

C⁴ISR Involvement with the Distributed Engineering Plant (DEP)

BeEm V. Le
SSC San Diego

BACKGROUND

In February 1998, the Fleet was concerned about interoperability failures among combat systems recently installed in deploying fleet units. These failures led to two modern combatants being tied to the pier during their Battle Group deployment. During the final 6 months before Battle Group deployment, shipboard and Battle Group "debugging" of systems consumed valuable fleet training time. In March 1998, the Chief of Naval Operations assigned to Naval Sea Systems Command (NAVSEA) the responsibility to address combat systems interoperability problems across Battle Management Command, Control, Communications, Computers, and Intelligence (BMC⁴I)/combat systems, and to coordinate resolution with the Fleet. In April 1998, NAVSEA formed the Task Force on Combat System Interoperability to study the interoperability crisis and provide recommendations for solutions. In May 1998, the Task Force was formally tasked to determine the feasibility and cost of using a land-based Distributed Engineering Plant (DEP) to support the design, development, test, and evaluation of interoperability of Battle Force systems. In June 1998, the Task Force on Combat System Interoperability reported that the establishment of a DEP was technically possible, but organizationally difficult because of the diverse group of organizations and elements. The Task Force also stressed that a DEP is only a tool to enable good design decisions early in the acquisition process. Following the Task Force Report, the collection of government activities represented in Table 1 formed a cooperative effort known as the Navy Alliance.

The Navy Alliance, made up of surface, air, subsurface, and command, control, communications, computers, intelligence, surveillance, and reconnaissance (C⁴ISR) components, crosses all Navy Systems Commands (SYSCOMS). The Navy Alliance developed a proposal for the establishment and implementation of a Navy DEP. The following sections

ABSTRACT

The Navy's requirement for interoperability between systems and Battle Groups led to the development of the Distributed Engineering Plant (DEP). The DEP Battle Group Interoperability Test (BGIT) was a combination of several Navy laboratories in which command, control, communications, computers, intelligence, surveillance, and reconnaissance (C⁴ISR) systems were tested within the DEP. This paper focuses on C⁴ISR integration and interoperability testing accomplished by the DEP BGIT program. It also discusses the support that C⁴ISR systems provide the Fleet and problems found during the DEP BGIT.

TABLE 1. Navy Alliance.

Naval Surface Warfare Center/Dahlgren Division—Dahlgren, VA
Aegis Combat Systems Center—Wallops Island, VA
Naval Warfare Analysis Station—Corona, CA
Naval Undersea Warfare Center—Newport, RI
Naval Surface Warfare Center/Port Hueneme Division (PHD)—Oxnard, CA
SSC San Diego—San Diego, CA
Naval Surface Warfare Center/PHD—Dam Neck, VA
SSC Charleston—Charleston, SC
Naval Surface Warfare Center/PHD—San Diego, CA
Aegis Training and Readiness Center—Dahlgren, VA
Naval Research Laboratory—Arlington, VA
Johns Hopkins University (JHU) Applied Physics Laboratory—Laurel, MD
Naval Air Warfare Center/Aircraft Division—Patuxent River, MD
Naval Air Warfare Center/ Weapons Division—China Lake, CA

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE AUG 2001		2. REPORT TYPE		3. DATES COVERED -	
4. TITLE AND SUBTITLE C4ISR Involvement with the Distributed Engineering Plant (DEP)				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Space and Naval Warfare Systems Center, 53560 Hull Street, San Diego, CA, 92152-5001				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT The Navy's requirement for interoperability between systems and Battle Groups led to the development of the Distributed Engineering Plant (DEP). The DEP Battle Group Interoperability Test (BGIT) was a combination of several Navy laboratories in which command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems were tested within the DEP. This paper focuses on C4ISR integration and interoperability testing accomplished by the DEP BGIT program. It also discusses the support that C4ISR systems provide the Fleet and problems found during the DEP BGIT.					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 6	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

describe the DEP concept as drafted by the Task Force, and developed and engineered by the Navy Alliance. The DEP was founded on the existence of shore-based combat system sites. These combat system sites were built to replicate the hardware, computer programs, connectivity, and environment of the ship and aircraft combat systems as much as possible. The DEP extends this concept to the Battle Group level by interconnecting these combat system sites to replicate a Battle Group. Given that the DEP is founded on shore-based combat systems, understanding the DEP begins with an understanding of a basic combat system. The combat system consists of many important elements integrated to form a system.

