DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

2 July 2001

The Honorable Bob Stump
Chairman, Committee on
Armed Services
House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

The Fiscal Year 2001 House Armed Services Committee Report 106-616 directed the Secretary of the Navy to report on the Navy's program plan and funding for the Common Command and Decision System (CC&D) preplanned product improvement (P3I) program and for insertion of advanced technology in the Cooperative Engagement Capability/Ship Self-Defense (CEC/SSD) integrated combat system.

The enclosed report presents Navy's plans associated with the development of the CC&D program. Included is a description of the program's objectives, progress to date, and plans for development and implementation. Also included in this report is a discussion of Navy's evaluation of advanced technologies for the CEC program.

A similar letter has been sent to Chairmen Levin, Inouye, and Lewis. As always, if I can be of any further assistance, please let me know.

Sincerely,

Gordon R. England
Secretary of the Navy

Enclosure

Copy to:
The Honorable Ike Skelton
Ranking Minority Member

A REPORT TO THE CONGRESSIONAL DEFENSE COMMITTEES

ON

COMMON COMMAND AND DECISION PROGRAM

AND

NAVY PLANS TO INTRODUCE ADVANCED TECHNOLOGY INTO COMBAT SYSTEMS

Prepared by

Program Executive Office
Theater Surface Combatants
Arlington, VA 22242

June 2001

Enclosure

Table of Contents

List of Figures

I. Requirement

The House Armed Services Committee Report 106-616 requested the Secretary of the Navy to report to the congressional defense committees on the Navy's program plan and funding for the Common Command and Decision (CC&D) Preplanned Product Improvement (P^3I) program and for insertion of advanced technology in the Cooperative Engagement Capability (CEC)/Ship Self-Defense (SSD) integrated combat system with the submission of the Fiscal Year 2002 budget request.

The Committee made note of the Navy's progress in resolving interoperability issues between CEC and Navy SSD combat systems. The Committee also noted that the Navy initiated studies in 1999 for a CC&D system that would be a P3I to the Aegis Weapons System (AWS) and the Ship Self Defense System Mk 2 (SSDS Mk2) and would replace the command and decision capability presently in these systems with a common architecture. Such an architecture would reduce future combat systems life-cycle costs, enable the fielding of new or modified combat systems capabilities more quickly and at a lower cost, enhance system interoperability, and eliminate the redundant, conflicting, processing that is inherent in these systems.

The Committee also noted that the Navy plans to evaluate a proposed new approach to CEC data processing and transmission (Tactical Component Network) (TCN), which would conserve CEC communications bandwidth and provide for a wider, more efficient CEC network. Furthermore, the Committee encouraged the Navy to seek technology insertion opportunities that will improve the interoperability of Navy combat systems and CEC's capabilities for naval and joint forces.

II. Executive Summary

The CC&D program has been established to develop a set of computer programs that perform selected command and decision functions in an identical manner across multiple units. This program has the potential to significantly contribute to the definition and integration of network centric warfare concepts into the Navy's vision for future naval operations. The overall program objective is to develop next generation command and decision system elements to improve interoperability among Battle Force participating units. A CC&D capability is integral to achieving long term interoperability within the naval and joint environment by providing a common approach to key interoperability functions, such as correlating the information flow from off-board sources with on-board information sources. This is essential to achieving the Single Integrated Air Picture (SIAP), which is being engineered by the SIAP System Engineering Task Force.

Improved interoperability will result from the use of selected common computer programs on different units leading to common situational awareness, which in turn leads to more effective warfighting capability. Navy's ability to upgrade warfighting capability with a reduced cycle time and reduced development and support costs are also improved through the use of these common computer programs. Capability will be developed once and shared across multiple combat systems thereby reducing development and ownership costs.

In Fiscal Year 2001, operational requirements, technical studies, risk reduction demonstrations, and acquisition strategies are being evaluated using funds previously provided by the Congress. At the conclusion of Fiscal Year 2001, the program is scheduled to undergo a milestone decision review to proceed with technical development.

