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 0603271N: *Electromagnetic Systems 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	56.092	75.506	82.143	14.100	96.243	101.071	105.239	108.364	97.743	Continuing	Continuing
2913: *Electromagnetic Systems Advanced Technology*	37.144	58.577	82.143	0.000	82.143	101.071	105.239	108.364	97.743	Continuing	Continuing
2933: *Wide Focal Planar Array Camera S&T*	0.000	0.000	0.000	14.100	14.100	0.000	0.000	0.000	0.000	0.000	14.100
9999: *Congressional Adds*	18.948	16.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	131.879

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 Element (PE) address technologies critical to enabling the transformation of discrete functions to network centric warfare capabilities which simultaneously perform Radar, Electronic Warfare (EW), and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links. The Electromagnetic Systems Advanced Technology program addresses Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems. The Program emphasizes near to mid-term transition opportunities by developing and demonstrating technologies supporting the Future Naval Capabilities (FNC) Program Enabling Capabilities (ECs): Long Range Detection and Tracking, Advanced Electronic Sensor Systems for Missile Defense, Satellite Communication (SATCOM) Vulnerability Mitigation; Affordable Common Radar Architecture, Next Generation Countermeasures Technologies for Ship Missile Defense, Next Generation Airborne Electronic Attack, Low Cost Over the Horizon Communication, SATCOM and Line of Sight (LOS) Apertures, Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms, Countermeasures Technologies for Anti-Ship Missile Defense (ASMD), Global Applications for Data Exfiltration (GLADEX), and Radar Electronic Attack Protection (REAP). Within the Naval Transformational Roadmap, this investment offers affordable options for the transformational capabilities required by the Sea Shield (Theater Air and Missile Defense), Sea Strike (Persistent Intelligence, Surveillance, and Reconnaissance), and ForceNet (Communications and Networking) SeaPower 21 Naval Warfighting Pillars.

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 0603271N: *Electromagnetic Systems Advanced Technology*

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	55.866	65.827	0.000	0.000	0.000
Current President's Budget	56.092	75.506	82.143	14.100	96.243
Total Adjustments	0.226	9.679	82.143	14.100	96.243
• Congressional General Reductions		-0.315			
• Congressional Directed Reductions		-7.000			
• Congressional Rescissions	0.000	-0.006			
• Congressional Adds		17.000			
• Congressional Directed Transfers		0.000			
• Reprogrammings	1.259	0.000			
• SBIR/STTR Transfer	-1.033	0.000			
• Program Adjustments	0.000	0.000	82.143	0.000	82.143
• Rate/Misc Adjustments	0.000	0.000	0.000	14.100	14.100

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2009	FY 2010
Project: 9999: *Congressional Adds*		
Congressional Add: *C BAND ACTIVE ARRAY RADAR*	3.989	0.000
Congressional Add: *PACIFIC AIRBORNE SURVEILLANCE & TESTING*	14.959	16.929
Congressional Add Subtotals for Project: 9999	18.948	16.929
Congressional Add Totals for all Projects	18.948	16.929

Change Summary Explanation

Technical: FY 2010 reflects the realignment of the Global Positioning System (GPS) & Navigation Technology Activity from PE 0603235N because the technology development efforts are directly related to the current mission of this Program Element.

Schedule: Not applicable.

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 0603271N: *Electromagnetic Systems Advanced Technology*

