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

BA: 02 PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: Common Picture Applied Research

COST: (Dollars in Thousands)

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Common Picture Applied Research	142,203	95,432	60,134	72,612	75,504	76,897	78,462

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this Program Element (PE) addresses technologies that enable the transformation to network centric warfare, which relies on information to connect assets and provide timely and accurate understanding of the environment. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The focus is on a high performance network that achieves a common situational awareness that connects geographically distributed forces into a unified Naval Force. Technologies emphasized provide warfighters with a robust, secure, mission responsive network; integrated information leading automated courses of action; and presentation of knowledge to speed understanding. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The program explores and demonstrates technologies that enable options for Knowledge Superiority and Assurance (KSA), Missile Defense (MD), and Fleet and Force Protection (FFP) Future Naval Capabilities (FNC). In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," "Sea Strike" Ship-to-Objective Maneuver, and "Sea Shield" Theater Air and Missile Defense.

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

BA: 02 PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: Common Picture Applied Research

PROGRAM CHANGE SUMMARY:

	FY 2003	FY 2004	FY 2005
FY 2004-2005 President's Budget Submission	148,222	59,022	70,120
Cong. Rescissions/Adjustments/Undist.Reductions	0	-1,164	0
Congressional Actions	0	37,575	0
Execution Adjustments	-2,540	0	0
Inflation Savings	0	0	-226
Rate Adjustments	0	-1	-60
SBIR Assessment	-3,479	0	0
Technical Adjustments	0	0	-9,700
FY 2005 President's Budget Submission	142,203	95,432	60,134

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

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

BA: 02 PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: Common Picture Applied Research
PROJECT TITLE: Common Picture Applied Research

COST: (Dollars in Thousands)

Project Number & Title	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
Common Picture Applied Research	142,203	95,432	60,134	72,612	75,504	76,897	78,462

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this project addresses technologies that enable the transformation to network centric warfare, which relies on information to connect assets and provide timely and accurate understanding of the environment. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The focus is on a high performance network that achieves a common situational awareness that connects geographically distributed forces into a unified Naval Force. Technologies emphasized provide warfighters with a robust, secure, mission responsive network; integrated information leading automated courses of action; and presentation of knowledge to speed understanding. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The project explores and demonstrates technologies that enable options for Knowledge Superiority and Assurance (KSA), Missile Defense (MD), and Fleet and Force Protection (FFP) Future Naval Capabilities (FNC). In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," "Sea Strike" Ship-to-Objective Maneuver, and "Sea Shield" Theater Air and Missile Defense.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2003	FY 2004	FY 2005
Network Command, Control and Combat Systems	22,410	18,631	20,857

This initiative explores development of advanced technologies that contribute to integrated decision-making and mission execution to achieve battlespace superiority. The activity emphasizes activity that leverage the power of networks to exploit information and information technology, and maximize the capability of platforms to use information to accomplish missions. This provides a force multiplier effect and supports Joint/coalition combat operations. This activity has six focus areas: (1) information management which

addresses technologies to reduce informational demands; (2) image processing and exploitation, which enables image enhancement, feature extraction, and dissemination; (3) visualization technology, providing improved battlespace views, including augmented virtual reality; (4) battlespace decision aids, which assist with optimized planning, assessing, executing, and monitoring of operations; (5) networked command and control (C2) for combat applications, supporting laboratory testing of network centric concepts; and (6) information network situational awareness, which focuses on secure, seamless information exchange within networked systems (weapons, sensors, etc.).

FY 2003 Accomplishments:

- Continued work on the multi-resolution, multi-scale image registration to address issues in multi-sensor, multi-model, multi-channel image registration/coordination with applications to precision targeting, image enhancement, change detection and fusion. Techniques evaluated included those that are contrast invariant, automatic, and take into account three-dimensional projective transformations from two dimensional images. Visualization technology plans included applying computer graphics algorithms to visualize uncertainty for underwater environmental and target data.
- Conducted a pre-launch flyout deconfliction for the Real Time Deconfliction effort.
- Extended Just-In-Time Real Time Replication (JITRTR) algorithm to work in a dynamic environment, such as a Distributed Collaborative Environment, where it is not possible to know about all data access requirements for the Distributed Real-Time Combat Systems (DRCS) effort. New algorithms used an initial estimate of data access requirements to determine when and where to create replicas of the real-time data. The new algorithms produced replication transactions that made copies of time-critical data in locations where the data was needed. The DRCS effort also conducted a limited objective experiment with Special Operational Forces (SOF) operators to collect valuable operational information needed to develop the algorithms.

