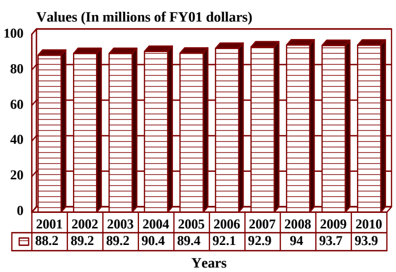
C^3 Technology (US Navy) - Archived 02/2002

Outlook

- Funding increase of US$12.7 million for FY01
- Ongoing development, testing and evaluation
- Funding for computer technology previously contained within PE#0602234N, realigned within the C^3 Technology program
- **The Bush administration has transferred the efforts under this program to numerous other program elements**

Forecast Funding Levels
2001 - 2010



Orientation

Description. The US Navy's command, control, and communications (C^3) technology supports future C^3 and surveillance systems for surface, air, and space platforms of naval warfare.

Sponsor

US Navy
Naval Air Development Center
Warminster, Pennsylvania (PA)
USA

Naval Command, Control & Ocean Surveillance Center
San Diego, California (CA)
USA

Naval Ocean Systems Center
San Diego, California (CA)
USA

Naval Research Laboratory
Washington, DC
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Naval Underwater Systems Center
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Naval Weapons Research Center
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Status. Ongoing technology development.

Total Produced. Does not apply, as this program develops a technology base to be used in other programs.

Application. This effort provides the technologies needed by the primary warfare areas to develop more survivable C^3 systems, secure communications, tactical communications interoperability, timely data fusion, decision aids, and accurate navigation systems.

Price Range. Indeterminate, due to the developmental nature of this program.

Technical Data

Design Features. Due to the present emphasis on joint operations, achieving Joint Service/NATO tactical C^3 system interoperability is a high priority. Often, today's combat decisions must be executed in seconds, while the amount of data required by a commander to conduct operations and the threats to his communications links are rapidly increasing. The new long-range weapons require more precise navigation.

Up until FY86, the C^3 Technology program was organized under more than a dozen different project headings. At the end of FY94, the US Navy's C^3 Technology program was restructured and retitled to Space and Electronic Warfare (SEW) Technology. The overall SEW Technology program covered the following areas: C^3 System Architecture, Communications, Command Support, Radar, EO/IR Technology, and Navigation.

In FY98, the program was again restructured and retitled Communications, Command, and Control, Intelligence, Surveillance and Reconnaissance (C^{3}ISR). A separate project, Space and Electronic Warfare (SEW) Engineering, under program element SEW Architecture/Engineering Support, also contributes to the Navy's C^3 Technology program.

C^{3}ISR covers the areas of radar technology; EO/IR technology; multi-sensor technology; communications networks; communications (strategic and tactical secure, reliable and survivable command and control, including the use of such unconventional media as IR and UV); command support (information management and the use of artificial intelligence); and navigation (research global navigation requirements, including autonomous and over-the-horizon applications). SEW Engineering focuses on developing, testing, and validating Naval C^4ISR architecture to support naval missions in both joint and coalition theaters.

Variants/Upgrades

This is a technology development program that supports US Navy requirements by providing new technology as well as upgrading present capabilities. Upgrade work includes the following: improvements for network routing algorithms to shorten net cycle time; improving dynamic network membership algorithms; developing and testing enhancements to the plan recognition system in order to allow handling of more diverse scenarios; developing approaches for improving the accuracy of battleforce navigation based on navigational performance requirements of battleforce C^2 operations; and developing second-generation fiber-optic gyros.

Program Review

Background. Background detail prior to FY98 is grouped under three major segments: C^3 System Architecture, Communications, and Command Support. Beginning with the FY91 budget documents, there was no further project division within each major segment.

C^3 System Architecture. In FY89, this project centered on land-based testing of integrated, high, and ultra-high frequency communications using existing line-of-sight equipment to simulate intra-battlegroup communications. It also focused on conducting a prototype experiment to develop a method for effective technology transition to advanced systems development program elements. In FY90, the following events occurred: demonstration of battlegroup communications using networked HF and UHF line-of-sight (LOS) links; completion of the transition of the Unified Network Technology initiative to 6.3A Advanced Technology Demonstration; and development of algorithms for dissemination of topology/connectivity information in a battlegroup environment.