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems 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
2913: *Electromagnetic Systems Advanced Technology*	37.144	58.577	82.143	0.000	82.143	101.071	105.239	108.364	97.743	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project emphasizes near to mid-term transition opportunities by developing and demonstrating technologies which enable affordable options for transformational capabilities required by the Sea Shield, Sea Strike, and ForceNet pillars. Work in this project addresses cost-effective RF technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
ADVANCED MULTI-FUNCTION RF TECHNOLOGY	37.144	0.000	0.000	0.000	0.000
This effort develops, demonstrates, and transitions affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures capable of transmitting and receiving multiple, simultaneous, independent RF beams while providing reduced signature and numbers of apertures. Program activity goals include development and demonstration of multi functional RF technologies applicable to systems development for Advanced Destroyers (DD(X)), Advanced Cruisers (CG(X)), Aircraft Carriers (CVNs), and other ship classes. These technologies will provide reduced recurring costs for total system functionality; reduced number of topside antennas and support systems; reduced ship radar cross section; reduced number of unique spares and lower ship manning requirements; ability to upgrade systems and capabilities with reduced cost, time, and complexity while mitigating the risk of obsolescence; and ability to rapidly exploit technological innovation through open systems concepts. This activity also includes Multifunction Systems Technology developments that directly support the Department of Defense Joint Warfighter Science and Technology Plan and the Defense Technology Area Plans.					
The objective is as follows:					

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Development of an affordable, open architecture Digital Array Radar for CG(X). Development, testing, and technology demonstration of communications, electronic attack, electronic surveillance, and radar functions in multi-function apertures. Development of a Multi Function Electronic Warfare (MFEW)/Electronic Surveillance (ES) Advanced Development Model (ADM) architecture demonstrating key ES capabilities for several simultaneous ES functions and capable of supporting additional RF functions. Conducting MFEW/ES ADM testing that satisfies DD(X) acquisition program Technology Development (TD) phase requirements to enable a smooth transition of AMRF technology to the DD(X) System Development and Demonstration (SDD) Acquisition Phase with minimal changes in system architecture. Electronic Attack (EA) Techniques maintain effective countermeasures in the face of increasingly sophisticated naval threats. *FY 2009 Accomplishments:* In addition to being performed here in FY 2009, the following efforts transfer to the Integrated Topside (INTOP) Innovative Naval Prototype R2 Activity in FY 2010: - Initiated Integrated Digital Apertures and Array Radar System (IDAARS), a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and provide the appropriate control and synergy of the functionality such that the RF functions automatically support one another providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle to ensure continuing competition for maintenance and replacement parts. - Initiated technical studies of enabling RF components for submarine SATCOM arrays. (Which is a part of the above IDAARS effort.)				