FY 2004 Plans:

- Demonstrate multi-modal image registration for multi-resolution and multi-scale image processing effort.
- Develop high accuracy mobile tracking and registration algorithms used in augmented reality systems for military operations in urban terrain (MOUT).
- Demonstrate prioritized real time data replication and dissemination algorithms to prioritize the delivery of real time information from unattended distributed sensors in support of operational missions.
- Compare alternative architectures for the Theater Battlespace Command & Control.
- Design a Quality of Service (QoS) real-time model that enables the expression of time critical concepts and level of QoS. This will be invaluable in FORCEnet and Network Centric Warfare deployments to predict where, when, and why scheduling and network bottlenecks will occur.

- Demonstrate new techniques for providing improved computer network defense and improved situational awareness.
- Conduct laboratory demonstrations of distributed real-time networked data element replication and conduct cross database comparisons Real Time Deconfliction effort.
- Develop advanced algorithms, software tools and decision aids to handle and process large volumes of information.

FY 2005 Plans:

- Continue image registration error analysis for the multi-resolution and multi-scale image processing effort.
- Evaluate value of 3D techniques to enhance visualization technology.
- Conduct worst-case detection and conflict avoidance experimentation for the Real Time Deconfliction effort.
- Augment the real world information with computer-generated information in the Battlefield Augmented Reality System effort. The activity will also design a modular framework to support the system design and enable the insertion of custom scheduling and replication solutions. Other efforts will focus on the middleware layer to support emerging network centric sensor-to shooter systems.

	FY 2003	FY 2004	FY 2005
Knowledge Superiority and Assurance	20,301	15,661	16,000

Knowledge Superiority and Assurance explores fundamental technologies that enhance the Navy's capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture through 1) Common Consistent Knowledge; 2) Dynamically Managed, Interoperable, High-Capacity Connectivity; and 3) Time-Sensitive Decision-making. Common Consistent Knowledge addresses the needs of operating forces for common picture information in the planning, monitoring, and re-planning cycle of operational and tactical force employment. Dynamically Managed, Interoperable, High-Capacity Connectivity addresses wireless network technology critical to the performance and robustness of Naval communications by providing higher data rates, expanded coverage to disadvantaged platforms, and improved bandwidth management. Time-Sensitive Decision-making supports tactical operations where the timeliness and accuracy of decisions is crucial to the successful and efficient application of available forces.

FY 2003 Accomplishments:

- Developed Cryptologic Management Analysis and Support Segment (CMASS) algorithms for Indications and

Warning (I&W), including automatic recognition of reportable events and automatic generation of routine periodic reports.

- Refined Environmental Visualization forecasting algorithms.
- Refined Knowledge Web Technologies by expanding the integration of information from multiple sources.
- Refined the middleware for the Defense Information Infrastructure Common Operating Environment (DII COE) to improve interoperability in-theater by enabling users to share contact information, overlays, fleet message information and displays.
- Developed additional algorithms for the Human Alerting and Interruption Logistics to assist in data management.
- Continued development of the Extensible Tactical Command, Control, Communications, Computers and Intelligence (C4I) Framework (XTCF).
- Continued development of an extensible data management framework to enable stovepiped real-time and near real-time intelligence, surveillance, and reconnaissance (ISR) systems to share data and common services seamlessly, thus increasing the speed of command and span of information access.
- Developed algorithms and tools that guide staffs through doctrine-based planning, improving mission planning cycles.
- Continued development of architecture to improve mission planning by enabling automatic, rapid, and accurate assessments of air activities in preparing strike assets for attack. This activity also initiated the Underwater Surveillance Data-Link Network to develop a reliable, wireless over-the-horizon and line-of-sight bi-directional communication capability between remotely deployed sonobuoys and ships, aircraft and shore data processing stations and the Analytic Support Architecture to reduce the time required to manually discern enemy air defense activities.

