enhanced AJ GPS Receiver Technology. - Completed the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project. Precision Time and Time Transfer: - Completed the GPS Synchronization of a Chip-scale Atomic Clock project. - Completed the Qualification of a Commercial-Off-The-Shelf Miniature Atomic Clock project. Non-GPS Navigation Technology: - Completed the development of Integrated Optically Transduced Gyro Assembly project. - Completed the development of Scaleable Integrated Micro Optical Gyroscope project. - Completed the development of Navigation Grade Microfabricated Integrated Optical Gyro project. - Completed the development of Navigation Grade Sub-Harmonic Lateral Mode Gyro project. - Completed the Simultaneous Localization and Mapping Inertial Measurement Unit non-GPS Navigator project. In addition to being performed here in FY 2009, the following efforts transfer to PE 0603271N in FY 2010: GPS Anti-Jam Antennas and Receivers: - Continued the Adaptive Temporal Suppression of GPS Structured Interference project.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system. Precision Time and Time Transfer: - 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). Non-GPS Navigation Technology: - Continued the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer. - Continued the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications. - Continued the MEMS Gyro-cluster INS for Tactical Platforms project. - Continued the Precision Celestial Navigation System (PCNS) project. - Continued the Dead Reckoning Advanced Tight Coupling (DRATC) project. - Continued the navigation grade Inertial Navigation System (INS) using fiber optic/MEMS gyros and electro-optic accelerometers. - Initiated the development of the Sonar Aided Bathymetric Navigation Technology. - Initiated the Optically Transduced MEMS Inertial Navigation System project. - Initiated the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Initiated the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project.					
HIGH-INTEGRITY GLOBAL POSITIONING SYSTEM (HIGPS) 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 GPS navigation and timing capabilities. Enhancements include improved anti-jam performance,	48.445	56.151	40.911	0.000	40.911

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
improved accuracy of navigation and positioning, increased availability of satellite navigation signals, improved accuracy in time stability transfer, and faster acquisition times. 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. 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. The decrease from FY 2010 to 2011 is due to the completion of research and demonstration activities for the HIGPS TCD project. *FY 2009 Accomplishments:* - Continued the HIGPS 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 2009 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. *FY 2010 Plans:* - Continue the HIGPS TCD project. *FY 2011 Base Plans:* - Complete the HIGPS TCD project.					
INFORMATION SECURITY RESEARCH	1.902	1.698	1.840	0.000	1.840

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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: 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. 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. 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. The decrease between FY 2009 and FY 2010 was due to an increased level of effort on a one time basis during FY 2009 to support Information Security Research associated with software programmable payload opportunities. The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2009 Accomplishments:* Network Situation Awareness & Security: - Continued development of a tool for the development of agents that integrates UML and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers. Network Traffic Analysis and Assessment:					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- 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. - Continued 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 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. - Completed 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. - 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. - Initiate new high assurance security protocols for networks and communications infrastructure with particular emphasis on attack resistance and security management. Network Traffic Analysis and Assessment: - Continue all efforts of FY 2009.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Information Assurance: - Continue all efforts of FY 2009 less those noted as completed above. - 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. *FY 2011 Base Plans:* Network Situation Awareness & Security: - Continue all efforts of FY 2010 less those noted as completed above. Network Traffic Analysis and Assessment: - Complete 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. - Complete the development of capabilities and an infrastructure that will support the management of high assurance devices/components used within Navy networks. Ensure the approach is supported by the Navy's network centric architecture. Information Assurance: - Continue all efforts of FY 2010 less those noted as completed above. - Initiate enclave boundary security controller to protect Navy networks from attack and exploitation with emphasis on addressing malware, detection, data exfiltration, general attack detection, network reconstitution, exploitable cross-infrastructure dependencies.					
KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA) 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	32.350	45.089	53.969	0.000	53.969