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiated SATCOM Array technical designs. (Which is a part of the above IDAARS effort.) - Initiated studies for EA design as follow-on to MFEW capability for forward-fit and back-fit. (Which is a part of the above IDAARS effort.) - Initiated development of architecture and interfaces and their application to wide-band SATCOM communications array for submarines. (Which is a part of the above IDAARS effort.) - Initiated development of functional queue management software. (Which is a part of the above IDAARS effort.) - Initiated development of control interface software for the resource allocation manager. (Which is a part of the above IDAARS effort.) In addition to being performed here in FY 2009, the following efforts transfer to the Electronic and Electromagnetic Systems R-2 Activity in FY 2010: - Continued FNC EC Long Range Detection and Tracking. Captured and extended the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM). - Continued the Next Generation Airborne Electronic Attack effort. - Continued FNC EC Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms. Developed Partial Array consisting of high efficiency non-commercial off-the-shelf (COTS) transmitter element chains using wide band-gap semiconductors, mixed signal digital, RF, microwave, millimeter wave and associated passive components, exploiting Development & Implementation (D&I) advances in high power, high efficiency digital S- and X-band microwave amplifiers to reduce cooling and prime power needs, enabling affordable radar and EA solutions for CG(X) and DD(X). Developed and demonstrated the technology for extending the digital domain further into the transmitter RF hardware, i.e., bringing the digital domain closer to the radiating element, enabling Navy systems to continue to exploit advancements in COTS computing capacity for signal generation and processing, and require the activity to only develop the combined RF/digital hardware. Targeted cost reductions					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
to enable ubiquitous deployment of advanced radiating systems with affordable development and procurement costs. This EC takes the lead for development of efficient, high power RF digital-microwave transmitter technology by exploiting new technologies such as Wide Band Gap (WBG) semiconductors for substantial savings of prime power requirements and topside weight and moment. This provides a potential for smaller ships and reduced acquisition and life cycle costs. - Continued H-60 Tactical Common Data Link (TCDL) project. - Continued Low cost SATCOM-on-the-Move array for Marine Corps. - Continued nested, coplanar array/ Modular Integrated Link Electronics System (MILES) design and integration. - Initiated the Affordable Common Radar Architecture (ACRA) effort by defining interface specifications. - Initiated the Enhanced Nulka Payload FNC effort by starting system architecture design. - Initiated the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by starting system architecture design and Low Voltage Gallium Arsenide (GaAs) High Power Amplifier (HPA) Monolithic Microwave Integrated Circuit (MMIC) purchases. Acquisition Workforce Fund - Funded DoD Acquisition Workforce Fund.					
ELECTRONIC AND ELECTROMAGNETIC SYSTEMS	0.000	33.021	39.124	0.000	39.124
The overarching objective of this activity is to develop, test, and demonstrate communications, electronic attack (EA), electronic surveillance (ES), electronic warfare (EW), and radar functions. This activity also includes development of affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures. A portion of this PE is devoted to mid-term technology development in close concert with acquisition programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition program of record. In this PE, these FNC ECs span across Electronics, EW, Radar, and Communications technology areas. This activity also appears in PE 0602271N. For ECs receiving funding from both PE's, the PE					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
0602271N portion is generally focused on component design and development while the funding from this PE is focused on integration and demonstration. Effective FY 2010, resources and budget justification associated with the FNC ECs, formerly identified with the ADVANCED MULTI-FUNCTION RF TECHNOLOGY activity, are realigned into this activity. This realignment serves to better describe the full electromagnetic spectrum nature of the research initiatives and improve the tracking and justification of FNC initiatives within the budget submission. The major objectives of this activity are: a) Affordable Common Radar Architecture (ACRA) - Develop a scalable, open radar architecture that addresses affordability challenges for 5 different radars. b) Low Cost Over The Horizon (OTH) Communication, SATCOM and Line Of Sight (LOS) Apertures - Provide apertures, link electronics and programmable terminal components that are suitable for multiple platforms. c) SATCOM Vulnerability Mitigation - Develop a diverse, multi-tier communications networking capability for Naval strike forces. d) Long Range Detection and Tracking - Ability to detect, track and identify (ID) future anti-ship ballistic missiles, advanced cruise missiles, aircraft and Unmanned Air Vehicles (UAVs). e) Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms - Develop and demonstrate affordable components in beamforming element chains for efficient S- and X-Band radar, and EA using highly efficient digital solid state electronics components covering the RF and microwave frequencies.					