FY 2004 Plans:

- Continue development of CMASS software to provide a single repository for intercept data, automatic operator alerting, and voice analysis; conduct operational test.
- Continue refining Environmental Visualization forecasting algorithms to provide information less than an hour old for strike operations.
- Conduct at-sea tests in XTCF to establish and demonstrate a data management framework that enables more rapid and timely technical and developmental exploitation of emerging, complex, and heterogeneous data sources for the Common Picture.
- Continue refinement of Knowledge Web Technologies and conduct demonstrations of the tools and procedures.
- Refine the Analytic Support Architecture to improve location accuracy for air defense threats.
- Refine the Underwater Surveillance Data-Link Network algorithms and conduct a demonstration.

FY 2005 Plans:

• Continue demonstrations of CMASS. Develop capability to automate linkage of Commander's Intent to cryptologic and intelligence system management, posting of information, processing, and use.
• Extend Environmental Visualization capabilities to large deck amphibious assault ships to support meteorological products for multiple users in support of strike operations.
• Continue improving human interfaces including Knowledge Web Technologies to provide integration operational and tactical source information for the common picture through information aggregation techniques, filtering, and data mining, as well as intelligent software agents.
• Refine heterogeneous data fusion techniques in XTCF.
• Focus on integration an0d information sharing across component commands, tactical units, coalition forces, and non-governmental agencies using web-based crisis information management techniques, visualization capabilities, and group planning tools. Emphasize common undersea picture challenges in information understanding.
• Explore rapid course of action development using synthetic semi-automated forces for fast, large-scale, high-fidelity simulations, including models of human cognition and visualization techniques for assessing outcomes and uncertainties.

	FY 2003	FY 2004	FY 2005
Communication and Networks	9,000	8,231	8,611

This initiative develops wireless communications network technologies critical to the performance and robustness of Naval communications for air, ship, submarine, and land platforms. Developments include bandwidth efficient communication techniques; advanced networking techniques for robust, highly dynamic environments; interoperable wireless networks for secure communications and protocols; bandwidth and network management techniques that can effectively manage and allocate bandwidth across tactical and theater levels in support of wireless network centric operations. The exploration payoffs include increased network data rates, improved coalition interoperability, dynamic bandwidth management, greater mobile network connectivity, and efficient waveforms to improve communications with land forces.

FY 2003 Accomplishments:

• Developed the Dynamic Backbone Subnet networking protocol suite for mobility management of heterogeneous networks; integrated it with an IEEE 802.11 Wireless Local Area Network (WLAN) device; field tested it in a small, mobile network to determine if there were improvements in Low Probability of Intercept/Low Probability of Detection (LPI/D) for remote users.

- Developed, adapted to Naval satellite channels, and field tested a dynamic access controller prototype for bandwidth management.
- Conducted a multinational demonstration of interoperable networks in a coalition environment, including mobility, routing, security, and network management with various application services for the Interoperable Networks for Secure Communication (INSC) effort.
- Developed a real-time emulation of tactical phased array networking and scheduling algorithms on a multi-PC networked system, as well as laboratory testing of the emulation. Fabricated and tested digital receiver components. Developed, designed and implemented software for a bandwidth efficient waveform (with advanced modulation, coding, and adaptive equalization) into a prototype modem.
- Developed a medium access control algorithm to allow multiple submarines to share a single satellite communications channel and simulated performance.
- Integrated LPI/D technology with WLAN to provide wireless network access devices for vulnerable assets.
- Designed an optical, tunable, microwave filter for multifunction antennas.

FY 2004 Plans:

- Continue INSC experimentation and results sharing from multinational demonstrations of interoperable networks in a coalition environment and organize a symposium for dissemination and presentation of contributions from each nation.
- Field test tactical phased array networking and scheduling algorithms using a small set of mobile platforms and phased arrays.
- Integrate the digital receiver front-end on a cryocooler for a demonstration of the superconductive digital receiver. This Joint Tactical Radio System (JTRS)-compliant receiver (software programmable) can be used to mitigate several classes of cosite interference problems. A prototype modem will be tested over Line-of-Site (LOS) channels (with bandwidth efficient waveform using advanced modulation, coding and adaptive equalization techniques); the waveform design will be provided to JTRS and the ARC-210 radio programs.
- Integrate LPI/D technology with a secure WLAN to provide wireless network access devices for vulnerable assets and demonstrate this technology. The optical, tunable microwave filter components will be integrated and a fully integrated adaptive microwave filter front-end will be demonstrated for multifunction antennas.
- Evaluate and develop solutions to next generation Internet Protocol (IP) technology to meet Navy/Marine Corps networking challenges particularly mission responsive quality of service; and develop options for addressing existing problems through enhanced capabilities of IPv6 technology.