The development and simulation analysis of improved network routing algorithms to shorten net cycle time and reduce message delays and overhead was completed in FY91. Other accomplishments included: investigation of low-data-rate voice techniques and associated protocols in packet-switched UHF/LOS tactical networks for point-to-point and conference-mode communications; and development of a new reliable datagram protocol for connectionless service by enhancing the US Department of Defense (DoD) standard Users Datagram Protocol (UDP) with new error-control algorithm.

By the end of FY92, the improved network routing protocols – to accommodate more efficient data throughput and dynamic network membership – had been completed. Development of a new battlegroup subnetwork architecture, utilizing higher capacity super-high frequency (SHF) links capable out to extended line-of-sight ranges, was initiated. Hardware and software was integrated into the advanced submarine communications testbed.

Evaluation of a US Navy developed network access and routing architecture, Minimum Coverage Approximation/Handoff Assigned Multiple Access (MINCAP/HAMA) against standard time division multiple access (TMDA) network, was completed in FY93. MINCAP/HAMA improves the efficiency and throughput of the network. Other work consisted of building a testbed for the US Navy Theater Extension Network (TENet). TENet is a high-capacity radio communication network that extends the commercial, terrestrial, high-data-rate communication network employing Asynchronous Transport Mode switches and fiber optic cables to the fleet at sea.

The three services agreed to jointly develop TENet in FY94. To evaluate standard protocols and demonstrate the capability to interoperate, a tri-service testbed had to be developed. The TENet testbed links some Laboratories, CECOM, and NRaD with commercially based high-data-rate links. The first demonstration validated the capability to communicate at 1.544 Mbps (commercial T1 rate). Other work during this time period included demonstrating the exchange of digital data, imagery, and video between the three services.

Demonstration of the capability to communicate at T3 rates (45 Mbps) over the tri-service TENet testbed began in FY95. Other efforts centered on investigating the extension of the data rate to OC-3 rates (155 Mbps) and applying the submarine network simulation model to the Communication Support System architecture.

Throughout much of FY96, efforts focused on increasing the data rates over the tri-service testbed to OC-3 (155 Mbps). Work was also begun on applying the submarine network simulation model to specific network protocol suites – such as the MINCAP/HAMA and Enhanced Link 16 – to establish a performance baseline for submarine participation in battlegroup networks.

Testing of the tri-service testbed at data rates up to OC-3 (155 Mbps) was conducted during FY97. Development was also begun on modifications to protocols specifically suited to the submarine as a disadvantaged node. Once these efforts were under way, the submarine network simulation model was employed to assess the modifications.

Communications. Development of survivability protocols for battle group communications networks began in FY85. Work involving packet communications over HF and UHF line-of-sight communications links continued in FY86. During FY87, the US Navy demonstrated automated multi-network controller technology for technical control of HF and UHF data links. The FY88 program included fleet demonstrations of multi-network controller technology for technical control of datalinks.

For the Communications segment as a whole, FY89 work included transitioning the VHSIC terminal brassboard to PE#0604577N. In FY90, the following was accomplished: development and transitioning of the wideband amplifier for the submarine buoyant-cable antenna to the Submarine Integrated Antenna System (SIAS) program; the conducting of a joint Arctic experiment with the US Air Force to investigate meteor-burst antenna performance; completion of investigations into the effects of partial correlation, jamming, and fading on the performance of the Low-Probability-of-Intercept (LPI) spread spectrum waveform; and the signing of memorandum of understanding with the US Air Force to develop LPI airborne communications.

At-sea demonstrations of an ELF on-hull antenna for submarines in the arctic were conducted in FY91. Project activities also consisted of the following: experiments of a two-way relay buoy; investigation of new wideband communications modes, including atmospheric evaporation ducts and troposcatter; demonstration of a signal time-out protocol implemented on an HF adaptive antenna array; and joint development with the US Air Force of a covert airborne communication system using LPI spread-spectrum waveforms.