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
f) Countermeasure Technologies for Anti-Ship Missile Defense (ASMD) - Improve ship survivability by disrupting the terminal engagement phase of hostile Anti-Ship Cruise Missiles/ Anti-Ship Ballistic Missiles (ASCM/ASBM), including improvements to both onboard Surface Electronic Warfare Improvement Program (SEWIP) and offboard Nulka RF EA systems.					
g) Next Generation Countermeasure Technologies for Ship Missile Defense - Develop and demonstrate the fundamental technologies required to conduct next generation, persistent EW in support of ship, sea base, and littoral force missile defense operations in a distributed, coordinated manner across the entire battlespace.					
h) Next Generation Airborne Electronic Attack - Develop and demonstrate advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide Suppression of Enemy Air Defenses (SEAD), deliver Non-Kinetic Fires, counter Integrated Air Defense Systems (IADS), and provide suppression of Command, Control & Communications (C3) links and data networks.					
i) Global Applications for Data Exfiltration (GLADEX) - Develop a capability for monitoring and relay of unattended sensor data for global situational awareness. Benefits include security through encryption, reduced dependence on commercial systems, and reduced collection needs by manned and unmanned in-area assets. It addresses a shortfall to monitor shipping in territorial waters and the open ocean to combat terrorism, and, enforce criminal law.					
j) Radar Electronic Attack Protection (REAP) - Develop single platform precision passive Electronic Support Measure (ESM) and Electronic Protection (EP) techniques and technology to counter hostile use of modern Electronic Attack (EA) self protection jammers.					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
k) Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3 - Develop integrated RF communications and RF jammer capability that addresses the electromagnetic interference (EMI) issue to enable interoperability. The increase from FY 2010 to FY 2011 is due to increased investment supporting research for the JCREW 3.3 effort. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2010 Plans:* Affordable Common Radar Architecture (ACRA): - Continue the ACRA effort by defining interface specifications. This effort is developing a radar architecture which moves the digital conversions as close to the antenna as possible for substantial performance and supportability improvements. Low Cost Over The Horizon (OTH) Communication, Satellite Communication (SATCOM) and Line Of Sight (LOS) Apertures: - Continue H-60 Tactical Common Data Link (TCDL) project. This effort develops a scalable, low cost, light weight, low drag multichannel Jam Resistant (JR) Tactical Common Data Link (TCDL) relay and networking terminal. - Continue Low cost SATCOM-on-the-Move array for Marine Corps. This effort develops a low cost, scaleable SATCOM on-the-move communication system for both High Data Rate (HDR) and Low Data Rate (LDR) Marine Corps vehicular communications. - Continue nested, coplanar array/Modular Integrated Link Electronics System (MILES) design and integration. This effort develops a communications array which will provide Ultra High Frequency (UHF) LOS functionality and Ku-Band communications for Naval Tactical Networking (NTN).					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
SATCOM Vulnerability Mitigation: - Initiate development of hardware and software appliques that implement waveforms, protocols, and techniques to significantly increase the data throughput on High Frequency (HF) communications channels. - Initiate development of multi-link, UHF, millimeter wave, air-to-air, air to ground and SATCOM terminals for networking airborne platforms with other airborne assets. Long Range Detection and Tracking: - Continue FNC EC Long Range Detection and Tracking. Capture and extend the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM). This effort demonstrates the ability to perform simultaneous full volume radar coverage of contacts at long ranges and in dense contact environments. Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue to develop and demonstrate affordable components in beamforming element chains for efficient S- and X-Band radar, and EA using highly efficient digital solid state electronics components covering the RF and microwave frequencies. Countermeasure Technologies for Anti-Ship Missile Defense (ASMD): - Continue the Enhanced Nulka Payload FNC effort by starting system architecture design. This effort develops an affordable and extremely compact RF payload for the Nulka offboard decoy with an Electronically Scanned Array (ESA) transmitter, compact receiver chain, and advanced isolation materials. - Continue the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by starting system architecture design and Low Voltage Gallium Arsenide (GaAs) High Power Amplifier (HPA) Monolithic Microwave Integrated Circuit (MMIC) purchases. This effort develops					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
affordable and reliable solid state transmitter technologies to engage anti-ship cruise and ballistic missile RF seekers. Next Generation Countermeasure Technologies for Ship Missile Defense: - Continue the development of technologies to demonstrate effective EW countermeasures for ship missile defense operations in a distributed coordinated manner across the entire battlespace. Next Generation Airborne Electronic Attack: - Continue the Next Generation Airborne Electronic Attack FNC effort by demonstrating critical subsystems operating in the RF low- and mid-bands. This effort develops and demonstrates advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide suppression of enemy air defenses (SEAD), deliver non-kinetic fires, counter integrated air defense systems (IADS), and provide suppression of C3 links and data networks. *FY 2011 Base Plans:* Affordable Common Radar Architecture (ACRA): - Continue all efforts of FY 2010. Low Cost Over The Horizon (OTH) Communication, SATCOM and Line Of Sight (LOS) Apertures: - Complete H-60 Tactical Common Data Link (TCDL) project (also known as Air Platform Relay and Routing). This effort develops a scalable, low cost, light weight, low drag multichannel TCDL relay and networking terminal. - Complete Low cost SATCOM-on-the-Move array for Marine Corps. This effort develops a low cost, scaleable SATCOM on-the-move communications terminal design for both HDR and LDR Marine Corps vehicular communications. - Complete nested, coplanar array/MILES design and integration. This effort develops a					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
communications array which will provide Ku-Band line of sight communications for naval tactical networking afloat. SATCOM Vulnerability Mitigation: - Continue all efforts of FY 2010. Long Range Detection and Tracking: - Complete FNC EC Long Range Detection and Tracking. Capture and extend the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture DAR single face ADM. This effort demonstrates the ability to perform simultaneous full volume radar coverage of contacts at long ranges and in dense contact environments. Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue all efforts of FY 2010. Countermeasure Technologies for Anti-Ship Missile Defense (ASMD): - Continue all efforts of FY 2010. Next Generation Countermeasure Technologies for Ship Missile Defense: - Continue all efforts of FY 2010. Next Generation Airborne Electronic Attack: - Continue all efforts of FY 2010. Global Applications for Data Exfiltration (GLADEX): - Initiate the development, integration, and demonstration of a nano-sat satellite bus with all its requisite structural, power, thermal, control, and separation subsystems.					