FY 2005 Plans:

• Continue testing next generation IP software solutions and options on Navy, DoD, and coalition networking test beds; investigate IP version 6 (IPv6) and IP version 4 (IPv4) network coexistence strategies; and provision of IPv6 technology solutions into USN/USMC IP architectures.

	FY 2003	FY 2004	FY 2005
Multi-Source Integration and Combat Identification	7,900	6,981	7,175

Multi-Source Integration (MSI) and Combat Identification (CID) directly supports the Missile Defense Future Naval Capability (FNC) by addressing needs for MSI, fusion, system architecture, automated sensor management and algorithms to fuse, filter and correlate on-board sensor and off-board battlespace information from tactical data links, satellite communications and interoperable cooperative engagement networks.

FY 2003 Accomplishments:

• Continued MSI project development and testing of algorithms to integrate radio frequency (RF) Sensors, Identification Friend or Foe (IFF), Joint Tactical Information Distribution System (JTIDS). Correlate satellite communications (SATCOM) data to the integrated track file of the E-2C mission computer.
• Continued Advanced Sensor Networking Technology (ASNT) development and testing of algorithms for electronic warfare support in data association and Cooperative Engagement Capability (CEC) track correlation.
• Continued Composite Combat Identification (CCID) project development of algorithms to correlate and fuse CEC data with intelligence, surveillance and reconnaissance (ISR) data processed aboard reconnaissance aircraft and Ship Signal Exploitation Equipment (SSEE)-equipped surface ships. Continued CCID project development of common identification (ID) reasoning algorithm for the naval open architecture combat system.

FY 2004 Plans:

• Continue MSI project development and testing of algorithms for the E-2C mission computer.
• Continue MSI project development and testing of algorithms for the CEC program.
• Complete development of CCID algorithms to correlate and fuse CEC data with ISR data processed onboard reconnaissance aircraft and continue development for SSEE-equipped surface ships. Continue development of a common ID reasoning algorithm for the naval open architecture combat system.

FY 2005 Plans:

- Continue MSI algorithm development and testing for the E-2C aircraft and begin efforts to apply these algorithms to other platforms, including the naval open architecture combat system.
- Continue development of ASNT algorithms for integration of electronic surveillance (ES) data into CEC.
- Conduct subsystem integration and systems integration laboratory testing of the CCID common reasoning algorithm. Continue to develop and test algorithms to correlate CEC data with ISR data onboard SSEE-equipped ships.

	FY 2003	FY 2004	FY 2005
Human Computer Interface	8,007	4,174	5,491

This activity focuses on improving platform, task force and battle group operations by developing decision support technology for incorporation into operational systems. The goals are to enhance human performance effectiveness; improve decision support and decision-making collaboration; improve human-centered design; and accelerate insertion of advanced human factors engineering technology into existing and new weapons systems. The payoff is the creation of decision-action cycles that are faster than an enemy's, and reduced workload and staffing requirements. Specific objectives include achieving improved situational awareness and speed of command through a deeper understanding of human capabilities and limitations, as well as accomplishing quality performance in complex, dynamic, high-tempo and uncertain threat environments. These objectives are being pursued in three focus areas: Decision Support and Organizational Design; Collaboration and Knowledge Management; and Human-Computer Interaction/Visualization.

FY 2003 Accomplishments:

- Developed optimization algorithms for Command and Control (C2) applications to enhance execution monitoring and dynamic replanning of Naval tactical missions.
- Developed a collaboration advisor tool that provides guidelines and interventions to optimize team decision-making performance.
- Demonstrated new concepts of shared virtual surfaces for quick-reaction team pattern recognition and decision-making.
- Developed and tested advanced audio technology and interactive audio management user interfaces for sonar workstations. This technology reduces tactical decision times by 10% and head movements by 24%, with no performance tradeoffs.
- Developed a computational cognitive model to describe human-automation interactions with respect to information integration in real-time critical decision-making problems.