The transition of the submarine extremely-high-frequency satellite communications antenna to engineering development under Submarine Integrated Antenna Systems (SIAS) program began in FY92. Additional project accomplishments (in cooperation with the US Air Force) included extending the Adaptive Locally-Optimum Processing (ALOP) technique to the high-frequency (HF) band and determining its potential applicability to the joint Service (US Air Force/Army/Navy) multiband, multimode radio program, as well as completing fabrication and test of the joint Service Low-Probability-of-Intercept (LPI) airborne communication system.

Development of the adaptive locally optimum processing algorithm for the SPEAKEASY joint-service multiband-multimode radio was continued in FY93. The algorithm employs high-speed digital signal processing to cancel large interfering signals from the passband of a receiver. This capability is particularly important onboard US Navy ships, on which high power transmitters are located in close proximity to sensitive receiving systems. Both the Low-Probability-of-Intercept airborne communication system and the advanced digital anti-submarine warfare receiver were transitioned to Advanced Technology Demonstration programs. Also, the land-based vibration testing of the submarine on-hull extremely-low-frequency (ELF) antenna was completed. This effort eliminated the need to deploy a 2,000-foot buoyant cable antenna to improve maneuverability and eliminate course constraints for ELF reception.

The following year's activities focused on: preparing plans and hardware for installation of the on-hull ELF antenna onboard a submarine for testing; investigation of candidate super-high frequency (SHF) antennas for submarine deployment; performance of single-antenna field tests of the ELF corona antenna; and investigation of the joint-service SPEAKEASY radio for use as a communications relay and as a gateway between two different networks.

Development of key technologies for embedding SHF antenna arrays in aircraft skin was the focal point of FY95. Other work centered on conducting at-sea measurement and demonstration of the submarine on-hull ELF antenna; conducting dual-antenna field tests of the ELF corona antenna array; conducting field testing of a submarine SHF antenna; and initiating Phase 2 of the SPEAKEASY radio program with the Advanced Research Project Agency (ARPA), National Security Agency (NSA), and other services.

Key communications technologies development continued through FY96. The at-sea measurements of the on-hull ELF submarine antenna were expected to be completed by the end of 1996. An analysis to extend the aircraft antenna array design to a conformal array was performed. Testing of the optically controlled antenna was completed and transitioning potential to aircraft platforms explored. The development of a high-frequency jammer processor and testing/evaluation of language identification algorithms (developed by the US Air Force) also commenced in FY96.

Experiments conducted in FY97 included the following: simulations and testing of aircraft networking protocols, the transition of an automated message distribution system to naval C^3 aircraft; the completion of bandwidth-efficient modulations for UHF communications development and its transition to the Communications Support Systems program; field tests and demonstrations of the high frequency jammer processor on airborne and ship platforms; and development of the language/speaker recognition processor, which has become more urgent as military threats shift from the former-Soviet Union to regional theaters such as Iraq, Bosnia, Haiti, and Somalia.

Command Support. In FY87, the US Navy installed US Air Force decentralized operating technology in a US Navy testbed, and demonstrated communications networking technology for the AEGIS system. During FY88, the US Navy investigated security models for application to the US Navy Desk Top Computer and Flag Data Display Systems.

The Command Support segment accomplished the following in FY89: development of a PC-based map-generation capability for use in afloat and ashore command centers; development of a template-based situation assessment model for all-source data fusion; and transition of network interface technologies to the US Navy Desk Top Computer and Flag Data Display System programs. FY90 work included the installation of the Advanced Real-Time Distributed Operating System (ARTS) into the laboratory testbed.

The following year, FY91, included the fabrication and testing of a closed-loop fiber-optic gyro; the performance of Phase 2 tests of the geomagnetic navigation system in northern latitudes, and the identification of technology issues associated with improving battleforce navigation. During Operation Desert Storm, the Air Strike Planning Advisor was successfully deployed in support of pre-mission weaponeering in a high-sortie-rate environment. Solid-state and optical disk memory technology was deployed in a variety of weapons systems.

Activities for FY92 included the transition of real-time scheduling to the real-time distributed operating system (R-MACH); the transition of FIBERTAP, a network monitor for the Fiber Distributed Data Interface, to the NTCS-A; and the completion of Express Transport Protocol (XTP) demonstrations on a fiber-optic local area network.

