FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2919 Common Picture Advanced Technology	49,888	36,895	69,194	73,620	62,792	60,262	56,418	57,491
R9020 National Cargo Tracking Program	1,633							
R9145 Command Center Visualization		6,846						
R9146 Improved Shipboard Combat Information Center		3,521						
Total	51,521	47,262	69,194	73,620	62,792	60,262	56,418	57,491

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) includes funds for the advanced technology development, test and evaluation of a dynamic distributed common picture based on leading edge technologies that will improve situational awareness across Command echelons from the Combatant Commander to tactical units afloat and warfighters ashore. The goal is to mature technologies that exploit information and networking technology to ensure mission success in an unpredictable warfighting environment. It creates network centric capability by demonstrating 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. This program will demonstrate the ability to build and maintain a common operational and tactical picture that provides Naval Forces the capability to self-synchronize, increase speed of command, and optimize resource allocations. The Common Picture Program supports the Knowledge Superiority and Assurance (KSA), Missile Defense (MD), Littoral Anti-Submarine Warfare (ASW), and Fleet/Force Protection (FFP) Future Naval Capabilities (FNC). Advanced technologies to be developed, tested and demonstrated include: (1) multi-media information integration, correlation, archiving and tools for knowledge extraction; (2) multi-source integration (MSI) for composite combat identification (CID) and target tracking; (3)cross-ASW platform acoustic data collaboration, sharing and correlation; (4) development of tools to certify systems for dependability and Information Assurance (IA) properties; (5) small platform situational awareness and protection development of composite routing techniques for integrating real-time and near real-time networks; (6)information networks for cooperative target tracking; (7) efforts to find alternative timing and positioning products to reduce the risk of enemy jamming of the Global Positioning System (GPS); and (8) efforts to integrate undersea environmental and marine mammal information into tactical decisions aids and into the common operational picture. Within the Naval Transformation Roadmap, this investment will technically enable and demonstrate

the "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," and "Ship-to-Objective Maneuver" capabilities required by "Sea Strike".

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	49,807	37,753	44,022	63,556
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		10,600		
SBIR Reduction	-1,091			
Execution Adjustments	3,047			
Cong Rescissions/Adjustments/Undistributed Reductions	-242	-579		
S&T Program Adjustments			2,836	865
NWCF Rate Adjustments			-208	-10
Efficiencies at NWCF Activities			-182	-204
Pay Raise/Inflation Adjustments		-512	-1,274	-1,587
USCG Vessel Tracking			10,000	11,000
Joint Program Office Special Technology Countermeasures			14,000	
FY 2004/2005 President's Budget Submission:	51,521	47,262	69,194	73,620

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
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FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Knowledge Superiority and Assurance (KSA)	14,650	16,197	24,713	40,161

KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA): The objective of KSA Future Naval Capability (FNC) is to create and deliver underpinning technologies that enable Network-Centric Operations, including the FORCEnet concept for Naval warfare. The approach involves technology developments in the areas of a) common consistent knowledge, b) dynamically managed, interoperable, high-capacity connectivity, and c) time-sensitive decision-making. Common consistent knowledge meets operating force requirements for common picture information in planning, monitoring and replanning. Dynamically managed interoperable high-capacity connectivity addresses wireless and Quality of Service (QOS) network technology. Time sensitive decision-making supports tactical operations where timeliness and accuracy in decisions is crucial. The pay-off will be knowledge-based threat assessment and rapid response for emergent, time-critical events. The goal of this activity is to support greater speed of command and increased combat power with a reduced workforce.