Space and Naval Warfare Systems Command (SPAWAR) and DEP

The plan from SSC San Diego and Space and Naval Warfare Systems Center, Charleston (SSC Charleston) was to incorporate the C4ISR family of systems into the DEP. This plan complemented the Battle Group/Battle Force (BG/BF) interoperability Navy Alliance proposal, but focused on implementing the DEP C4ISR component. The plan also detailed the roles of major Space and Naval Warfare Systems Command (SPAWAR) participants and provided a technical approach for integration of SPAWAR test resources with the DEP.

SPAWAR's mission was to deliver integrated interoperable C4ISR systems to the operational Fleet. SPAWAR had implemented an initial capability to build, integrate, test, and support systems by establishing the Systems Integration Environment (SIE), a robust engineering infrastructure that supported this evolution. The success of the DEP was also essential to horizontal integration, not only of the SPAWAR product lines, but also between Department of the Navy (DoN) combat systems and information systems. Many combat systems and C4ISR integration issues (singly and collectively) existed and needed to be identified and resolved with the DEP BG/BF integration and test process. It was SPAWAR's plan that commitment and participation in DEP by SSC San Diego and SSC Charleston would more quickly identify, quantify, and resolve fleet interoperability issues. SPAWAR's first approach was to use the SIE as a DEP extension while evaluating C4ISR capability. SSC San Diego and SSC Charleston would do this by adopting a management approach that complemented the Alliance approach and by leveraging infrastructure and resources as much as possible. SPAWAR would phase in implementation of its C4ISR site to complement the DEP process.

SPAWAR is the Navy's C4ISR product and service provider, supplying advanced information systems technology to the Fleet. Programs such as the Joint Maritime Communications System (JMCOMS), Automated Digital Network System (ADNS), Global Command and Control System—Maritime (GCCS-M), Information Technology for the 21st Century (IT-21), and Navy Wide Intranet (NWI) are initiatives that are critical to the implementation of network-centric warfare. SPAWAR is initially integrating command resources to provide a virtual environment for C4ISR development and testing initiatives around the globe. SPAWAR provides integrated information hardware and software systems to the Navy, other branches of the military, other agencies of the federal government, and prospective nations. The command organizational structure has three fleet-focused "Pillars"—Engineering, Installations, and Operations.

Since technology and systems change about every 16 months, training sailors and Marines on new technology becomes paramount. By focusing on deploying battle and amphibious-ready groups, SPAWAR works to ensure that new capabilities are provided to fleet units likely to need them the most—deploying Battle and Amphibious Ready Groups. SPAWAR 05 sets goals for systems engineering and for the use and management of the SIE to reduce risk, measure results, and ensure delivery of tested and validated capability to the Fleet. SPAWAR 051 is the systems engineer responsible for the development of end-to-end C⁴ISR systems designed to provide required capabilities for each deploying Battle Group. SPAWAR 053 acts as the primary manager/test directorate for complex highly integrated C⁴ISR integration test and evaluation. SPAWAR 053 establishes and maintains the test and evaluation processes, policies, and test infrastructure, including the SIE for the claimancy. These factors are tailored to fit specific program needs. Because the complexity of the program and its requirements vary, the management structure must have varying depth. SPAWAR 053 tailors the integration test organization to fit the complexity of each program. As a major player in the Alliance, SPAWAR 053 is a member of the Technical Advisory Board, the Systems Engineering Group (SEG), the Network Engineering Group (NEG), and the Collaborative Engineering Group (CEG). NAVSEA is assigned central responsibility to address BMC⁴I/Combat Systems interoperability problems within the SYSCOMs/Program Evaluation Offices (PEOs) and to coordinate resolution with the Fleet.

ACCOMPLISHMENTS

The first Battle Group that SPAWAR participated in was USS *Dwight D. Eisenhower* (CVN 69) (IKE) (Figure 1). During IKE BGIT, SSC San Diego and SSC Charleston accomplished the following:

- Executed limited Y2K testing between C⁴ISR systems and combat systems in accordance with the Navy Y2K Master Plan
- Added the ability to test a mix-match of real-time and non-real-time tracks
- Added the ability to mix live/simulated C⁴ISR tracks
- Added the limited ability to test joint C⁴ISR assets
- Added the ability to test C⁴ISR interfaces to several Naval Air Systems Command (NAVAIR) platforms (E2-C, F14D (Joint Tactical Information Distribution System [JTIDS]), F18 (Multifunction Information Distribution System [MIDS]), P-3, and S-3 aircraft)
- Developed/incorporated initial Common Simulation (SIM)/Stimulation (STIM) capabilities required to test C⁴ISR systems
- Developed/incorporated initial Data Extraction (DX)/analysis capabilities to test C⁴ISR systems
- Led efforts to enhance and implement full collaborative engineering capabilities for the Alliance
- Provided leads in C⁴ISR systems engineering functions in the DEP
- SPAWAR leveraged SIE test requirements and assets to address DEP goals during IKE BGIT
- Established an interface between SPAWAR C⁴ISR SIE and DEP, which replicated the ship configurations for the Automated Digital Network System (ADNS), GCCS-M, and the Officer in Tactical Command Information Exchange Subsystem (OTCIXS) for the IKE BGIT

- Planned and conducted a Battle Group Interoperability (BGI) Test Program that included C⁴ISR, combat systems, and several select "multi-source inputs"
- Supported the Navy Y2K Master Test Plan Level 2 and Level 3 test for C⁴ISR systems that interfaced to combat systems
- Supported the development of a "common" SIM/STIM C⁴ISR component for use in the DEP and SIE SIM/STIM environment.

Besides the IKE BGIT, SPAWAR has been a participant in the USS *George Washington* (CVN 73), USS *Abraham Lincoln* (CVN 72)/USS *Harry S. Truman* (CVN 75), USS *Constellation* (CV 64)/USS *Enterprise* (CVN 65), and USS *Carl Vinson* (CVN 70) BGITs. During these BGITs, several technical reports were written to document fleet findings for the C⁴ISR systems, particularly GCCS-M and Common Operational Picture (COP) Sync Tools (CST). These problems have been documented and reported to the Fleet and Program Office for correction.