The Cronus distributed computing environment was transitioned to the Operational Support System (OSS) in FY93. (Cronus permits networking of a number of dissimilar command and control systems within a command center.) The following project activities were also accomplished in FY93: installation of the integrated XTP with the real-time distributed operating system (RT-mach) on a real-time testbed; installation of the High Grade Security Experiment (HiGS) testbed; performance of at-sea demonstrations of the prototype ASW data quality monitoring system; and demonstration and transition of the tactical image viewer with feature and shape extraction algorithms to the OSS project.

XTP was transitioned to US DoD and commercial standards organizations in FY94. Development efforts also included: investigating key technical issues in integrating XTP with RT-Mach distributed operating system; initiating joint effort with the US Air Force to evaluate the new prototype Trusted Heterogeneous Architecture (THETA) distributed operating system; transitioning the High Performance Network Interface Unit to the High Speed Digital Switch (HSDS) and the NTCS-A programs; and developing improvements in tactical image exploitation including an object-oriented database for extracting objects from images.

XTP integration with the RT-Mach distributed operating systems was demonstrated in FY95. Progress was also made on the following: integrating the THETA distributed operating system with the HiGS testbed for test and evaluation; transitioning the ASW Data Quality Monitoring System to the NTCS-A and the Joint Operations Tactical System II (JOTS II); completing development of the tactical image exploitation system and transitioning it to the OSS and NTCS-A programs; and developing multiple interdependent routing algorithms for strike warfare that incorporate joint strike/weapon capability for mobile targets.

Efforts during FY96 focused on demonstrating and transitioning the Strike Routing Module into the 6.3 Real-Time Support program, as well as verifying and reporting a tested approach to perform fast, complex simulations of mission force level planning. Also on the agenda was the completion and transition of image/test exploitation and retrieval tools, COBRA-compliant distributed computing to 6.3 ATD, Portable C^4I for the JTF, and a distributed security system to an operational command site for evaluation.

Note: *In FY98, the US Navy's C^3 Technology program was restructured into two Program Element (PE) numbers; PE#0602232N and PE#0604707N.*

PE#0602232N - Communications, Command and Control, Intelligence, Surveillance &

Reconnaissance (C3ISR). The main goal of the C3ISR program is to provide the US Navy with the ability to interconnect government and commercial telecommunication assets in a worldwide network. This network is expected to be responsive to regional theater challenges and to the nation's needs. C3ISR is made up of eight segments which are broken down for easier summation: Radar Technology, EO/IR Technology, Multi-Sensor Technology, Communications Networks, Radio Communications, Command Support, Navigation, and Strategic Systems Technology.

Radar Technology. This program was designed to address US Navy surveillance needs and to exploit radar sensor technology opportunities. It focuses on major platforms such as ships, aircraft, and crosscutting technologies that apply across platforms. Special emphasis is placed on affordability and sensor performance in complex target, Electronic Countermeasure (ECM), and adverse environmental conditions including littoral operations.

A multiband, flexible waveform shipboard radar sensor was installed at Wallops Island in FY99. Additional Radar Technology activities included the following: continued development of adaptive waveforms for the multiband shipboard radar; the integration of a scale model, voltage controlled diode array with the testbed radar system; the continuation of the Millimeter Wave High Resolution Radar Demonstration Model development; the characterization performance of a scale model UHF electronically scanned array; the completion of technology development for a UHF digital receiver; the continuation of the US Air Force's and DARPA's joint program to develop automatic target recognition algorithms; and various additional activities.

Radar Technology program efforts for FY00 included the implementation of adaptive waveforms into the multiband shipboard radar testbed. Additional FY00 activities included the following: integrating the UHF Digital Receiver into the improved Mountaintop experimental radar at PMRF, Hawaii; completing flight test characterization of the Concealed Target Detection/ Ground Penetrating Ultra Wideband Radar; and other various projects.

Accomplishments planned for FY01 include the continuation of the performance evaluation of the High Power Millimeter Wave Radar Demonstration Model in varying target and clutter conditions. Risk reduction development of the UHF Electronically Steered Antenna (UESA) array will also be continued, emphasizing space-time adaptive processing and solid-state transmitter module development to improve E-2C radar performance in littoral environments.

EO/IR Technology. Work within this segment of PE#0602232N addresses US Navy Surveillance needs and exploits technology opportunities leading to advanced Electro-Optical (EO) sensor and processing capabilities. This segment also emphasizes the needs of major US Navy air platforms and develops crosscutting technologies that apply across platforms.