FY 2002 ACCOMPLISHMENTS:
Developed software and demonstrated the Integrated Decision Support System Product Suite in a laboratory setting, which reduced time critical strike pre-mission planning time by enabling rapid access to relevant information sources, course-of-action analysis, and vulnerability assessments through the use of autonomous software agents. Developed a Link 16 dynamic network management tool and a new time-slot allocation protocol that reconfigures the network faster to allow for entry and exit of network participants and achieves a five-fold throughput improvement over the current fielded operational capability by accessing all available time-slots instead of leaving them dedicated to absent network participants. Demonstrated tactical and operational improvements in the exchange of information between U.S. and Allied/Coalition forces using virtual private networks and secure web servers in the Multi-national Virtual Operations Network Effort. The Commander In Chief Twenty-First Century Advanced Concept Technology Demonstration (CINC 21 ACTD) demonstrated distributed, collaborative planning and execution with an effort that increased speed and quality of command decisions by providing visualization, knowledge management, network monitoring, and collaboration tailored to command decision points. The CINC 21 initiative enabled the Combatant Commanders and Joint Task Force staffs to effectively manage multiple crises and theater security coordination using a flexible web-based decision support portal. The Virtual Information Center Technologies for Open Source Requirements effort provided tailored, web-based access to open source data, enabling naval forces to improve situational understanding by retrieving non-traditional information sources relevant to their operations.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
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FY 2003 PLANS:
Enhance the Integrated Decision Support System Product Suite by conducting at sea demonstrations. Continue the Multi-National Virtual Operation Network with at sea demonstrations in early FY 2003 between UK naval platforms and US naval platforms. Continue the Link 16 efforts, refining and testing the time-slot allocation protocol. This activity will also refine the features of the Virtual Information Center Technologies for Open Source Requirements by improving the filters required to retrieve diverse information. Continue development of a Joint Mission Planning System for Expeditionary Forces Surface Assault Planning (Continued from PE 0602235N). Continue to support the CINC 21 ACTD by developing additional demonstrations of distributed collaborative planning and execution tools to support command decisions. Initiate development of necessary software and system certification of secure coalition web servers to share tactical multiple media data products with coalition forces.

FY 2004 PLANS:
Continue the at-sea demonstration of dynamic reconfiguration of Link 16, the CINC 21 ACTD and the Multi-National Virtual Operational Network. Capitalize on the results of several initiatives to develop large scale integrated end-to-end demonstrations focusing on the following priorities: demonstrating increased speed and quality of command decisions by providing visualization, knowledge management, network monitoring, and collaboration tailored to command decision points; enabling dispersed decision-makers to synchronize operations and assess alternative plans through groupware and collaborative work sessions; enabling integration and information sharing across commands through a web-based crisis management tool; and supporting rapid course of action development (faster than real-time) with simulations and models.

FY 2005 PLANS:
Conduct large scale integrated end-to-end capabilities demonstrations of initiatives that focus course of action analysis (such as the Integrated Product Suite), providing cross-force and cross-echelon situational awareness by demonstrating the capability to manage complex, heterogeneous information through advanced information search, retrieval and management techniques and user-tailorable, intuitive, situation-at-a-glance visualization technology, demonstrating command decision-making, dynamically managed connectivity (e.g., Link 16 and other initiatives), and collaborative planning (CINC 21 ACTD), as well as replanning and rehearsals of operational and tactical forces. These integrated capabilities demonstrations will bring together the technologies developed in previous years for testing in an operational environment to demonstrate improved warfighting support.

	FY 02	FY 03	FY 04	FY 05
Integrated Anti-Submarine Warfare (IASW)	4,600	4,600	0	0

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
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INTEGRATED ANTI-SUBMARINE WARFARE: Integrated ASW (IASW) supports the Littoral Anti-Submarine Warfare (LASW) FNC. The emphasis is on developing a common Anti-Submarine Warfare (ASW) tactical and environmental picture to improve detecting, tracking, and classifying subsurface platforms while reducing false alarms and increasing the timeliness of inputs to the common undersea picture. Technologies that will be developed and demonstrated include cross platform data fusion; common sensor performance predictions across platforms; capturing sensor performance uncertainty; command and control and tactical level data fusion; decision aids and displays for ASW. These technologies will provide input to the common tactical and environmental ASW picture, significantly enhancing ASW effectiveness. While advanced information technology has transformed many aspects of warfare, achieving the same transformation to network-centric capabilities in the ASW environment has proven significantly harder to implement because of restricted connectivity to submarine platforms and bottom-deployed systems. Advances in data fusion, decision aids, and display technologies are needed to fully achieve ASW network-centric warfare.

FY 2002 ACCOMPLISHMENTS:
IASW extended the technology previously developed for inter-platform fusion between surface combatant ships and Maritime Patrol Aircraft (MPA). Efforts were initiated efforts to fuse inter-and intra-platform data to support the common ASW tactical picture and were supported the effort with data collections and at sea operational tests. Data collections were performed in Ship ASW Readiness Measurement (SHAREM) 141 and 142.

FY 2003 PLANS:
IASW will conclude the development and assessment of the advanced inter-and intra-platform fusion engines, installing the fusion hardware and software, conducting the final sea test, and documenting the results of the assessments and sea tests. In particular, the FY 2003 focus of the effort will be on inter-platform fusion of Distant Thunder data. The final deliverable will be an integrated hardware and software system.

FY 2004 PLANS: Not applicable.

FY 2005 PLANS: Not applicable.