The notional program schedule stated in House Armed Services Committee Report 106-616 refers to an initial operating capability (IOC) in September 2008. It is technically and programmatically possible to develop an executable CC&D capability by early calendar year 2005. However, funding constraints do not currently support this timeline.

III. Common Command and Decision System Overview and Concept of Operations

A. Objectives

The CC&D program objective is to develop next generation command and decision system elements in order to improve interoperability, significantly reduce life cycle costs, and reduce the time required to introduce new warfighting capabilities into the fleet. Improved force interoperability is a key objective of the CC&D development effort and the approach will provide a standardized, interoperable command and control capability applicable to multiple units of the naval battle force. Life cycle costs will be reduced by the systems engineering approach, which reduces the number of computer programs that must be maintained and the training associated with each computer program. CC&D will also enable the Navy to field new or modified warfighting capabilities more quickly and at a lower cost by eliminating the redundant and conflicting processing now inherent in the present systems.

This open architecture capability will provide a significant improvement in shared battlefield knowledge, the ability to collaboratively plan and execute missions within the task force or battle group, and ultimately results in the timely application of naval combat power.

The introduction of the CC&D capability into the fleet through installation first in destroyers, cruisers, carriers, and amphibious ships will provide a proof of principle that a common approach can be achieved. Once proven, the desired extension of the CC&D beyond Navy surface ships to other Naval units and into joint service applications will be more readily achieved.

B. Background

CC&D has been initiated to address the long-term goal of achieving a common and open computer program architecture to resolve interoperability proble.ns in the fleet, while reducing life cycle costs and the time to introduce new and modified capabilities. Specifically, CC&D will provide a cost effective and coordinated engineering approach to standardize and streamline the Navy's surface command and decision capability development. The present Navy surface fleet includes different combat systems. The two primary systems are:

The AWS is installed in Aegis equipped destroyers and cruisers. The AWS was first deployed in 1983 and is now comprised of multiple equipment and computer

program baselines. Evolutionary AWS Baselines 6 Phase I, 6 Phase III, and 7 Phase I are under development.

The SSDS is installed in amphibious assault ships. The Mark 1 variant was first deployed in 1997 in landing ship docks (LSDs). A Mark 2 variant is under development and will be installed in CVNs, LPDs and LHDs. It incorporates the functionality in the Advanced Combat Direction System (ACDS) as well.

The Navy's CEC system enhances warfighting capability by distributing sensor data among fleet units in a task force or battle group. CEC is installed in seven ships and two primary land based test sites. It completed its operational evaluation in May 2001.

These systems were designed and developed at different points in time, for different classes of ships and by different design agents. They perform a number of common functions in unique ways that contribute to fleet interoperability problems. Constrained funding, technology limitations, and changing mission requirements have further exacerbated these problems. Advances in computing technology, changing operational concepts for the Navy, and reduced funding and manpower levels are providing the impetus to improve the Navy's ability to make battle force units operate more efficiently as a force. Advances in computer processing power and networking technologies have proven that substantial improvements are possible. The latest Aegis improvements and demonstrations of CEC have advanced new operational concepts and technologies; however, substantial improvements in command and decision elements are necessary to meet the demands of 21st century warfare.

C. Operational Concept

The foundation of Network Centric Warfare (NCW) lies in the ability to develop, distribute, and use information in new ways. Figure 1 describes the concept used to exploit all available sensors to provide the information necessary to create a Common Tactical Picture (CTP) of the actual battlefield environment. This common picture must be timely, accurate, complete, and deconflicted. Additionally, that picture must be shared by all elements of the naval battle force as well. Ultimately this picture must also be shared among all joint and allied forces operating with the battle force.