The dual-band airborne Infrared Search and Track (IRST) sensor was integrated into a fleet configured E-2C aircraft during FY99 EO/IR Technology activities. Additional work that occurred in FY99 included the following: the continued development of target discrimination and recognition algorithms; the continuation of Hyperspectral infrared sensors development as a joint US Air Force and DARO project; the continuation of modeling and simulation of multi-wavelength EO passive and active sensors; the integration of multifunction EO sensor technology developed in FY98 with a distributed aperture IR sensor system (DAIRS); and the initiation of development and demonstration of the Hyperspectral EO Imaging technology on the EP-3 aircraft.

Activities in FY00 included flight evaluation of the dual-band IRST on a fleet E-2C aircraft; the integration of the BMDO-funded eye safe laser sensor into the dual-band airborne E-2C IRST; the continuation of target discrimination and recognition development; the continuation of multi-wavelength passive and active EO sensor modeling and simulation; the transition of DAIRS to the ATD project; the continuation of Hyperspectral Imaging sensor and processing development; and the initiation of laser and laser identification image profiling development.

EO/IR technology development will also receive support in the following areas during FY01: development of split aperture optics to enable E-2C surveillance IRST to simultaneously detect and track both theater ballistic and cruise missiles; development of target discrimination algorithms once deficiencies identified during the previous year's land and flight evaluations are corrected.

Multi-Sensor Technology. FY98 work activity for this C3ISR segment included the development and integration of encoded modulation waveforms into existing aircraft (F/A-18, AV-8B) for laser interrogation of an IFF system; the development of data fusion/resource management processing to facilitate autonomous multi-sensor operation; and the integration of Commercial-Off-The-Shelf (COTS) sensors (radar, ESM, EO) into a multi-sensor testbed.

One activity this segment focused on in FY99 was the transition of targeting avionics sensor technology to PMA 242. This was done in order to provide precision targeting capabilities for US Navy and HARM-capable international aircraft.

Additional FY00 activities included the continued evaluation of Radar Resource Management processing algorithms and evaluation of multi-sensor integration and data fusion algorithms in the E-2C aircraft Sensor Integration Laboratory.

Communications Networks. FY98 activities consisted of designing and testing prototype software for the high-performance transport protocol and QOS enhancements to the Internet Protocol (IP); installing Asynchronous Transfer Mode (ATM) machines in the ATM networking testbed; developing the Domain Name server for heterogeneous mobile networks; and coordinating with the DARPA Warfighters Internet program.

The workload for Communications Network in FY99 included the continued development of technologies critical to performance and robustness of Naval Communications networks. Other projects involved the testing and analysis of the prototype software for the high-performance reliable multicast transport protocol; the incorporation of the enhanced transport and prototype software in the ATM network testbed; the investigation of technical issues related to ATM use; and the development of intelligent local agents for heterogeneous mobile network management.

Activities in FY00 included the continued development of technologies critical to performance and robustness of Naval Communications networks. Additional activities included the development of key communications network technologies for air, surface, and subsurface platforms; performance evaluation of the new reliable multicast and IP Quality of Service (QOS) protocols; and testing of various ATM switches for levels of performance and interoperability.

Planned activities for FY01 include the transitioning of radar processing technology improvements to AEGIS SPY-ID radar to improve track constancy and quality against theater ballistic missile targets. Development of MSI technology specifically for the E-2C airborne early warning aircraft sensors and network centric warfare systems will also continue.

Radio Communications. This segment is focused upon the development of key communications technologies for air, surface, and subsurface vehicles. Full-configuration at-sea testing of the compact low-profile buoyant cable submarine antenna was carried out in FY98, as was preparation of the on-hull extremely low frequency (ELF) submarine antenna for transition to engineering development; and development of the framework for reception of the Global Broadcast Service (GBS) on naval ships and aircraft.

For FY99, this segment included a US$1 million congressional add-on for the development of the Hybrid Wireless Fiber Communications Technology project. Other projects covered in FY99 included the following: completion of residual noise tests of the on-hull Extremely Low Frequency (ELF) submarine antenna; analysis of data derived from sea tests on the low profile buoyant cable submarine antenna; and completion of the structurally-embedded and reconfigurable aircraft array development.