	FY 02	FY 03	FY 04	FY 05
Multi-Source Integration (MSI) and Combat Identification (CID)	7,500	3,300	4,006	7,125

MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID): The emphasis of this Missile Defense FNC activity is to mature and test advanced technologies for Multi-Source Integration (MSI) to improve situational awareness and reduce

operator workload; improve cooperative target tracking; improve Combat Identification (CID) to characterize objects in the battlespace and direct military operations and weapons resources with a high degree of confidence; and to extend Naval capabilities for engaging air targets near point of origin by using all source data to formulate a common operational and tactical picture of the total battle space.

FY 2002 ACCOMPLISHMENTS:
This activity initiated efforts to fabricate an advanced development model of the Affordable Ground Based Radar (AGBR). AGBR technology is planned for insertion into the Marine Corps Multi-Role Radar System (MRRS) for development in the Fiscal Year 2005 time frame. (This effort moved to PE 0603271N in FY 2003.)

Other FY 2002 accomplishments include algorithms for the E-2C aircraft MSI which correlate and fuse multiple off-board satellite communications (SATCOM) data. The Composite Combat ID (CCID) project continued to develop algorithms and computer efforts to fuse and correlate EP-3E Story Maker non-real-time Intelligence, Surveillance and Reconnaissance (ISR) identification information with real-time radio frequency (RF) sensors and Cooperative Engagement Capability (CEC) track data. The CCID project also initiated related efforts to correlate ISR data in Ship Signal Exploitation Equipment (SSEE) with CEC track data and to develop a CID common reasoning algorithm for naval open architecture combat systems.

FY 2003 PLANS:
The initial SATCOM MSI capability transitioned to the E-2C acquisition program in December 2002. The MSI project will continue developing algorithms to integrate RF sensors, Identification Friend or Foe (IFF) data, CEC and Joint Tactical Information Distribution System (JTIDS) data. The CCID effort will continue development of algorithms to correlate and fuse CEC data with ISR data processed aboard EP-3E aircraft and SSEE-equipped surface ships and an advanced CID common reasoning algorithm for the naval open architecture combat system.

FY 2004 PLANS:
The MSI effort will continue developing and testing algorithms to integrate RF Sensors, IFF, and JTIDS to SATCOM Electronic Intelligence data broadcasts. An advanced sensor netting technology (ASNT) project begun in FY 2002 in PE 0602235N will continue development of advanced algorithms for integration of electronic surveillance (ES) data into the CEC program. The CCID effort will complete development of algorithms to correlate and fuse CEC data with ISR data processed aboard EP-3E aircraft and continue development of an advanced common reasoning algorithm for the naval open architecture combat system.

FY 2005 PLANS
The MSI effort will continue algorithm development efforts for the integration of RF Sensors, IFF, and JTIDS to SATCOM Electronic Intelligence data broadcasts in the E-2C aircraft and begin efforts to apply these algorithms to other

platforms, including the naval open architecture combat system. The ASNT effort will continue development of advanced algorithms for integration of ES data into the CEC program. The CCID effort will conduct subsystem integration and systems integration laboratory testing of a common reasoning algorithm, while continuing to develop algorithms to correlate and fuse CEC data processed aboard SSEE-equipped surface ships.

	FY 02	FY 03	FY 04	FY 05
Platform Protection/Electronic Warfare Systems	1,000	3,800	8,477	7,336

PLATFORM PROTECTION/ELECTRONIC WARFARE SYSTEMS: This activity supports the Fleet/Force Protection (FFP) FNC. Current small platforms (both surface and airborne) have little to no Situational Awareness (SA) capability which significantly jeopardizes their battlefield effectiveness and combat survivability. This activity addresses developing the Electronic Warfare Integrated System for Small Platforms (EWISSP), a compact, small platform electronic warfare capability consisting of radio frequency (RF) and electro-optic (EO) and infrared (IR) sensors for platforms such as smaller ships, amphibious assault vehicles, and surveillance aircraft. This activity integrates successful proof-of-concept hardware and software developed under PE 0602235N, into systems suitable for capability demonstration under Naval environments and tactical conditions. The SA system, a subset of the EWISSP effort addresses several small surface platform self protection system integration requirements and employs monolithic micro/
ave integrated circuit (MMIC) devices and a new antenna to form an extremely compact, low volume/lightweight system that provides very accurate hemispheric direction finding and self-protection capability against threat missile systems.