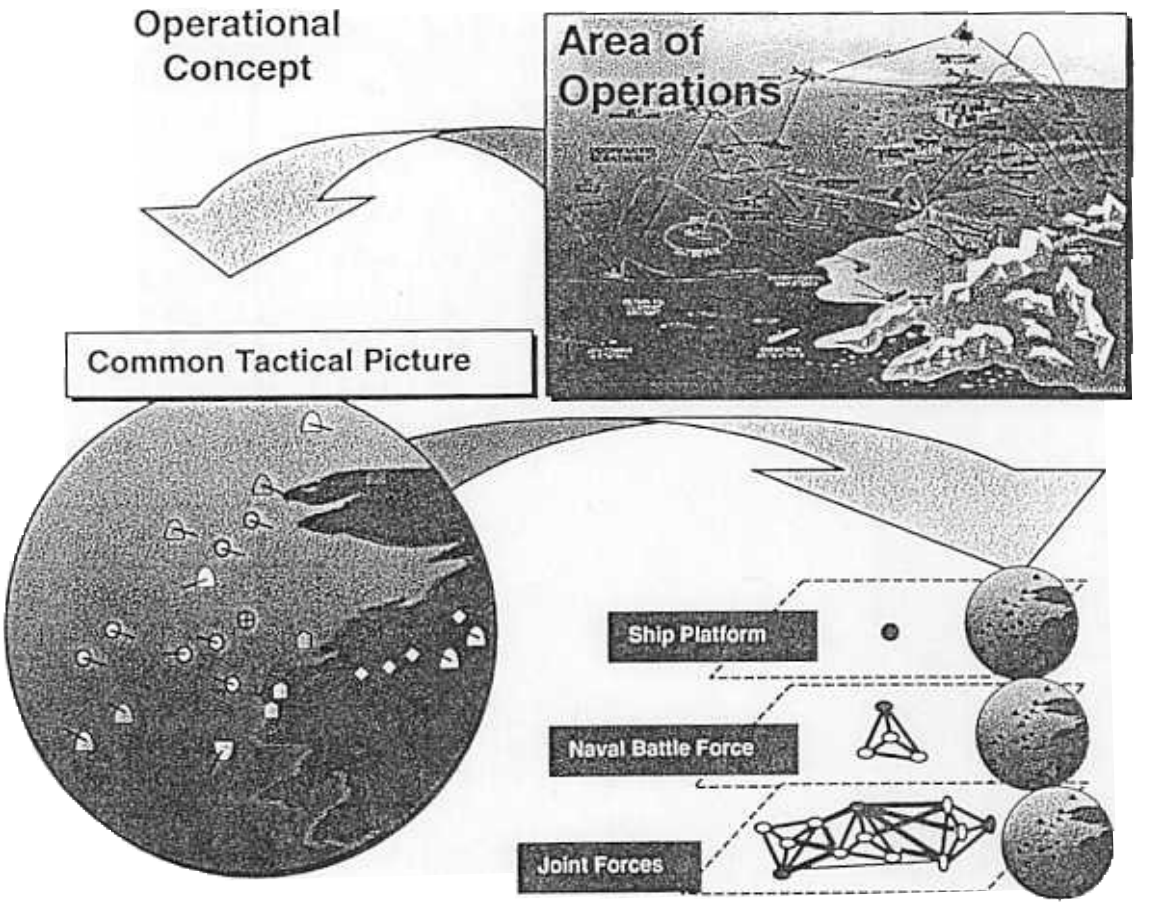

Figure 1: Operational Concept

D. Architectural Approach

The key to CC&D architectural structure is embedded in the concept of computer program layering to isolate complexity and allow for rapid development, insertion of new capability, and lower life cycle costs. Figure 2 describes the overall structure of the architecture. The functional architecture view provides the combat functions necessary to execute the warfare mission. This functional layer is based on clean partitioning of tasks. This allows tasks to be decoupled so that a change in one task does not necessitate a rippling change upstream and downstream. Common functions can then be executed in different combat systems in identical manner thereby improving interoperability as well as delivery cycle-time and life cycle costs.

The logical architecture provides a standard set of services that allow the combat functions to communicate with one another, as well as with processes external to the system thereby further improving interoperability and lower costs. Additionally, this layer isolates the combat functions from the computer equipment, which will be commercial off the shelf (COTS) items, which change much more quickly than the computer programs. This isolation

from the physical computers allows for a more rapid, less costly introduction of new equipment than if that isolation was not in place.