Activities in FY00 included the investigation of CDMA links as a back channel for GPS; the transition of the low-profile buoyant cable antenna enhancement to the Advanced Technology Development program; the transition of the on-hull ELF antenna to the Submarine Integrated Antenna System (SAIS) program; the development of technologies that will enable large aperture multiple frequency band, multiple function antennas for present and future attack submarines; and the transition of the improved modem technology for UHF line-of-sight communications to the Joint Tactical Radio Systems (JTRS) program.

Planned accomplishments for FY01 include the demonstration of the CDMA satellite link as a GBS back-channel employing commercial or military satellites. Also planned is the integration of submarine electromagnetic structures with a large aperture multiband, multifunction submarine antenna for satellite communications.

Command Support. This segment of C^{3}ISR develops and demonstrates software components and technologies that promote the US Navy's concept of Network-Centric Warfare and the Joint Chiefs Joint Vision 2010. The focus of the program appears to be on militarily-unique information processing technologies that ensure information dominance through vastly improved speed of command.

In FY98, the Command Support segment activities included the completion and demonstration of an object-oriented database management architecture prototype; the support demonstration of the Common Operational Picture/Common Tactical Picture (CO/CTP); the transition of collaborative environment technology to Space and Naval Warfare Systems (SPAWAR); the initiation of development for an Element Level Strike Planner; and development of a formal model protecting against data storage spoofing.

The continued development of software agents for intelligent data exploitation and retrieval continued in FY99, as did the continued efforts to develop a real-time static scheduling service; and the evaluation of the Covariance Intersection approach as a method to fuse data in a distributed environment. Other FY99 activities not in support of COP/CTP included: the continued development of collaborative environment tools; the development of case-based plan authoring and advanced use interfaces; and the definition of requirements and design specification for Adaptive Rules of Engagement.

FY00 activities included the continued development of intelligent agent technology to provide agent-based user profiling in support of COP/CTP and the development of an initial prototype for a tactical collaborative environment to use during littoral warfare.

Navigation. Work consisted of performing a concept demonstration of the candidate signal structure in FY98 for reduced Global Positioning System (GPS) vulnerability; completing laboratory evaluations of high-performance fiber-optic gyro (FOG) for submarine applications; and identifying techniques for data compression and bulk processing applicable to fast processing of GPS.

Activities for FY00 included the continued development of key navigation technologies for air, surface, and subsurface platforms; the transition of the high performance fiber-optic gyro, Advanced Model-II to the Director, US Navy Strategic Systems Project, and the laboratory proof-of-concept demonstration of the next-generation digital GPS receiver for anti-jam performance. Advanced technologies were also developed to reduce the vulnerability of GPS to jamming and spoofing.

Strategic Systems Technology. The objective of this C^3ISR segment is to develop and demonstrate technologies in the areas of Missile Flight Science, Submarine Navigation, and Underwater Missile Launch. These technologies are then expected to be used to sustain strategic capabilities.

The FY00 activities included the development of first order methodologies for drag reduction, nuclear survivability, and solid motor ignition codes for the flight science design and analysis tool. It is also expected that the first order electronic database for Underwater Missile Launch tool was developed.

PE#0604707N - Project X2144 - SEW Engineering. This project is a non-acquisition engineering effort defined as the neutralization or destruction of enemy targets and the enhancement of friendly force battle management through integrated employment of the electromagnetic spectrum and the medium of space. The project focuses upon three major areas: 1) making sure that the composite operational capabilities of SEW system conform to the Naval C^4ISR architecture as related to the National Defense Strategy; 2) ensuring that the systems support emerging fleet requirements as documented and necessitated through concepts such as Network Centric Warfare, Integrated Information Base, IT-21, and the Naval Virtual Intranet; and 3) ensuring that the SEW systems and systems integration effort involve leading edge technology and transfer of information processing technologies primarily through integration of government and commercial off-the-shelf (GOTS/COTS) products.

In FY98, this project supported the continued development and validation of a Naval C^4ISR architecture based on the multi-tier framework of operational, system, and technical to support naval missions in a Joint and Coalition theater. Additional FY98 activities included participation with the Joint Battle Center and Naval Battle Laboratories to verify and validate operational and system architectures and continued architectural and system engineering efforts leading to incremental design and implementation, specifically the integration of JMCOMS, JMCIS, and CDS.