FY 2002 ACCOMPLISHMENTS:
During Phase I of the four phase EWISSP initiative, the threats to small Navy and Marine combat platforms were defined, individual vehicle integration and installation requirements/limitations were determined, and measurements of the platform signature (RF/MMW/IR) were conducted.

FY 2003 PLANS:
Plans for FY 2003 for the EWISSP initiative include initiating Phase II acceptance testing of the Shipboard Laser Acquisition System (SBLAS). Ninety-degree system testing will be conducted. The various component modules will be fabricated and integrated within the system. Phase I of the EWISSP initiative will conclude in FY 2003.

FY 2004 PLANS:
The EWISSP initiative will continue with Phase II of its development plan. During the three year Phase II effort, plans include continuation of the development, fabrication, integration, test, and demonstration of a low cost highly

integrated Electronic Warfare (EW) system for small vehicles that operate in a littoral environment. Initial emphasis will be on demonstrating the application of advanced technology to increase the survivability of the Marine Advance Amphibious Assault Vehicle (AAAV). EWISSP will be developed as a highly integrated EW system based on an open architecture design to allow rapid technology insertion. Using the results and technology demonstrated during the previous fiscal year efforts, the development of the SA and Electronic Attack (EA) subsystems that operate in the Millimeter Wave (MMW), RF, EO, and IR regions will begin with subsystem design, parts procurement, and initial assembly and integration. Subsystems will be designed and fabricated to integrate with the AAAV, but with enough flexibility to integrate with small platforms such as the Landing Craft, Air Cushion (LCAC) and Landing Craft, Utility (LCU) vehicles. Testing of a prototype flexible mast for MMW and EO sensors will be performed in parallel with compatibility testing with existing and/or planned basic physical and electrical designs and features of host platforms. Integration of the EWISSP with the AAAV will involve a significant effort due to limited space and power available in the AAAV as well as severe restrictions on modifications to the vehicle's exterior configuration.

FY 2005 PLANS
Phase II will continue with the fabrication, assembly and integration of SA and EA subsystems. Focus will be on hardware and software integration at the subsystem level. Incremental testing of subsystems will be conducted as they are assembled to ensure technical performance requirements are being met. Significant effort will be invested in software integration between subsystems as well as preparing for subsequent system integration and test with component modules assembled into a brass board configuration for laboratory and limited field testing. As part of the transition effort, configuration management of the design will be implemented to track development and integration progress and identify technology insertion points.

	FY 02	FY 03	FY 04	FY 05
Communication Security	15,000	0	0	0

COMMUNICATION SECURITY: Classified Program

	FY 02	FY 03	FY 04	FY 05
Information Security Research	1,000	1,998	1,998	1,998

INFORMATION SECURITY RESEARCH: The goal of this activity is to ensure the continued protection of Navy and Joint information and information systems — the information infrastructure — from hostile exploitation and attack. Protecting the information infrastructure of joint, coalition, and Naval tactical commands requires situational awareness of

network assets and operations. The rapid rate of change in the underlying commercial and government information infrastructures makes the provision of security an increasingly complex and dynamic problem. Information Assurance (IA) technologies and deployment strategies must evolve quickly to meet the rapidly evolving threats and vulnerabilities. In close cooperation with Office of the Chief of Naval Operations and National Security Agency, this activity focuses on integrating successful proof of concept research prototypes developed under PE 0602235N. The goals are to: improve network resistance to denial of service attacks; improve the Indications and Warnings of suspect activities through tool and process development; conduct traffic analysis; develop network sensors to monitor and assess network status and health; identify new capabilities to analyze and network vulnerabilities and attacks; measure the effectiveness of IA protective measures; and recertify IA software.

FY 2002 ACCOMPLISHMENTS:
Proved the mathematical correctness of the security policy model for the next generation Programmable Embedded Infosec Products (PEIP) and the PEIP kernel that provides secure two-way network communications. Designed a new collaborative software tool for security configuration control and management to facilitate combining assurance evidence needed in software system certification and accreditation. Designed network tools for unobserved monitoring and data collection of intrusive behaviors on networks. Validated a prototype device, known as the Naval Research Laboratory (NRL) Network Pump, for securely transferring data from a lower to a higher level of classification.

FY 2003 PLANS:
Continue to examine the tools and methodologies that will ensure network survivability. Develop and validate secure group network protocols for peer-to-peer trusted hosts, as well as developing tools and methodologies to formally prove assurance properties and to enable data analysis from passive monitoring of intrusive network behaviors. Continue the development of the NRL Network Pump.