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
aspects of a given 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. 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, and Computer Network Defense and Information Assurance 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 integration, efforts are underway to develop rapid, accurate decision making and dynamic, efficient, mission-responsive communications and networks. Objectives of the current ECs 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 Service Oriented Architecture (SOA). b) Combat ID Information Management of Coordinated Electronic Surveillance: Develop 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. Demonstrations will be conducted in an operational Sea Trial environment. The benefits to the war-fighter include: More effective use of tactical sensors to maintain track and identify consistent with Commander's priorities; tactical sensor resources allocated effectively to complement					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Intelligence coverage; reduction in exposure of friendly forces to hostile action; order of magnitude reduction to false recognition and improper identification of significant military entities consistent with sensor capabilities; SOA enabled applications and infrastructure. c) Combat ID in the Maritime Domain to Reveal Contact Intent: Develop 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. Benefits to the Naval decision-maker include: automated interpretation of asset relationships and threat/impact assessment; automated processing over wide disparate datasets; recognition of anomalies, and proactive means to confirm or discount suspicious activity; framework extension of fusion to a real-time SOA enterprise environment. d) Automated Control of Large Sensor Networks: Develop a capability for automated and mission specific tactical sensor fields capable of fulfilling specific mission objectives with smart sensors that are capable of forwarding knowledge vice raw data. Technical development efforts also include a fusion engine capable of translating tactical sensor data into appropriate situational awareness for battalion level forces and below. Integration of the tactical sensor network with Distributed Common Ground System (DCGS) will assure that fusion, visualization, resource management and information dissemination engines run seamlessly from the individual Marine to the Commander, Joint Task Force (CJTF). e) OCO Focused Tactical Persistent Surveillance: Develop a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to OCO. This includes organic sensors for small tactical expeditionary units, capable of supporting the dynamic character of modern operations from the highly mobile to the long-term. Also, Tracking, Tagging and Locating (TTL) technical development of Quantum dot, Electro-Optic (EO) phase shifted and optical tags for use against vehicles and high priority entities. Finally the effort includes technical development to enhance					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
tactical sensor communications for a two-way high data rate radio. Technology allows for automatic adaptation of waveforms for increased network capacity. f) Globally Netted Joint/Coalition Force Maritime Component Commander: Develop 'globally-networked, theater-focused' maritime capabilities to enhance Joint Task Force (JTF) and COCOMs' ability to execute their intentions. The efforts will support multiple users and multiple roles to access data at any command echelon; provide consistent, qualified, and traceable operational & tactical maritime information across theaters; provide pedigree to provide a clear representation of complex situation and threat elements; supports user interaction across the SOA environment. The benefits to Naval forces include: exploitation of navy presence FORWARD to monitor vessels, people, cargo and designated missions, areas of interest within the global maritime environment; access to all relevant databases; and collection, analysis, and dissemination of relevant information. g) Dynamic Tactical Communications Networks: Develop, integrate and demonstrate dynamically adaptive automated software algorithms, protocols, and network management techniques that provide a rapidly auto-configuring and self-organizing networking capability. This capability will adapt to available links of opportunity at lower echelons and assure priority movement of critical data intra-network and through reachback gateway networks that interface with the Global Information Grid (GIG) across multiple security/routing domains. Benefits of this effort to the war-fighter include: timely exchange of situational awareness and C2 information for the Naval Expeditionary Combatant forces; high throughput tactical network access/delivery, SOA and coalition interoperability through a reliable communications grid; ad-hoc re-tasking and targeting of warriors, weapons and sensors with minimum human intervention; shortened kill chain for tactical engagement missions. h) Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): Develop a capability that will provide the maritime commander with agile and responsive control and management of tactical Anti-Submarine Warfare (ASW) interactions in a net-centric enterprise environment. Focus will address					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
classified ASW requirements for command and control at the tactical level. Benefits to Naval forces include flexible command and control among tactical units with severely degraded communications with the Maritime Operations Center. i) High-bandwidth Free-space Laser Communication (Lasercomm): Develop an affordable, reliable and high-bandwidth Free-Space Lasercomm capability which is adaptive and agile in mitigating a wide range of atmospheric and sea surface/state turbulence, precipitation and obscuration conditions. Benefits include real-time high-bandwidth direct ship-ship, ship-air and ship-shore links in RF denied environments; enhanced reachback for Forward Operating Bases (FOB) to Marine expeditionary Command Operation Centers (COC) with limited SATCOM access; and biometrics information sharing between Marine Interdiction Operation (MIO) parties. j) Actionable Intelligence Enabled by Persistent Surveillance: Develop a capability to provide accurate threat detection by exposing the enemy's vulnerabilities, unmasking their latent networks, discovering their tactics, techniques, procedures and exploiting in new ways the vast amount of sensor data available today against an irregular threat. Also being developed: an electro-optical, infrared and laser Intelligence, Surveillance, and Reconnaissance Targeting (ISRT) optics technology, capable of wide Field of View/Field of Range (FOV/FOR) at variable resolution & pointing direction, for installation in mobile platforms without gimbals; a light weight, low cost sensor suite and autonomy algorithms to enable detection and avoidance of all classes of aircraft or Unmanned Aerial Vehicles (UAV). k) Pro-Active Computer Network Defense and Information Assurance: Develop a capability to 1) identify and counter real-time threats to the network during mission execution; 2) provide dynamic security management and component management of network-based assets to support mission execution; and 3) ensure mission essential capabilities and data exist despite malicious cyber actions. Specific efforts include: 1) Next Generation Sensors and Gateways to provide security and control mechanisms to protect networks, data and systems from attacks (e.g., malicious code, data exfiltration);					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