Work in FY99 focused on developing plans for the integration of maturing system developments, military, and commercial technologies that support enhanced operational capabilities in key CINC priority areas and Joint Mission Area (JMA) Assessment Thrust Areas. Other work focused on updating the high-level systems and operational architecture processes to support long-range planning for the following projects: Joint Vision 2010, Copernicus, Forward C^4I for the Warrior, Joint Air Operations Functional Process Improvement, Theater Battle Management (in conjunction with the US Air Force), Digitization of the Battlefield (with the US Army), and Marine Air Ground Task Force (MAGTF) C^4I architectures. Lastly, Navy C^4ISR architectures were developed in conjunction with such offices as the US Department of Defense (DoD) Architecture Coordination Council (ACC) and the ASD (C^3I) Joint Technical Architecture (JTA) Development Group.

Activities in FY00 included the generation of Copernicus Implementation Guidance; the augmentation/maintenance/update of the Overarching C^4ISR Operational Requirements Documentation; the enhancement and refinement of the C^4ISR Planned Systems Design for the POM years; and continued support for the Joint Technical Architecture/Standards development/documentation and implementation effort.

Funding

US FUNDING

	FY00		FY01		FY02 (Req)		FY03 (Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (US Navy)								
PE#0602232N Communications, Command, and Control, Intelligence, Surveillance, and Reconnaissance (C^4ISR)	-	91.2	-	80.0	-	81.1	-	82.0
PE#0604707N SEW Architecture/ Eng Support Project X2144 SEW Engineering	-	8.6	-	8.2	-	8.1	-	7.2
Total		99.8		88.2		89.2		89.2

	FY04 (Req)		FY05 (Req)		FY06 (Req)		FY07 (Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (US Navy)								
PE#0602232N Communications, Command, and Control, Intelligence, Surveillance, and Reconnaissance (C^4ISR)	-	81.3	-	80.0	-	82.9	-	83.4
PE#0604707N SEW Architecture/ Eng Support Project X2144 SEW Engineering	-	9.1	-	9.4	-	9.2	-	9.5
Total		90.4		89.4		92.1	-	92.9

All US$ are in millions.

Source: US Department of Defense FY2000/2001 Biennial RDT&E Descriptive Summary

Note: FY99 funding includes an increase of US$1.1 million to correct a budgeting error. Transfer of funds from PE#0605866N.

Recent Contracts

Very little contract information is available that can be directly attributable to work done under this program. Listed below are contract awards (or parts of the contract) that can conceivably fall under the realm of this program effort.

Contractor	Award ($ millions)	Date/Description
APL/Johns Hopkins Univ.	1568.9	Jan 1997 – US$3.5 million CPFF ID/IQ contract with a five-year ordering period in the amount not-to-exceed US$1,568,969,689. Provides support for specific US Navy and other government programs. These programs include: surface missile systems, ballistic missile systems, radar, sonar, space systems, undersea warfare, anti-air warfare, C^3, and related technologies. Expected complete by September 2002. (N00024-98-D-8124)
SAIC	18.4	Aug 1997 – An ID/IQ task order contract with a base year minimum ordering quantity of US$5,000 and a maximum order limitation of US$18,477,583 to provide technical engineering services for information support systems, C^3, and implementation class desks to support PMW 152, PMW 176, and SPAWAR 05F. Work will include technical and engineering services required to install an integrated C^4I suite into new construction ships and to update and modernize ships of the active Fleet. If exercised, these options would increase the contract's maximum order limitation to US$98.1 million. Contract is expected to be completed by August 2002. (N00039-97-D-0056)
Semcor	18.4	Aug 1997 – An indefinite delivery/indefinite quantity task order contract with a base year minimum ordering quantity of US$5,000 and a maximum order limitation of US$18,477,583 to provide technical engineering services for information support systems, C^3 and implementation class desks to support PMW 152, PMW 176, and SPAWAR 05F. Work will include technical and engineering services required to install an integrated C^4I suite into new construction ships and to update and modernize ships of the active Fleet. If exercised, these options would increase the contract's maximum order limitation to US$98.1 million. Contract is expected to be completed by August 2002. (N00039-97-D-0097)
Logicon	9.8	Sep 1998 – Modification to previously awarded contract for technical support services for standard design engineering, analysis, developmental and certification testing, test operations analysis support, and configuration management as they pertain to C^4I systems at the Navy Center for Tactical Systems interoperability, San Diego, California. This contract contains options which, if exercised, would bring its total cumulative value to US$49,908,613. Contract completed September 1999. (N00244-96-C-5078)