FY 2004 PLANS:
Continue to develop and validate secure group network protocols within a small enclave, as well as developing the tools and methodologies to formally prove and verify scaleable assurance properties and to enable correlated analysis from passive monitoring of intrusive network behaviors in near real-time. Work on the NRL Network Pump will continue, to include developing methodologies to securely transfer data from a high level of classification to a lower level within an enclave.

FY 2005 PLANS:
Continue to develop and validate general scaleable secure group network protocols for multiple trusted coalition partners along with the tools and methodologies to formally prove and certify assurance properties about information sharing and to enable correlated statistical analysis of pro-active monitoring of intrusive network behaviors in near

real-time. Continue to develop the NRL Network Pump, focusing on the ability to transfer data securely from high to lower levels of classification across dissimilar networks.

	FY 02	FY 03	FY 04	FY 05
Extending the Littoral Battlespace	1,000	1,000	0	0

EXTENDING THE LITTORAL BATTLESPACE: Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) transition phase was re-focused and re-named Joint Task Force Wide Area Relay Network (JTF WARNET). This activity is designed to bring tactical level network connectivity and data interoperability within a Joint Task Force across all services, with operational deployment following final system tests. This activity will demonstrate enhanced integrated command, control/fires, and targeting capability in support of joint dispersed units, thus enabling common situational awareness, enhanced access to joint fires and facilitating dynamic maneuver while reducing fratricides.

FY 2002 ACCOMPLISHMENTS:
The activity focused on transition of proven technologies to multiple acquisition programs and system tests of the ELB ACTD equipment and application suite in preparation for calendar year (CY) 2004 deployment with Joint Task Force elements including a Navy Carrier Battle Group, Amphibious Readiness Group, Marine Air-Ground Task Force, Army Brigade Combat Team and Air Force Air Operations Center. This activity received Joint Requirements Oversight Council (JROC) approval of change of focus from ELB to JTF WARNET. Other accomplishments include procuring long lead radios, authoring application and database elements, and performing system integration and testing. This activity also supported field demonstrations of selected sensor systems in multiple exercises, including Millennium Challenge 02, and established a Transition Integrated Product Process Team to with integrating products across the DoD.

FY 2003 PLANS:
The JTF WARNET will complete final design and integration of hardware and software network components, perform system level integration and testing and conduct system level training for operational forces. This activity will conduct an end-to-end field demonstration of JTF WARNET components culminating in a pre-deployment exercise, prepare for FY 2004 operational deployment and implement transition agreements to acquisition programs of record.

FY 2004 PLANS: Not applicable.

FY 2005 PLANS: Not applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
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	FY 02	FY 03	FY 04	FY 05
Global Positioning System (GPS) & Navigation Technology	3,638	5,000	5,000	5,000

GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY: This activity is concerned with the enhancement of GPS capabilities (in the area of anti-jam technology) and the development of several technologies that provide the Navy with alternative navigation methods to the Global Positioning System (GPS). This activity also develops the atomic clock for inclusion in Naval systems. The alternative navigation methods investigated include GPS receivers with a tightly coupled Inertial Navigation System (INS); organic Link-16 relative navigation; gravity gradiometer development, used in a terrain following concept; and an electro-optic accelerometer developed as an improved element in INS. The atomic clock efforts include small, low-cost Rubidium (Rb), Coherent Population Trapping (CPT) atomic clock development, and Precision Rb Maser Atomic Clock. These areas will provide alternatives to GPS navigation and alternatives to the availability of precision, GPS-provided, time transfer. These areas are being pursued to remove the operational risks associated with enemy jamming of GPS functions.

FY 2002 Accomplishments:
Completed the Anti-Jam (AJ) Automatic Integrity Measurement Equipment (AIME) receiver. Completed the Tightly Coupled GPS and INS effort, in which the range measurement circuit of the GPS receiver was tightly coupled to the INS, achieving very high accuracy and compact size. This approach yields more accurate positioning and has the potential for wide Navy/DoD application and low unit cost. The small, low cost Rb CPT Clock development effort continued as an engineering development model (the size of 40 cc). The development model was completed and underwent laboratory testing. Improved digital circuitry was developed in parallel with present analog circuits. The digital approach produces a significant size and power consumption reduction. The Precision Rb Maser Atomic Clock development effort continued in laboratory testing and involved the development of gas holding cells that minimized wall collision effects and improved stability and precision. In a significant developmental breakthrough, the Atom Interferometer Gravity Gradiometer effort miniaturized the entire apparatus from room-size to microwave oven-size, while increasing sensitivity. Initiated the Electro-optic Accelerometer effort. This Miniature Electro-mechanical System (MEMS) was determined to be uniquely sensitive and established a totally new class of devices within MEMS that were not challenged by high, relative frictional losses and attendant sensor/device noise. Initiated the Organic Link-16 Relative Navigation effort, which will define improved positional accuracy and precision time transfer. Completed GPS-Tightly Coupled GPS device at Raytheon Corporation. The high Immunity to jamming and the small physical size of this device make it very a significant enhancement to military navigation. Proposed compact design of a Gravity Gradiometer Device is a very significant accomplishment because it transforms a room-sized device (funded earlier in this effort) to one that is of the order of