2) Next Generation Security Protocols and Security Management Protocols to provide hardened, highly survivable, stealthy, reconfigurable overlay of protocols onto networks to ensure network-base configuration and control of security components essential to mission operations, as well as provide data provenance to support dynamic resource management and decision support; and 3) Common Operational Security Decision System to aggregate, correlate, fuse and visualize network security posture information to support integrated warfighting decisions. l) Fast Magic: Develop a capability for enabling Information Operations from tactical platforms in a net-centric environment. Details are classified. m) NRL Space: Develop a capability to integrate multiple sensor information from multiple net-centered data stores in a service oriented architecture environment for persistent vessel tracking situational awareness. Details are classified. The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity. The increase from FY 2009 through FY 2010 is due to the initiation of 5 new FNC ECs and to the expansion of investment within ECs which will commence in FY 2009. New EC initiations for FY 2010 include: Free-space Optical Terminal (FOT), Modulating Retro-reflector Unit (MRU), Autonomous UAV Collision Avoidance System, Operational Adaptation Enterprise Services, and Ultra Wide FOV Area Surveillance System. The FY 2010 shift in FNC investment within 0603235N is consistent with overall program objectives and maturation of research initiatives within this PE. FNC program investment remains consistent with prior year plans and Navy objectives and approval. The increase from FY 2010 to FY 2011 is associated with the following:					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate three new FNC Enabling Capabilities (ECs): Pro-Active Computer Network Defense and Information Assurance, Fast Magic, and NRL Space. - Continue ramp up of ongoing EC efforts: High-bandwidth Free-space Lasercomm, GWOT Focused Tactical Persistent Surveillance, Globally Netted Joint/Coalition Force Maritime Component Commander, Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC), Actionable Intelligence Enabled by Persistent Surveillance, and FNC Common Picture Technology. *FY 2009 Accomplishments:* COCOM to Marine Combat ID: - Completed the Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide GIG-compliant core enterprise Services and Community of Interest (COI) Services which will ensure warfighting COIs access to information required from any source for rapid situation awareness assessment. Combat ID Information Management of Coordinated Electronic Surveillance: - Initiated 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. - Initiated 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. Combat ID in the Maritime Domain to Reveal Contact Intent: - 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- 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. - 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. Automated Control of Large Sensor Networks: - 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. - Initiated 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. OCO Focused Tactical Persistent Surveillance: - Continued the development of a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to overseas contingency operations. This includes organic sensors 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. Globally Netted Joint/Coalition Force Maritime Component Commander:					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continued 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). - Initiated 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. Dynamic Tactical Communications Networks: - Initiated effort to develop and apply emerging technologies that support self-organizing networking and assured communications exchange in tactical communications networks. - Initiated 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. Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Initiated 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 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 SOA environment. - Initiated 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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. - Initiated 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. Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund. *FY 2010 Plans:* Combat ID Information Management of Coordinated Electronic Surveillance: - 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. - 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. Combat ID in the Maritime Domain to Reveal Contact Intent: - Continue all efforts of FY 2009. Automated Control of Large Sensor Networks: - Continue all efforts of FY 2009. - 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					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
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 during FY 2010. OCO Focused Tactical Persistent Surveillance: - Continue all efforts of FY 2009. - 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. - Initiate development, integration, and demonstration of a distributed architecture of smart metadata and analysis tools. Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2009. Dynamic Tactical Communications Networks: - Continue all efforts of FY 2009. Dynamic C2 for Tactical Forces and MOC: - Continue all efforts of FY 2009. High-bandwidth Free-Space Lasercomm: - 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. - 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate the development and integration of turbulence mitigation techniques to dual-mode free-space optical terminal electronics/optics. - 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. - 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. Actionable Intelligence Enabled by Persistent Surveillance: - 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. *FY 2011 Base Plans:* Combat ID in the Maritime Domain to Reveal Contact Intent: - Complete 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. - Complete 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. - Complete 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. Automated Control of Large Sensor Networks:					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Complete 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. - Complete 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. Tests will be conducted in an Advanced Warfighting Experiment. OCO Focused Tactical Persistent Surveillance: - Continue all efforts of FY 2010. Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2010. Dynamic Tactical Communications Networks: - Continue all efforts of FY 2010. Dynamic C2 for Tactical Forces and MOC: - Continue all efforts of FY 2010. High-bandwidth Free-space Lasercomm: - Continue all efforts of FY 2010. Actionable Intelligence Enabled by Persistent Surveillance: - Continue all efforts of FY 2010.					