Timetable

Year	Major Development
FY87	Demonstration of prototype buoyant cable antenna and a submarine-launched communications buoy for Arctic operations
FY88	Work on Stellar Horizon Atmospheric Navigation Program (SHAD) suspended due to budgetary constraints
FY89	Tested and transitioned tactical missile ring laser technology to advanced development
FY90	Completed transition of Unified Network Technology (UNT) to 6.3A Advanced Technology Demonstration (ATD). Developed wideband amplifier for the submarine buoyant-cable antenna to the Submarine Integrated Antenna System program
FY91	Developed jointly with the Air Force a covert airborne communication system employing LPI spread-spectrum waveforms. Tested a closed-loop fiber-optic gyro

Year	Major Development
FY92	Completed and transitioned the geomagnetic navigation system
FY93	Test improved AHARS-grade fiber-optic gyro
FY94	Flight-test stellar-inertial navigation system
FY95	Conducted at-sea demonstration on submarine on-hull ELF antenna. Completed shipboard fiber-optic development. Initiated Phase 2 of SPEAKEASY
FY96	At-sea ELF antenna experiments
FY97	Initiated development of language/speaker recognition processor
FY98	Test prototype software for the high performance transport protocol
FY99	Tests of Global Broadcast Service reception on board US Navy ships and aircraft
FY00	Implementation of adaptive waveforms into multiband shipboard radar testbed
FY01	Performance evaluation of high power millimeter wave radar demonstration model

Worldwide Distribution

This is primarily a **US Navy** program, although the service is jointly developing a covert airborne communication system with the **US Air Force**. It is likely that some aspects of the technology are being shared with selected Allied nations, especially those usually involved in joint operations with the US.

Forecast Rationale

Pressing emphasis on joint operations has made Joint Service/NATO tactical C^3 system interoperability a very high priority. Combat decisions must be executed in seconds, but both the amount of data required by a commander to conduct operations and the threats to his communications links are rapidly increasing. The major goal of the C^3 Technology (US Navy) program is to provide the capacity to interconnect government and commercial telecommunications assets worldwide that are efficient and responsive to regional theater challenges.

Funding for the C^3 Technology RDT&E program has been increasing substantially with an annual total of US$99.8 million in FY00 to an annual total of US$92.1 million (requested) for FY06. According to US Department of Defense (DoD) 2000/2001 RDTE budget documents, overall funding for FY00 through FY07 has increased by US$95.5 million over the last budget. It is extremely difficult to break out exactly how much funding the individual C^3 Technology programs receive, but it is assumed that they are receiving the bulk of the amount requested and awarded.

Although specific funding cannot be broken out of the whole, it is expected that the C^3 Technology (US Navy) program will continue to receive strong funding throughout the ten-year forecast period. The critical need to have enhanced and advanced C^3 technology systems deployed as fast as possible in support of all the fighting forces would seem to ensure that a high level of activity will continue for some time to come.

Finally, as funding for C^3 technology has only steadily increased, the very scope of the program has also had to grow to absorb the changing face of modern warfare. To this end, funding for computer technology development previously contained within PE#0602234N, has been realigned by the US DoD to be presented in the Command Support thrust of the C^3 Technology program element #0602232N. This new realignment will become effective this year (2001).

Ten-Year Outlook

ESTIMATED CALENDAR YEAR FUNDING ($ in millions)

			High Confidence Level			Good Confidence Level			Speculative			
Designation	Application	Thru 00	01	02	03	04	05	06	07	08	09	10	Total 01-10
C3IRS/SEW ENGINEERING	C3 TECHNOLOGY DEVELOPMENT (US NAVY)	561.300	88.200	89.200	89.200	90.400	89.400	92.100	92.900	94.000	93.700	93.900	913.000