This structure of multi-layering and isolation of change makes it practical that the CC&D programs can be installed on multiple ships and platforms within a battle group. This commonality of combat functions, in turn enables the battle force to exploit network centric warfare concepts.

CC&D Architecture

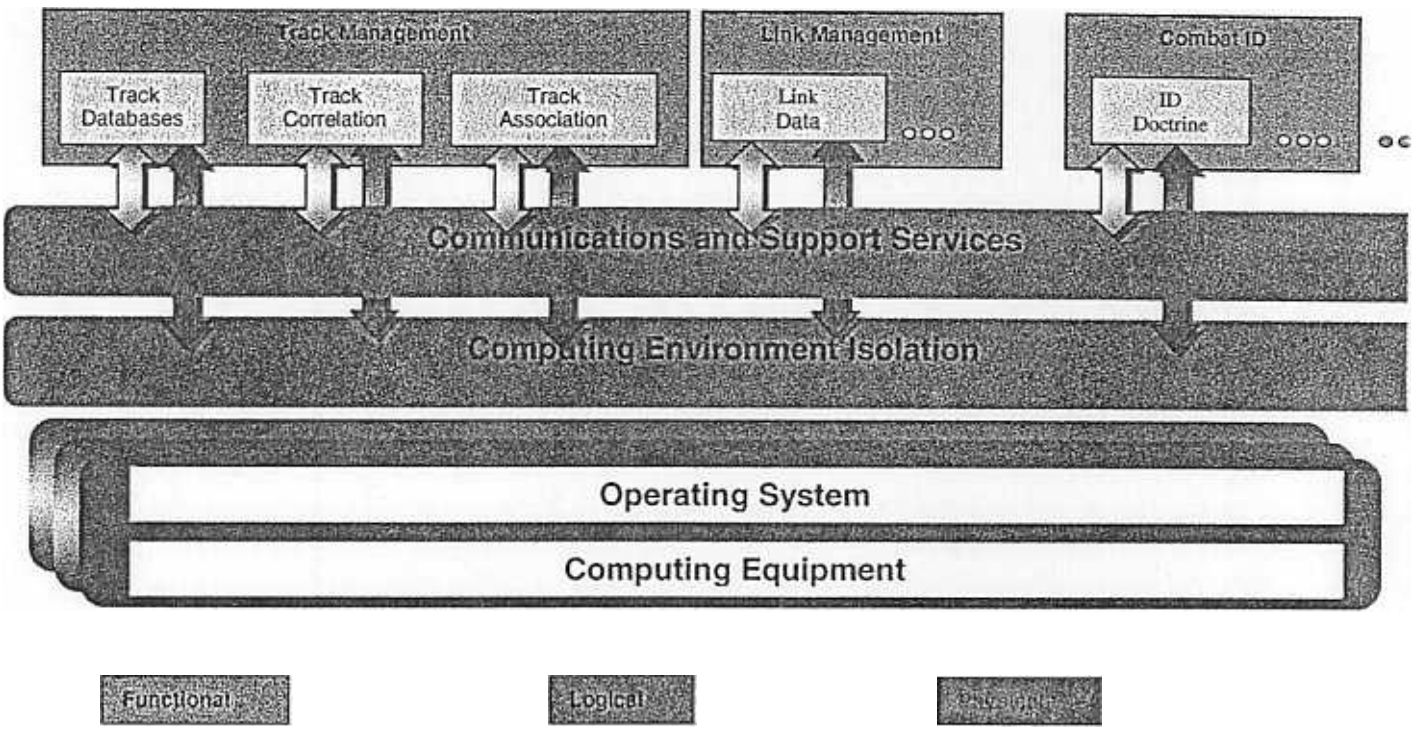

Figure 2: Architectural Concept

E. Common Command and Decision Functions Enable Network Centric Warfare Concepts

Figure 3 shows how CC&D will enable NCW concepts within the battle force. The left portion of the figure describes the principle functions and benefits of NCW. The right side shows how CC&D could implement those principle functions and benefits.