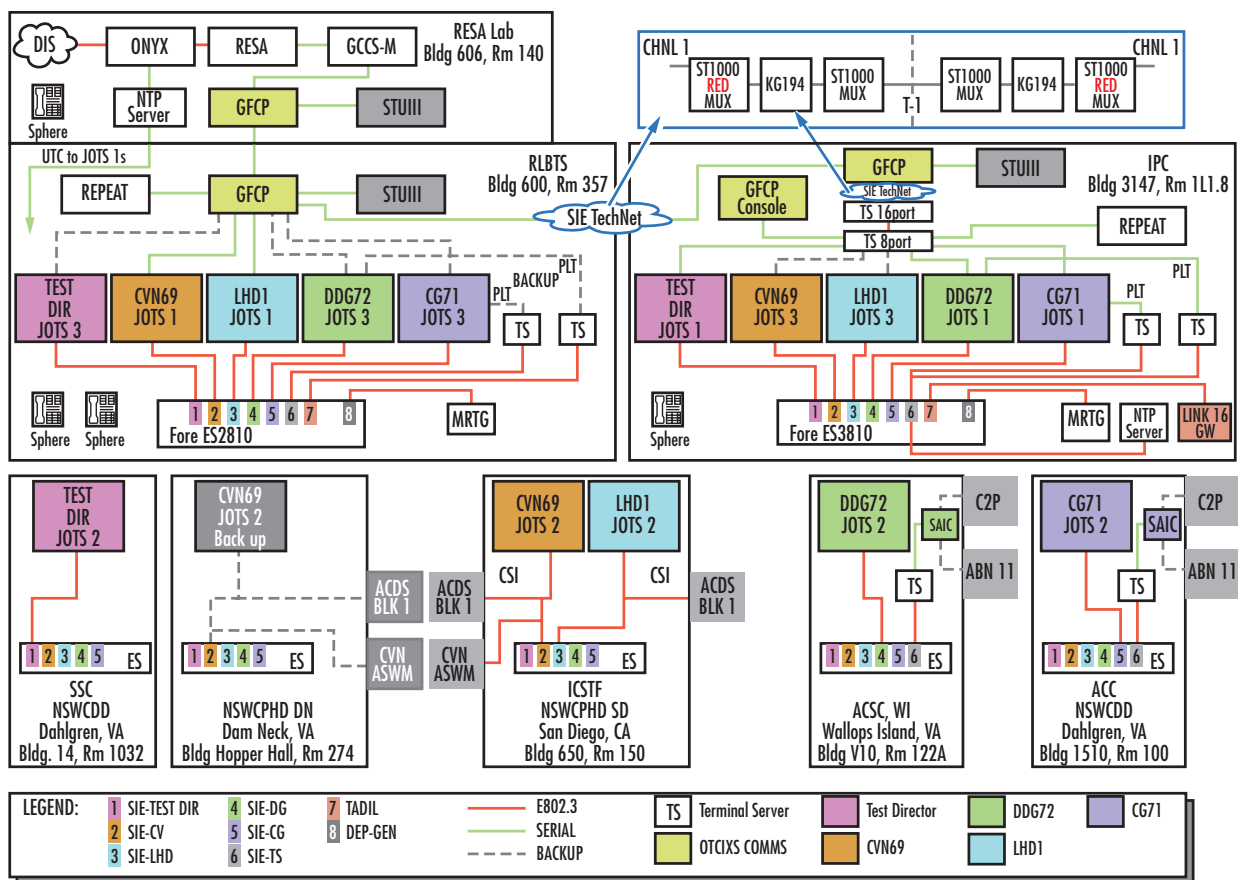


FIGURE 1. IKE DEP/SIE architecture.

LOOKING FORWARD—THE FUTURE

For the intermediate future, SPAWAR is planning to participate in USS *John F. Kennedy* (CV 67) BGIT, which is scheduled in June and July

2001. For this BGIT, GCCS-M will interface with the Advanced Combat Direction System (ACDS) Block 1 (two-way Combat System Integration [CSI] interface) and will interface with the Air Defense Systems Integrator (ADSI).

Looking ahead to FY 2002 and beyond, SPAWAR is planning to support and can include Joint Systems and Coalition Systems into the DEP. The overall focus of the original DEP Systems Engineering effort was to set up a disciplined and robust systems engineering process that leads to the development of a more interoperable joint force and the development of the DEP required to support that process. SPAWAR's system engineering process supports the concept in which the BF is the warfighting system rather than an individual platform. SIE offers a proven capability to build and test valid C⁴ISR architectures, which represent the complex operational C⁴ISR environment. The C⁴ISR SIE will further develop the DEP's ability to support overall force requirements to have interoperability "engineered-in." The direct interfaces between C⁴ISR and combat systems are limited today; however, highly integrated C⁴ISR systems on the other side of the direct interface system (e.g., GCCS-M) provide multi-source inputs that are fused together, providing vital information to the warfighter. Interoperability testing requires that many components besides the direct interface system be tied into the test architecture. Network-centric warfare and NWI will provide important timely information, extending the battlespace and supporting advanced mission planning. SPAWAR's commitment to the DEP will also support future efforts, including a closer integration of real-time and non-real-time command and control (C²), development of a common information base for C², and integration of the Tactical Digital Information Links (TADILs) into the common backbone. A valid C⁴ISR architecture has elements that operate at UNCLASSIFIED, SECRET, and Sensitive Compartmented Information (SCI) classification levels. All three are crucial for accurate integration and valid interoperability testing for BG C⁴ISR architecture and the integrated network security.

The original DEP effort was designed to support the important interoperability requirements of:

- A common tactical picture across all force elements
- The control and coordination of engagements at the force level
- Force-level planning

SPAWAR's specific goals, with other SYSCOMS, are to add the following important interoperability requirements of C⁴ISR:

- A common operational or tactical picture across all force elements
- Inclusion of the intelligence, information warfare (IW), cryptologic, and mission planning elements of BMC⁴I
- Inclusion of the meteorological, navigation, logistics elements of BMC⁴I
- Ability to simulate the NWI and Global Networked Information Enterprise (GNIE)
- Inclusion of real and simulated C⁴ISR networks (e.g., radio frequency [RF] and Internet Protocol [IP] networks)
- Integration of real-time and non-real time C² to include an integrated information base (IIB)

- Integration of the TADIL data into the common backbone
- GCCS–M for Submarine Combat Systems
- The COP Test will verify the capability to provide a common operational picture environment for interoperability testing. Several protocol scripts will be used to drive multiple SIMs/STIMs at various DEP sites. Data will be recorded. Track databases from C⁴ISR C² system base lines will be compared to ensure replication of known and/or expected performance.
- Link capabilities related to C⁴ISR will be tested to ensure the C⁴ISR DEP's capability to test interoperability. These capabilities include ADSI, multi-TADIL capability (MTC), and GCCS–M Tactical/Mobile, Coast Guard Link 11, and other related capabilities.



BeEm V. Le

BS in Electrical Engineering, Bradley University, 1987; BS in Mathematics, Bradley University, 1987

Current Research: Interoperable C⁴ISR systems; IT-21.