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 2919: *Communications Security*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Pro-Active Computer Network Defense and Information Assurance: - Initiate the development, integration and demonstration of Next Generation Sensors and Gateways to provide security and control mechanisms to protect networks, data and systems from attacks (e.g., malicious code, data exfiltration.) - Initiate the development, integration and demonstration of Next Generation Security Protocols and Security Management Protocols to provide hardened, highly survivable, stealthy, reconfigurable overlay of protocols onto networks to ensure network-base configuration and control of security components essential to mission operations, as well as provide data provenance to support dynamic resource management and decision support. - Initiate the development, integration and demonstration of Common Operational Security Decision System to aggregate, correlate, fuse and visualize network security posture information to support integrated warfighting decisions. Fast Magic: - Initiate the development of algorithms and demonstration of technologies and software for enabling Information Operations from tactical platforms in a net-centric environment. Details are classified. NRL Space: - Initiate the development of multiple intelligence fusion algorithms and software for dynamic distributed computing environments. Demonstrate the capability to integrate multiple sensor information from multiple net-centered data stores in a service oriented architecture environment for persistent vessel tracking situational awareness.					
Accomplishments/Planned Programs Subtotals	86.583	102.938	96.720	0.000	96.720

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy		DATE: February 2010
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C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
• 0602235N: *COMMON PICTURE APPLIED RESEARCH*	27.585	26.752	34.334	0.000	34.334	27.318	15.424	7.179	2.185	0.000	140.777

D. Acquisition Strategy

N/A

E. Performance Metrics

This PE supports the development of technologies that 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. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.

Specific examples of metrics under this PE include:

- Enable the coordinated Global Joint and Coalition Force Maritime Component Commander to 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).
- Enable faster planning of assets allocated to fill ISR coverage gaps by 100 times; 100 percent more coverage or 50 percent reduction in sensor asset usage to enable more effective allocation of assets to eliminate redundant ISR coverage; 95 percent of all significant military objects correctly located, tracked and identified.
- Enable self-organizing tactical communication networks by increasing multimember network size from 20 nodes to 200 nodes; decreasing time for networks auto-configuration from hours to five minutes for 200 nodes; and decreasing time for individual entities to join or leave a network from minutes (often hours) to 10 seconds.

Exhibit R-2A, RDT&E Project Justification: PB 2011 Navy			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603235N: *Common Picture Advanced Technology*	PROJECT 9999: *Congressional Adds*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	FY 2011 Base Estimate	FY 2011 OCO Estimate	FY 2011 Total Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	1.593	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24.970

A. Mission Description and Budget Item Justification

Congressional add.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Add: 4D Data Fusion Visualization *FY 2010 Plans:* This effort supports 4-D Data Fusion Visualization research.	0.000	1.593
Congressional Adds Subtotals	0.000	1.593

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional add.