- Developed simulated devices for the study of interface design with isomorphic interface control (the ability to swap in and out interface features) and built a detailed computational cognitive model that uses the same simulation as the human to perform the same task.
- Knowledge Web/Desks decision support systems were installed aboard the USS Constellation and Theodore Roosevelt. These systems significantly improved speed of command and efficiency of asset use by the Battle Group staffs.

FY 2004 Plans:

- Develop cognitive computational models of multi-echelon command decision-making to define critical knowledge components for command and control.
- Research to integrate optimization, discrete event and organizational effectiveness models in order to provide computational formalisms for the design of adaptive architectures for command and control.
- Develop user/agent interfaces for knowledge sharing in coalition teams.
- Develop cognitive models for agent-assisted asynchronous collaboration.
- Develop and test attention management tools for improved resumption after interruptions.
- Develop more general advanced audio interface components for multi-modal workstation, incorporate Anti Submarine Warfare (ASW) tasks in design.
- Construct isomorphic interface controls for three simulated devices that will enable the systematic manipulation of the perceptual-motor and cognitive effort required to use each device.
- Test and validate discourse analysis techniques for measuring communication content and flow as a tool for estimating team situational awareness.
- Develop and empirically validate a cognitive process-based model for agent-assisted asynchronous collaboration.

FY 2005 Plans:

- Conduct model-based simulations and experiments to investigate the effectiveness of heterarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts.
- Develop reconfigurable organization design structures for culturally diverse decision-making teams.
- Improve designs for integration of audio into Naval watchstations.
- Compare the performance of simulated human users with real users in acquisition of knowledge and performance ability for different interface designs of simulated devices.
- Develop video scene enhancement tools for improved team situational awareness.
- Develop an automated team knowledge elicitation tool for improved shared understanding in intelligence

analysis activities.

	FY 2003	FY 2004	FY 2005
Platform Awareness and Protection Electronic	2,000	2,618	2,000

This activity supports the Fleet and Force Protection (FFP) Future Naval Capability (FNC). Currently, small surface, ground and airborne platforms have little to no situation awareness (SA) or self-protection, which jeopardizes their effectiveness and survivability. The Electronic Warfare Integrated System for Small Platforms (EWISSP) program focuses on closing that gap by developing technologies to provide them with a full spectrum threat warning and countermeasures capability. This capability, when integrated with emitter identification and Low Probability of Intercept (LPI) radar detection systems, provides netted targeting information and cueing that enables self-protection. The Battlefield Ordnance Network Centric Employment (BONCE) effort will design and fabricate a compact, low cost, light weight active/passive electro-optic (EO)/infrared (IR) system for ordnance detection. The Tactical Reactive Command and Control (C2W)/Electronic Attack (EA) Network effort will develop and demonstrate a self-adapting, spatially distributed EA network for C2W.

FY 2003 Accomplishments:

- Conducted Shipboard Laser Acquisition System (SBLAS) 90-degree system design studies.
- Completed mechanical performance requirements for the Bi-Stem flexible countermeasures mast and began work on an Expeditionary Fighting Vehicle (EFV) compatible design.
- Evaluated data compression and transmission schemes and completed development of the detection algorithm framework and real-time processor under the BONCE effort.
- Analyzed and optimized hardware for the proof-of-concept demonstration and identified concept performance and enabling technology factors under the Tactical Reactive C2W/EA Network effort.

FY 2004 Plans:

- Conduct and complete laboratory performance explorations of a lightweight electro-optic/infrared (EO/IR) subsystem in preparation for Unmanned Aerial Vehicle (UAV) employment for BONCE.
- Explore and develop subsystem software interface algorithms for the 90-degree SBLAS system and continue exploration and refinement of the subsystem interface software for the EWISSP effort.

FY 2005 Plans:

- Continue exploration and refinement of the subsystem interface software for the EWISSP effort.