a cubic meter. This technological achievement, when completed, will have a wide range of Terrain-Aided Navigation applications, the most important of which concern submarines.
FY 2003 Plans:
Continue work on atomic clock efforts. A field test unit (FTU) of the small, low cost Rb CPT clock will be produced. The Precision Rb Maser Atomic Clock development research continues, providing very useful technical data to design a next generation precision Rb maser clock. Build on this Rb CPT-Atomic Clock effort, and fabricate a 10 cubic centimeter Rb CPT Atomic Clock. This small size, low power consumption, precision clock can have revolutionary effects upon time transfer among military platforms. The final objective of the Atom Interferometer Gravity Gradiometer effort will be concentrated on reducing the size of the optical and electronic (control) units of the gravity gradiometer. The Atom Interferometer Gravity Gradiometer effort will be completed in FY 2003. Work on the Electro-optic Accelerometer effort will focus on refining the monolithic fabrication process and ensuring that the calibration and stability of the device is suited to representative navigation technology applications. The Organic Link-16 Relative Navigation effort will continue to determine what minimal modifications to the link will provide the spatial and temporal precision needed when GPS is denied. The Scalable Multi-Element Space and Time Array Processing (STAP)-based Adaptive Array will be initiated to suppress jamming signals in the receiver. Initiate the Differential GPS Navigation with Link-16 (DGPS) effort to increase positional accuracy and data reliability. The concept of GPS augmentation such as Wide Area Augmentation System (WAAS) will be extended to a tactical situation where the communications link will be Link-16 instead of International Marine Satellite (INMARSAT-3 SATCOM). This will provide a much more accurate positioning system than that of a stand-alone GPS receiver. The new GPS M- code and C/Y- code Application Specific Integrated Circuit (ASIC) development effort will begin to exploit the gain this route provides when jamming is present. Also to be initiated in FY 2003 is an effort designed to speed the acquisition of M-Code. Initiated in FY 2003 were two bathymetric sonar programs, one to sense topological features of the sea floor for Navigation purposes and the other to measure a submarine's relative motion over the seafloor for the purpose of enhancing inertial sensor accuracy.

FY 2004 Plans:
The Organic Link-16 Relative Navigation effort will modify software to correct the precision time transfer, which will be implemented. The work on the Electro-optic Accelerometer will be concerned with utilization of the electro-optical accelerometer in practical Inertial Measurement Unit (IMU) and embedded GPS inertials (EGIs). In FY 2004, the DGPS will be tested in a test range to demonstrate the accuracy of the system. For GPS M-and C/Y-code ASIC, the requirements of the existing C/Y-codes and future M-code will be compared. The investigation will concentrate on the transition period when both codes could be hosted on a single receiver with a minimum disruption for Navy users. Also, a 7-element Space time Adaptive Processing (STAP) dual receiver-antenna will be developed for the Scalable Multi-Element STAP-based Adaptive Array effort. The thrust of the Field Programmable Gate Array (FPGA) GPS software receiver effort will be concerned with the development of a GPS software receiver, which can adapt to “near-far” reception in real time operation by making use of pseudolites. The gravity gradiometer effort, Kasevich-Stamford University, will continue

with calibration and field testing of the new compact design. The 10 cc Rb CPT Atomic Clock will be continued in FY04. The Acoustic Bathymetric Estimator is planned to complete performance trials and efforts to transition the effort to SP24 will be initiated.
FY 2005 Plans:
The Electro-optic Accelerometer effort will be applied to several DOD MEMS IMU efforts such as the Strategic Systems Project Office for submarine platforms. The Differential GPS Navigation with Link-16 effort will be demonstrated in a test bed capable of hosting an integrated navigation system and time refinement system. The GPS M- and C/Y-code ASIC development effort will be simulated and a final ASIC specification will be produced for further development of GPS MYCA ASIC. The Scalable Multi-Element STAP-based Adaptive Array effort will evolve into a 15-element STAP array with dual polarization, which will be developed and tested. The Acoustic Bathymetric Estimator (ABE) will be transitioned in this period. The Ultra-miniature Rb CPT Clock Development effort will provide both the optical and electronic subsystems of the ultra-miniature Rb CPT clock, and will be developed to achieve a size of 10 cc. The Deeply Integrated GPS Receiver with INS effort will provide fielded and future GPS user equipment with improved anti-jam margin for tracking GPS signals in strong interference environments.