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APPROPRIATION/BUDGET ACTIVITY 1319: *Research, Development, Test & Evaluation, Navy* BA 3: *Advanced Technology Development (ATD)*	R-1 ITEM NOMENCLATURE PE 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Initiate the development, integration, and demonstration of a nano-sat compatible payload and ground terminal for monitoring and relay of unattended sensor data. Radar Electronic Attack (EA) Protection: - Initiate the Identification and Defeat of Electronic Attack Systems (IDEAS) FNC effort by developing single platform precision passive electronic support measure (ESM) and electronic protection (EP) techniques and technology to counter hostile use of modern EA self protection jammers. Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3.3: - Initiate JCREW 3.3 component development.					
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY 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 activity will increase the operational effectiveness of U.S. Naval units. 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). Efforts identified in this R2 activity transfer from PE 0603235N in FY 2010. The major objectives of this activity are: a) GPS Anti-Jam Antennas and Receivers - Integrate and demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; to integrate and demonstrate anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats.	0.000	4.458	4.601	0.000	4.601

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
b) Precision Time and Time Transfer - Integrate and demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; to integrate and 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 - To integrate and demonstrate inertial navigation systems 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; to integrate and demonstrate 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 are non-inclusive examples for projects funded in this activity. *FY 2010 Plans:* GPS Anti-Jam Antennas and Receivers: - Continue the Adaptive Temporal Suppression of GPS Structured Interference project. - Continue the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system. Precision Time and Time Transfer: - 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). Non-GPS Navigation Technology:					

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
- Continue the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer. - Continue the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications. - Continue the MEMS Gyro-cluster INS for Tactical Platforms project. - Continue the Precision Celestial Navigation System (PCNS) project. - Continue the Dead Reckoning Advanced Tight Coupling (DRATC) project. - Continue the navigation grade Inertial Navigation System (INS) using fiber optic/MEMS gyros and electro-optic accelerometers. - Continue the development of the Sonar Aided Bathymetric Navigation Technology. - Continue the Optically Transduced MEMS Inertial Navigation System project. - Continue the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Continue the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project. *FY 2011 Base Plans:* GPS Anti-Jam Antennas and Receivers: - Complete Adaptive Temporal Suppression of Structured Interference. - Complete Anti-spoof Antenna Electronics using ESM and tracking. - Initiate Small Antenna Based Anti-spoofing project. - Initiate Advanced Spoofer Tracking. - Initiate Next Generation Global Positioning Satellite System - Situational Awareness (XGPSS-SA) Challenged Environment. Precision Time and Time Transfer: - Continue all efforts of FY 2010. - Initiate Distributed Time-frequency Device. - Initiate Tactical Grade Atomic Clock.					