NCW fundamentally deals with the conversion of information into military action on a force level. The flow begins with the communications and data links, which provide the Infostructure. There are two high level tasks, which must be accomplished within the Command and Control element at all organizational echelons. The first step is to understand what is happening by developing battlespace awareness which is the knowledge task. The second is to decide what to do and who should do it, which is the execution task. If these tasks can be accomplished efficiently and effectively, the resultant military operations will have a higher tempo of operations, be more responsive to changes in the battlespace that may be exploited, and will result in lower costs and risks in terms of men and material. Additionally, the more rapid, more precise application of military power will provide increased combat effectiveness.

The development of improved battlespace awareness results from netting of sensor information and the fusion of that information to create a precise and correct picture. CEC provides the netting of primary air surveillance and fire control sensors, which rapidly develops a shared air contact picture. This is instrumental in gaining battlespace awareness and knowledge. Shared awareness and knowledge is the foundation of collaborative planning to develop and understand the commander's intent. This full understanding of the commander's intent provides the basis for independent action, taking advantage of opportunities and challenges that appear to the tactical commanders, which remain, aligned or self-synchronized with the actions of the entire force.

CC&D will provide the fusion of netted sensor information with on-board and off-board track information to develop a CTP. This picture will be shared in a timely manner among all battle force elements with CC&D programs installed. CC&D will also provide the tactical decision aids, which embody doctrine and in-situ environmental information, which provides the background context to assess the CTP. The CTP provides the track kinematical explicit information. Tactical decision aides along with formal Tactics, Training, and Procedures (TTP) provide the more knowledge-based tacit information needed to make correct decisions rapidly.

The mission management functionality of CC&D will provide the basis for collaborative planning and the rapid execution of engagement decisions by the force will yield the expected NCW benefits of increased tempo of operations, increased responsiveness, lower risks, lower costs, and increased combat effectiveness.