	FY 02	FY 03	FY 04	FY 05
Marine Mammals	1,500	1,000	1,000	1,000

MARINE MAMMALS: This activity provides both data and models for making decisions regarding the interaction of Naval activities with protected marine life and habitats (e.g., marine mammals, birds, turtles, fish, fish habitat, etc.). In keeping with Navy environmental stewardship policies laid out in the National Environmental Policy Act (NEPA), Executive Order (E.O) 12114, SECNAVINST 5090.1.b., and related documents, the advanced technologies under this activity ensure Navy compliance with appropriate environmental laws while still maintaining full operational and exercise capabilities. This activity provides hardware and software solutions that are uniquely suited to the marine environment in which the Navy operates and which are uniquely compatible with existing tactical and meteorological and oceanographic assets used by Navy. No other agency or service is capable of providing the unique combination of biological information for a marine environment, placed in the context of other common tactical picture assets unique to the Navy's mission and area of operation.

FY 2002 Accomplishments: The Marine Mammal Monitoring on Navy Instrumented Test Ranges (M3R) initiative demonstrated the ability of Navy instrumented test ranges to self-monitor for protected marine life. It also initially examined problems of marine mammal call detection, multi-hydrophone detection report data association, and multilateration tracking. This effort is fully integrated with related efforts and is providing compatible, integrated monitoring at both the Advanced Undersea Test and Evaluation Command (AUTEC) (Bahamas) and Pacific Missile Range Facility (PMRF) (Kauai) Navy

Instrumented Test Ranges. M3R recorded marine mammal vocalization data on-site at both AUTEC and PMRF with periodic sampling of selected hydrophones and recordings initiated upon detection of call signals. At present, this effort has collected 7-hydrophone and 4-hydrophone acoustic recordings for a period of one year and has successfully tested the system capability for monitoring the full set of array hydrophones. This activity further established a database of marine mammal call data for the ranges, which is being used to develop automated detection algorithms for eventual completely hands-off operation.

This activity also developed and tested a real time unified detection algorithm at PMRF. This algorithm was used successfully to detect a wide variety of marine mammal calls, including broadband clicks and frequency sweeps, along with an algorithm to calculate the Time-Difference of Arrival (TDOA) between hydrophones. In addition, this initiative successfully modified AUTEC 3D hyperbolic multilateration tracking algorithms to accept associated, detected call data from multiple hydrophones. This initiative attached and recovered Woods Hole Oceanographic Institute (WHOI) tags on two pilot whales, provided real time 3-D track of several marine mammal species from a field of over 60 AUTEC sensor arrays, and used them to guide WHOI scientists to marine mammals for tagging and confirmation of species ID and location.

The Marine Mammal Acoustic Safety Criteria effort conducted Temporary Threshold Shift (TTS) measurements to quantify the impact of sounds on marine mammals. This activity completed TTS testing with two California sea lions exposed to single underwater impulses, with hearing thresholds measured at 1 and 10 kHz. This initiative also conducted a series of open water calibration measurements with US Navy shipborne tactical sonars (AN/SQS-53C) as a prelude to potential TTS measurements using the AN/SQS-53C sonar as a sound source. The entire Office of Naval Research (ONR) TTS program was reviewed by an external board of visitors Oct 1-2. The work was found to be of high scientific quality and recommendations of the Board of Visitors (BOV) will be implemented in the FY03 work plan.