CONGRESSIONAL PLUS-UPS:

	FY 2003	FY 2004
ADVANCED INTEGRATED RADAR, ELECTRONICS AND PHOTONICS (AIREP, FORMERLY UESA)	12,153	10,631

FY 03: Funds supported the development and demonstration of a non-rotating, electronically scanned radar technology via a series of land based tests at the Mountain Top (MT) range at the Pacific Missile Range Facility (PMRF), Kauai and follow-on flight tests in an appropriate aircraft. FY 04: Work will include establishing a Radar Test Bed at PMRF and conducting demonstrations at the site.

	FY 2003	FY 2004
COMMON SENSOR MODULE - MICROELECTRONIC SENSORS FOR UNATTENDED SURVEILLANCE AT REMOTE SITES	0	1,780

Funds will support the development of small common sensor modules for ground forces. These sensors will be networked to provide total situational awareness for the ground forces and to extend the integrated picture to the rest of the forces. This will develop prototype modules and conduct limited demonstrations.

	FY 2003	FY 2004
EXPEDITIONARY STRIKE GROUP NETWORK (3RD FLEET)	0	4,203

This effort will consist of installation, operator/maintenance training, and sustainment of a Tactical Component Network (TCN) on a selected Expeditionary Strike Group (ESG). ESG funds will provide the basic equipment suite, software operating licenses, and technical representative support for the duration of the installation. TCN installation will be conducted under “temporary alteration” parameters, and a portion of the funds will be set aside to pay for removal of the TCN equipment should that become necessary.

BA: 02 PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: Common Picture Applied Research
PROJECT TITLE: Common Picture Applied Research

	FY 2003	FY 2004
M2C2	12,150	1,978

FY 03: Developed and demonstrated the Mobile Modular Command Center (M2C2) in support of Naval Forces in the Mid-Pacific (MIDPAC) region, specifically at the Pacific Missile Range Facility (PMRF) on Kauai and potentially at the Pohakuloa Army training Range on Hawaii. This program developed and demonstrated: (1) Mobile Modular Command Center (M2C2) leveraging facilities in the Mid-Pacific (MIDPAC) region; (2) Cooperative Engagement Capability (CEC) antenna for Advance Hawkeye; and (3) Long Range Theater Ballistic Missile Defense (TBMD) Surveillance at PMRF. The M2C2 used an Open Network Architecture to integrate Marine communication systems and commercial communications systems into a single integrated picture display which provides real-time situational awareness. M2C2's Network architecture leveraged commercial off-the-shelf hardware for modular implementation.

FY 04: This funding will enable the development and demonstration of M2C2 in support of Naval Forces at the Pacific Missile Range Facility (PMRF) on Kauai and potentially at the Pohakuloa Army training Range on Hawaii. This program will develop and demonstrate Over-the-Horizon (long range), On-the move wide reach back capabilities for command and control functions for ground forces. Products include: (1) a tactical mobile Command and Control (C2) center capable of supporting multi-mission tactical operations-combat, peacekeeping and humanitarian assistance; (2) interface with US Army's Future Combat System (FCS) command and control functionality; and (3) support Ship-to Shore objectives by being transportable in a V-22/H-60 liftable configurations.

	FY 2003	FY 2004
NAIF	0	4,945

The Network Applications Integration Facility (NAIF) will serve as a global hub to support Tactical Component Network (TCN) operations, application development and integration, and expansion of TCN instantiation with the Fleet. The NAIF will support component and protocol standardization, global distribution of data, engagement coordination, and test and integration across land, sea, and air platforms. It will be manned to accommodate the operating parameters dictated by Fleet needs, and will surge to reflect exercise and/or operational contingencies. Contracts for support operations and sustainment will emphasize Hawaiian small businesses to the maximum extent practical.

	FY 2003	FY 2004
NATIONAL CENTER FOR ADVANCED SECURE SYSTEMS RESEARCH (NCASSR)	5,479	7,416

FY 03: Funds were used to develop an information centric (content-based) approach to security to meet the needs of tactical mobile forces operating in a network centric coalition warfare environment. The project addressed scalability, access control of information objects and user identification management. The effort is based upon current Information Technology standards and scalable to multiple applications and domains, including homeland security collaboration at all levels, critical infrastructure protection, and financial and medical information protection. FY 04: Continue the development and demonstration of information assurance research efforts in monitoring, containing and preventing hostile attacks, denial of service and malicious mobile code. Funding will also address continued advancements in comprehensive vulnerability analysis and the development of tamper-resistant hardware and software.