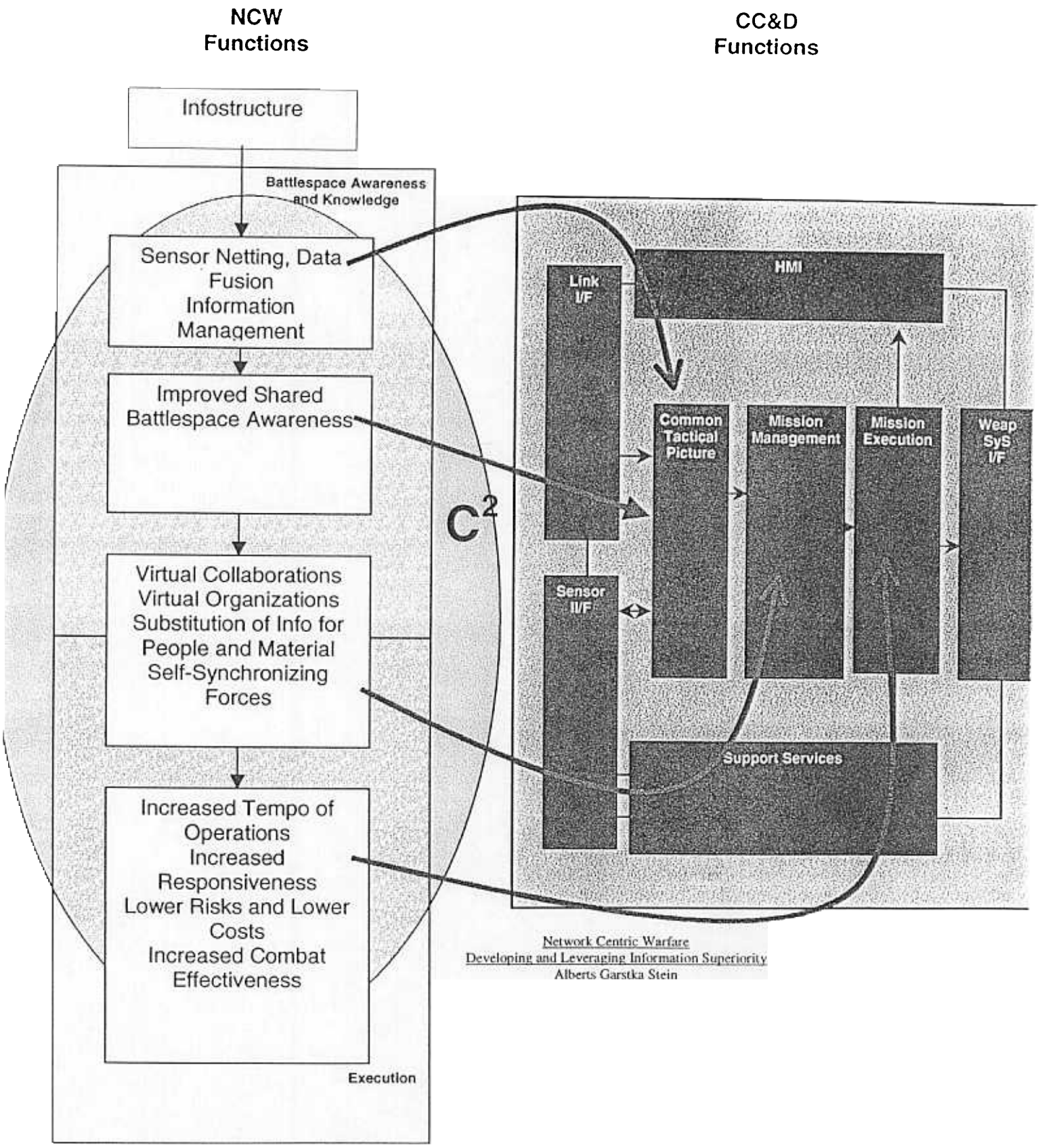

Figure 3: CC&D is an Enabler of Network Centric Warfare

IV. Common Command and Decision Program Overview

A. Progress to Date

Over the last year, the CC&D program has established the foundation necessary to achieve the program objectives. The Program Executive Officer for Theater Surface Combatants (PEO TSC) established a CC&D Program Office, PMS 468, in October 1999. The CC&D Program Office has completed the acquisition strategy and work is proceeding on program definition and risk reduction efforts. A draft Operational Requirements Document (ORD) has been developed and is undergoing analysis and further definition. The System/Subsystem Specification has been drafted and will become part of the planned request for proposals to be released in the Summer of 2001. The risk reduction effort is proceeding to execute demonstration experiments to ensure the viability of the architectural approach and portability of functions across different processing environments. The CC&D Program Office has initiated an essential analysis of the Theater Air and Missile Defense (TAMD) domain to ensure the end-to-end technical problems are well understood and requirements can be properly articulated, functions can be properly allocated, and interfaces to participating systems can be defined. Further, this analysis builds on the Battle Force Interoperability (BFI) analysis and will result in definitive Key Performance Parameters to be met by the CC&D program. This work is being coordinated with the Navy's lead organizations for battle force interoperability; the Naval Sea Systems Command Warfare Systems Directorate (NAVSEA 53) and the Assistant Secretary of the Navy (Research, Development and Acquisition) Chief Engineer (ASN (RD&A) CHENG). The CC&D Program Office has also developed the CC&D technical approach, detailed cost estimates, and a program schedule.

B. Common Command and Decision Program Plans and Funding

CC&D is a pre-planned product improvement (P^3I) program that will enhance the warfighting effectiveness of AWS and SSDS combat systems when fighting individually or as a force. It is anticipated that this program will be designated an Acquisition Category II (ACAT II) program and will be subject to the oversight of the ASN (RD&A), who will serve as Milestone Decision Authority (MDA).

Additionally, Navy will look into longer range plans to determine the impact of deploying CC&D functionality beyond the current set of ships. The need to resolve fleet interoperability issues and contain the total ownership costs of combat systems makes a compelling case to consider a broader deployment of this capability. The need for unambiguous exchange of information goes beyond the theater air and missile defense mission areas. It is a joint service, multi-warfare, multi-platform problem that extends not only to our own service but also to our Allies, Coalition Partners, and Non-Governmental Organizations (NGO) operating in the same theater. The following sections present the existing acquisition approach and program of record for CC&D.