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2913: *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Non-GPS Navigation Technology: - Continue all efforts of FY 2010. - Complete 5-cc Accelerometer with EGI System. - Complete MEMS Gyro-cluster. - Complete PCNS project. - Complete DRATC project. - Complete navigation grade INS using MEMS gyro project. - Complete Sonar Bathymetric Navigation. - Initiate Wavewinds project. - Initiate Small Unmanned Underwater Vehicle - Sonar Aided Inertial Navigation Technology (UUV-SAINT) project. - Initiate Portable PCNS project.					
INTEGRATED TOPSIDE (INTOP) INNOVATIVE NAVAL PROTOTYPE (INP) The overarching objective of the INTOP INP is to develop and demonstrate a prototype that integrates RF functions (EW, Radar, Communications, Navigation) into a common set of multi-function apertures through an architecture that is modular, scalable across all platforms, and open at the RF as well as computer and software level. The apertures are capable of providing multiple simultaneous, independent beams which can together perform any of the above functions. Effective FY 2010, resources and budget justification associated with Integrated Topside (INTOP) formerly referred to as Integrated Digital Apertures and Array Radar System (IDAARS) effort are realigned from the activity titled ADVANCED MULTI-FUNCTION RF TECHNOLOGY. This realignment allows for improved description of the critical and unique application of technology, program technical initiatives, and associated resources within the INP program. IDAARS commenced in FY 2009. The major objectives of this activity are:	0.000	21.098	38.418	0.000	38.418

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
a) Submarine SATCOM Array - Develop wide-band SATCOM array capable of supporting EW for submarines. b) Electronic Attack (EA) for Surface Combatants - Develop wide-band transmit array to support EA capability and other functions for surface combatants with potential application to other platforms. c) Architecture, Standards and Devices - Develop architecture and standards for wide-band multi-beam, multi-band arrays and below deck systems and the technology and electronic devices needed to make integrated array systems affordable. d) Surface Combatant Communication Array - Develop wide-band surface combatant communication array capable of supporting other RF functions. e) Resource Allocation Manager - Develop enterprise common Resource Allocation Manager. The increase from FY 2010 to FY2011 is due to increased investment required for the initiation of the development of prototype capability for EA for Surface Combatants. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2010 Plans:* Submarine SATCOM Array: - Complete technical studies of enabling radio frequency (RF) components for submarine SATCOM arrays. - Continue SATCOM Array technical designs. - Initiate prototype array development.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Electronic Attack (EA) for Surface Combatants: - Complete studies for EA design as follow-on to Multi-Function Electronic Warfare (MFEW) capability for forward-fit and back-fit. - Initiate design of EA capability. Architecture, Standards and Devices: - Continue IDAARS, a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and provide the appropriate control and synergy of the functionality such that the RF functions automatically support one another providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle to ensure continuing competition for maintenance and replacement parts. - Continue development of architecture and interfaces and their application to wide-band SATCOM arrays for submarines. - Initiate development of deckhouse and platform integration strategies and concepts. Surface Combatants Communications Array: - Initiate studies of array concepts. Resource Allocation Manager: - Continue development of functional queue management software. - Continue development of control interface software for the resource allocation manager. *FY 2011 Base Plans:* Submarine SATCOM Array:					

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
- Continue all efforts of FY 2010, less those noted as completed above. - Complete SATCOM Array technical designs. - Complete prototype array development. - Initiate integration and test program. Electronic Attack for Surface Combatants: - Continue all efforts of FY 2010, less those noted as completed above. - Initiate development of prototype capability. - Initiate integration and test program. Architecture, Standards and Devices: - Continue all efforts of FY 2010. Surface Combatant Communication Array: - Complete studies of array concepts. - Initiate design effort. Resource Allocation Manager: - Continue all efforts of FY 2010.					
Accomplishments/Planned Programs Subtotals	37.144	58.577	82.143	0.000	82.143