	FY 2003	FY 2004
NAVAL AUTOMATION AND INFORMATION MANAGEMENT TECHNOLOGY	2,380	989

FY 03: Established a formal framework for navigation and coordination of multiple heterogeneous assets operating in real-time; derived a solid foundation for distributed sensing and sensor fusion where information from individual robots was fused and presented to human operators, rather than raw data. FY 04: Improves performance and usability, while reducing cognitive demands of the interface, which leads to fewer operators needed to control the robot team. It supports the design of a modular hardware and software architecture with platform independent components supporting overall system functionality.

	FY 2003	FY 2004
RESEARCH IN AUGMENTED AND VIRTUAL ENVIRONMENT SYSTEMS (RAVES)	2,380	0

Funds were used to develop innovative software, hardware, and prototyping methods for producing effective and robust virtual and augmented reality systems for military applications. Additionally, algorithms and novel methods for technical areas that provide the underpinning of these systems including computer graphics, machine vision for tracking human body movement and image registration, optics for augmented reality displays, and human/computer interaction for navigation through 3D virtual worlds were developed. Strategies for integrating disparate augmented and virtual environments and scenario generation and after action review tools were developed. Algorithms and systems were developed for extracting and understanding information contained

in embedded systems that contain large numbers of diverse sensors and computers. Perception-based, multimodal interaction techniques, such as those using voice, gesture, 3D sound, and haptics, were developed and demonstrated. Evaluation and usability studies were performed to gain new understanding of the scientific underpinnings of all of the above systems and components. Potential applications include augmented reality systems for the dismounted warfighter, virtual reality systems for training and situational awareness, improved human/computer interaction techniques for situational awareness, medical and scientific visualization, and embedded training in military operations in urban terrain facilities.

	FY 2003	FY 2004
SUBMARINE ENABLING AIRBORNE DATA EXCHANGE AND ENHANCEMENT PROGRAM	1,429	0

Funds supported technologies to facilitate timely exchange of tactical data between airborne and submarine platforms.

	FY 2003	FY 2004
TACTICAL COMPONENT NETWORK	28,515	0

Funds supported the integration of the TCN at Pacific Missile Range Facility (PMRF) to support networking for the Navy's cooperative engagement capability demonstrations. Developed integrated modular command posts for various sites at PMRF and integrated range sensors with advanced sensors in development using TCN software. This effort included three tasks: 1) integration of TCN network capability at PMRF and use of 3rd Fleet assets to further demonstrate a single integrated picture; 2) continuation of the 7th fleet ESSEX ARG installation and demonstration through Cobra Gold (this also includes development of training modules for the fleet); and 3) participation in the TCN evaluation in support of Program Executive Office (Theater Surface Combatants) (PEO-TSC) to consider the applicability of an cooperative engagement capability.

	FY 2003	FY 2004
THEATER UNDERSEA WARFARE (TUSW) INITIATIVE	8,099	5,933

FY 03: Worked with the Maui High Performance Computing Center and PMRF to integrate the undersea picture to the single integrated picture using Web Centric ASW as the backbone technology. FY 04: This effort will demonstrate the ability of various platforms to connect with and use the integrated undersea picture via Web Centric ASW, as well as integrating additional data inputs.

	FY 2003	FY 2004
WEB BASED TECHNOLOGY INSERTION FOR THE EWT	0	1,261

This effort will take emerging web based solutions and apply them to an area such as time critical targeting and expeditionary warfare applications, and determine the effectiveness of using enterprise solutions to achieve a prescribed outcome. By use of the web based automated information management tools, this effort will incorporate critical Command and Control (C2) legacy systems into the web environment. Experiments will be conducted to determine efficiency and effectiveness of the architectures, both from a technical evaluation and Fleet Operator input.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603658N (Cooperative Engagement)
PE 0603640M (USMC Advanced Technology Demonstration)
PE 0604307N (Surface Combatant Combat Systems Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)

NON-NAVY RELATED RDT&E:

PE 0602204F (Aerospace Sensors)
PE 0602702F (Command Control and Communications)
PE 0602782A (Command Control and Communications Technology)

D. ACQUISITION STRATEGY:

Not Applicable