1.0 Acquisition Approach

CC&D is being developed in multiple phases, as illustrated in Figure 4. Phase A, which commenced in Fiscal Year 2000, is the concept and technology development phase. Efforts in this phase include requirements definition, engineering studies, technical

demonstrations, and acquisition strategy development. This phase will conclude with the milestone decision in Fiscal Year 2005.

System development and demonstration will commence in Phase B of the program, following the milestone decision in Fiscal Year 2005. This five-year effort will conclude with the delivery and functional testing of CC&D elements designed for fleet introduction into AWS and SSDS capable ships. Initial operating capability will be achieved in this phase and will consist of one Carrier Battle Group (CVBG) or Amphibious Readiness Group (ARG), outfitted with an initial fleet deployment CC&D meeting operational requirements. As noted, initial fleet introduction in accordance with the program of record is scheduled for 2010. This phase will conclude with the successful testing and demonstration of CC&D leading to a milestone decision in the same year.

Full fleet deployment will commence in Phase C, following a Milestone decision. This phase will provide for the deployment of CC&D modules and their operation with other combat systems. Program plans for this phase will be developed later in Phase B.

CC&D is planned for installation in multiple ship classes including carriers, cruisers, destroyers, and amphibious ships. It is intended to be available for installation as the command and decision system for new construction ships, and as a back-fit replacement system in existing ships where the equipment baseline is compatible. No host ship combat capability will be degraded to accommodate the installation of CC&D.

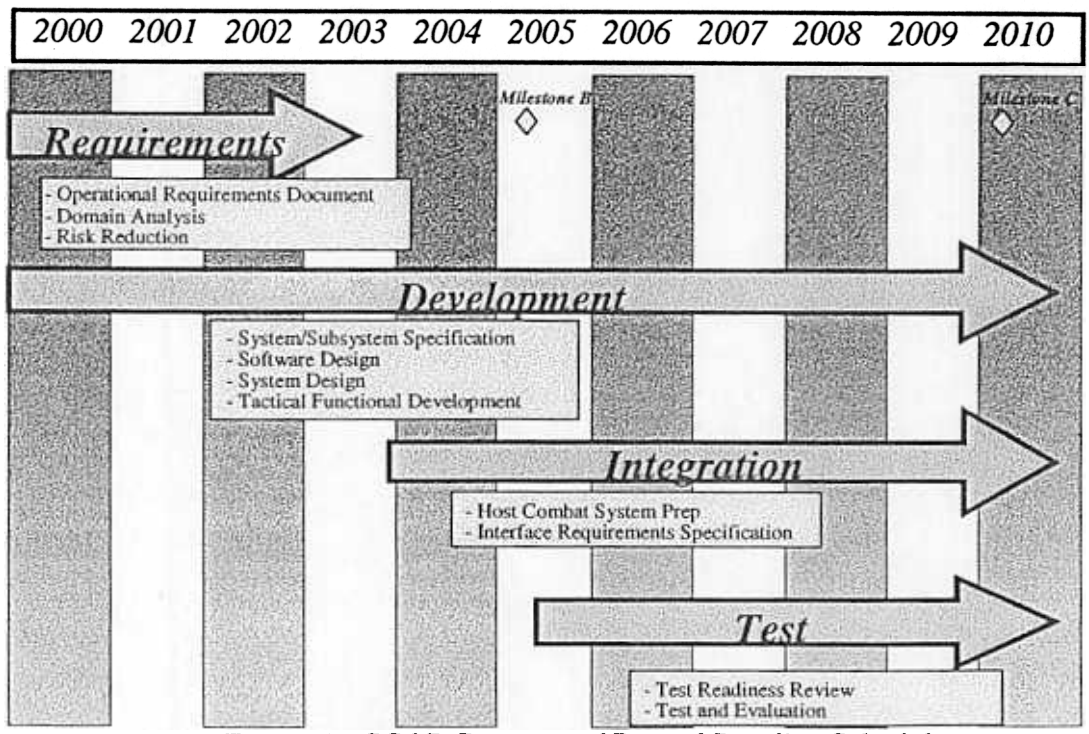

Figure 4 - CC&D Program of Record Baseline Schedule

CC&D development will occur through close coordination among the different programs, laboratories, and industry. A common computer program component library will be developed to preserve and maintain design knowledge and promulgated as an open