FY 2003 PLANS:
M3R will complete automated signal processing algorithm testing. The tested algorithms will enable the automatic collection of marine mammal data during usage of Navy test ranges. It will also provide an integral, non-interfering self-monitoring capability for environmentally compliant test range operations. M3R data will also be ground-tested (calibrated) against visual and other standardized acoustic monitoring assets, to correlate M3R detection data with estimated actual numbers and distributions of marine mammals on the range. These tests will include aerial visual surveys of the AUTEC range in January, ongoing aerial visual surveys at PMRF through April, and a test of whale detection radar and drone aircraft, also at PMRF (radar and drone aircraft projects funded by ONR STTR program). This ability to convert range detection rates to a numerical estimate of total animals present is critical to range environmental compliance documentation under National Environmental Policy Act (NEPA) and Navy regulations.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

The Prediction of Acoustic Safety Criteria initiative will prepare and demonstrate a synthesized model of TTS that is able to predict safety thresholds for any Navy sound source operated under any specified set of conditions. The result will be a set of consistent, standardized impact assessment criteria for all Naval activities emitting underwater sound. Based on Oct 2002 BOV review, the TTS program will focus on TTS thresholds for longer exposure durations (2-24 hours) to establish a minimum safe continuous exposure level. They will also investigate recovery rates from TTS to provide Navy with an algorithm for estimating TTS from intermittent sounds like sonar pings.

FY 2004 PLANS:
M3R has received widespread positive attention within Navy and has accelerated validated demonstrations and technology transfer plans. In FY04 and 05 M3R will be expanded to another Navy test range, the SCOR range in southern California, under CNO (NAVSEA) 6.4 funding. In FY05-06 M3R will be evaluated as a monitoring and mitigation asset for the East Coast Shallow Water Training Range (ECSWTR). During this same period M3R capabilities will be assessed for the new Navy range wide tactical theater training assessment planning (TAP) environmental information collection and management plan. With the completion of the unified model of TTS in FY 2003, and its adoption by Navy and other regulatory oversight organizations, FY 2004 efforts will focus on data collection for the purpose of strengthening and expanding the unified model, as needed. Data collection will continue to establish the time/energy tradeoff for long duration exposures and to establish a recovery rate algorithm to estimate TTS growth when the signal is intermittent. Specific TTS testing with 53C sonar signals will be decided by joint Office of Naval Research (ONR)/Chief of Naval Operations (CNO) investment planning in FY03-04.

FY 2005 PLANS:
M3R will have complete demonstration of its value as an operational tool to monitor range environmental management. M3R will demonstrate its ability to run at a non-interfering background level to enable simultaneous self-monitoring for environmental compliance while keeping the range fully operational for tactical missions.

	FY 02	FY 03	FY 04	FY 05
USCG Vessel Tracking	0	0	10,000	11,000

USCG Vessel Tracking: Details are of a higher classification.

	FY 02	FY 03	FY 04	FY 05
Joint Program Office Special Technology Countermeasures	0	0	14,000	0

Joint Program Office for Special Technology Countermeasures: Details are of a higher classification.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603640M (Marine Corps Advanced Technology Demonstrations)
PE 0603658N (Cooperative Engagement)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)
PE 0303140N (Information Systems Security Program)
PE 0308610N (Modeling and Simulation and Support)

NON-NAVY RELATED RDT&E:

PE 0603750D8Z (Advanced Concept Technology Demonstrations)

D. ACQUISITION STRATEGY: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: Various
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Congressional Plus-ups

Congressional Plus-Ups:

R9020	FY 02	FY 03
National Cargo Tracking Program	1,633	0

NATIONAL CARGO TRACKING PROGRAM: This effort was authorized and appropriated by Congress to develop the Navy's capability to track containerized cargo in support of Homeland Defense. The funds supported the ability to merge disparate data sources into a central database, allowing for the expeditious analysis of cargo-related data. Work included data warehouse development, integration of advanced analytical tools (software and analytical models) and deployment of analytical tools for cargo tracking.

R9145	FY 02	FY 03
Command Center Visualization	0	6,846

COMMAND CENTER VISUALIZATION: The purpose of this effort is to integrate and explore various automated information gathering, integration, and visualization techniques for integrating and presenting large amounts of multi media time sensitive information to the operator standing watch in operational command centers. This prototype command center visualization system will demonstrate the capability of emerging technologies to further automate and improve the warfighting operations of a command center resulting in improved speed of command and improved operational effectiveness with reduced manpower levels.

R9146	FY 02	FY 03
Improved Shipboard Combat Information Center (CIC)	0	3,521

IMPROVED SHIPBOARD COMBAT INFORMATION CENTER (CIC): The purpose of this effort is to integrate and explore various decision-making and display technologies for improving the CIC. This prototype system will demonstrate the capability of emerging technologies to further automate and improve the warfighting operations of surface ship combatant. The system will have technologies that can be re-configured depending on mission and tasking requirements and will allow CIC watchstanders to better receive, comprehend and respond to incoming data during combat operations. An improved shipboard CIC system will streamline and integrate information workflow, yielding improved speed of decision-making and improved operational effectiveness in combat situations.