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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
• 0602271N: *ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH*	14.673	19.469	28.829	0.000	28.829	24.803	11.936	5.151	1.303	0.000	106.164

D. Acquisition Strategy

N/A

E. Performance Metrics

Advanced Electronic Sensor Systems for Missile Defense and Long Range Detection and Tracking ECs are aligned to the Navy's Advanced Cruiser (CG(X)) plans and closely coordinated with Naval Sea Systems Command Integrated Warfare Systems (PEO IWS 2.0). Other performance metrics are discussed within the R-2a.

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 0603271N: *Electromagnetic Systems Advanced Technology*	PROJECT 2933: *Wide Focal Planar Array Camera S&T*	

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
2933: *Wide Focal Planar Array Camera S&T*	0.000	0.000	0.000	14.100	14.100	0.000	0.000	0.000	0.000	0.000	14.100

Note

This is a new Overseas Contingency Operations (OCO) project.

A. Mission Description and Budget Item Justification

This effort develops technology to support the maturation and demonstration of sensing and analysis capabilities that can enhance wide area tactical situational awareness and generate actionable intelligence.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Wide Focal Planar Array Camera S&T	0.000	0.000	0.000	14.100	14.100
This effort develops technology to support the maturation and demonstration of sensing and analysis capabilities that can enhance wide area tactical situational awareness and generate actionable intelligence. The major objectives of this activity are: A) Wide Focal Plane Array Camera (WFPAC) sensor - Develop an airborne sensor payload for a Group two-third form factor and procurement of a limited quantity of payloads in support of Unmanned Aerial Vehicle (UAV) integration and field user evaluation. Effort will also develop an advanced Mid Wavelength Infrared (MWIR) focal plane array in order to enable a night Group two-third wide area airborne payload and support Navy UAV integration effort as required.					

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
FY 2011 Base Plans: N/A *FY 2011 OCO Plans:* - Initiate and Complete effort to complete development, testing, integration and initial procurement of a Wide Focal Plane Array Camera (WFPAC) sensor for the RQ-7 "Shadow" Unmanned Aerial System (UAS), also referred to as the Marine Corps Tactical Unmanned Aerial System (MCTUAS), in support of OEF-Afghanistan. - Initiate and Complete development of a 59 megapixel WAAS payload in a shadow form factor by maturing the data link, adding color and a dual field of view for the purposes of field user technology and CONOPs evaluation, fabricate a limited number of sensors (4). - Initiate and Complete maturation for the design of a 64 megapixel mid range IR focal plan array.					
Accomplishments/Planned Programs Subtotals	0.000	0.000	0.000	14.100	14.100

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Successful development of a sensor to provide a 16 square kilometers persistent field of view with a .5m resolution at 10 frames per second (fps), which would allow real time for up to 10 local Common Data Link transceivers while also being stored for post-mission exploitation and forensics at two fps.

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 0603271N: *Electromagnetic Systems 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*	18.948	16.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	131.879

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010
Congressional Add: C BAND ACTIVE ARRAY RADAR *FY 2009 Accomplishments:* This effort supported the development of a C-Band Active Array Radar technology demonstrator.	3.989	0.000
Congressional Add: PACIFIC AIRBORNE SURVEILLANCE & TESTING *FY 2009 Accomplishments:* This effort supported the development of long range surveillance and reconnaissance capabilities that include feature aided tracking, operability in jamming environment, restricted spectrum, and identification of contacts. *FY 2010 Plans:* Continues support of Pacific Airborne Surveillance and Testing research.	14.959	16.929
Congressional Adds Subtotals	18.948	16.929

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

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional Interest Items not included in other Projects.