information source. Building on proven and certified common, reusable program components taken from the common library avoids combat system life cycle costs by providing integrated, tested, and maintained components. Computer program interface standards will be developed to ease the integration of future capabilities. This library will serve as the foundation for integration of CC&D across multiple combat systems. New design approaches, such as object-oriented analysis and design, are being considered for use where they can enhance program affordability and reliability. Improved cost avoidance in the area of computer program upgrades is anticipated through reuse of common components that only require one modification vice the modification of multiple configurations.

Joint government, industry, and laboratory teams are working to develop the engineering products. Three principal contractors who have a record of accomplishment in the area of combat systems are participating through an Integrated Process Team (IPT) program structure to provide technical expertise in the development. Navy and industry participants include:

Digital System Resources, Inc. successfully demonstrated middleware applications for submarine combat systems and will be providing middleware expertise.

Lockheed-Martin Naval Electronics & Surveillance Systems is the combat system engineering agent for the AWS and is providing technical assistance in the area of AWS integration.

Raytheon Naval and Maritime Systems, is the design agent for the SSDS Mk 2 and is providing technical assistance in the area of SSDS integration.

The Naval Surface Warfare Center (NSWC) Dahlgren Division is providing combat system development expertise.

A major component of the technical approach will be the use of middleware. This decouples the combat functions from the physical computing devices thus allowing for a rapid introduction of COTS processing devices and operating systems. In addition to the isolation from the processing devices, middleware will isolate functions from each other thereby, simplifying the introduction of new capabilities into the combat system.

The architecture components as well as end-to-end performance will be evaluated at the High Performance Distributed computing facility (HiPer-D) located at the Naval Surface Warfare Center Dahlgren Division Dahlgren, Virginia.

2.0 Program of Record

The program illustrated in Figure 4 is supported by the Fiscal Year 2002 President's Budget submission. The funding profile for the program of record is depicted in Figure 5 - CC&D Baseline Program Budget.

APPN RDT&E ($M)	Prior Years	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	TOTAL 02-07
Budget Estimate	50.0	5.4	14.4	26.4	29.8	38.4	39.1	153.5

Figure 5 - CC&D Program Budget

V. Combat System Advanced Technology Insertion

The Navy's plan for insertion of CC&D advanced technology into combat systems is built on two fundamental approaches similar to that used by the Advanced Processor Build (APB) techniques developed and proved by the Submarine Acoustic Rapid COTS Insertion (ARCI) Program.

First, in recognition of the continuous change in commercial processing technology, the Navy will develop (or convert in the case of legacy systems) selective functions of the command and decision computer programs so that they are independent of any specific commercial hardware and computer operating system. This is one of the fundamental elements of the CC&D program. One of the CC&D goals is to protect the sizable investment in our unique C&D programs. CC&D is utilizing a common middleware format that provides a buffer against underlying processing changes disruptive to system performance that are driven by the changes in the larger commercial market.

Second, all new functional command and decision programs will run on generally available commercial processing technology and will be compatible with the CC&D middleware. These programs will then be transportable to other hardware platforms. As funding becomes available, functional computer programs will be improved on an "as required" basis similar to the submarine program APB techniques. This will enable the future naval capabilities such as composite combat identification and distributed weapons control as well as small business innovative research projects to easily transition into the combat system through the CC&D APB-like approach.

The Navy has initiated a technical assessment of the Tactical Component Network (TCN). The assessment started in July 2000 and is planned to continue through February 2002. To date, four of 16 events have been completed. The remainder of the events are under review. The data resulting from these technical assessments will be available for use in the pending competition for CEC.

VI. Summary

CC&D will improve warfighting capability by improving fleet interoperability. Development of a common set of command and decision algorithms will result in improved shared situational awareness, improved combat system upgradeability, and reduced life cycle costs. A program office has been established and operational requirements for CC&D are under development. The program is making progress and is on track for initial fleet introduction in 2010.