REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1994	Professional Paper

4. TITLE AND SUBTITLE	5. FUNDING NUMBERS
JOINT MARITIME COMMAND INFORMATION SYSTEM (JMCIS)/SYNTHETIC THEATER OF WAR (STOW) INTERFACE	PR: CC28

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Naval Command, Control and Ocean Surveillance Center (NCCOSC) RDT&E Division San Diego, CA 92152-5001	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
Advanced Research Project Agency (ARPA) 3701 North Fairfax Drive Arlington, VA 22203	

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

DTIC
ELECTE
DEC 2 9 1994
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13. ABSTRACT *(Maximum 200 words)*

This particular effort, a subset of the ADS program, provides the ability to interface the Joint Maritime Command Information System (JMCIS) to the Synthetic Theater of War (STOW). JMCIS is an operational command control system providing tactical C2I planning, execution, and supervision support for all warfare areas at over 250 installations afloat and ashore. STOW is a spatially distributed synthetic battlefield represented by real world forces, simulators, and models and connected by the Defense Simulation Internet (DSI). By use of synthetic battlefields, performance of research, engineering, requirements definition, systems analysis, and training can occur at all levels in a more affordable manner.

DTIC QUALITY INSPECTED 2

19941227 118

Published in AFCEA Joint Symposium Proceedings, June 1994.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Joint Maritime Command Information System (JMCIS) Synthetic Theater of War (STOW)	
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAME AS REPORT

21a. NAME OF RESPONSIBLE INDIVIDUAL	21b. TELEPHONE *(include Area Code)*	21c. OFFICE SYMBOL
J. K. Byram	(619) 553–3957	Code 4221

21a. NAME OF RESPONSIBLE INDIVIDUAL	21b. TELEPHONE *(include Area Code)*	21c. OFFICE SYMBOL

Standard form 298 (BACK)

JOINT MARITIME COMMAND INFORMATION SYSTEM (JMCIS) / SYNTHETIC THEATER OF WAR (STOW) INTERFACE

28 December 1993

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CONTENTS

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1.0 BACKGROUND

1.1 MOTIVATION FOR THIS WORK

This effort is funded by the Advanced Research Program Agency's (ARPA) Advanced Distributed Simulation (ADS) Program, which was initiated in FY92 to provide direct support to the DoD's new Science and Technology (S&T) Strategy published by Director Defense Research and Engineering (DDR&E) in July 1992. This new strategy was motivated principally by the need to adapt our national defense policy and approach to the new world circumstances precipitated by the collapse of the Soviet empire and the subsequent reduced defense budget.

This particular effort, a subset of the ADS program, provides the ability to interface the Joint Maritime Command Information System (JMCIS) to the Synthetic Theater of War (STOW). JMCIS is an operational command control system providing tactical C2I planning, execution, and supervision support for all warfare areas at over 250 installations afloat and ashore. STOW is a spatially distributed synthetic battlefield represented by real world forces, simulators, and models and connected by the Defense Simulation Internet (DSI). By use of synthetic battlefields, performance of research, engineering, requirements definition, systems analysis, and training can occur at all levels in a more affordable manner.

1.2 DOCUMENT ORGANIZATION

This document specifies the functional requirements of the initial JMCIS/STOW interface. In section 2.0, a high level description of STOW is provided. Then, in section 3.0 JMCIS background, use, modules, hardware requirements, message data inputs and outputs, and current deployment is described. Lastly, in section 4.0 the alternative ways being examined in which JMCIS can interface with STOW, namely through the Research, Engineering, and Systems Analysis model (RESA), DSI, tactical communications, or a combination of each, are described.

2.0 SYNTHETIC THEATER OF WAR (STOW)

2.1 CREATION OF SYNTHETIC ENVIRONMENTS

One of the seven principal technology thrusts of the new S&T Strategy is that of Synthetic Environments. This involves the use of advanced information technologies such as ultra high bandwidth communications, distributed networked computer processing, and advanced range instrumentation. With these, creation of a fully integrated synthetic battlefield environment offers a new, more affordable paradigm for system acquisition and training. In addition, it represents a critical element in the support of the other six thrusts, which are

- Global surveillance and communications
- Precision strike
- Air superiority and defense
- Sea control and undersea superiority
- Advanced land combat
- Affordability technology.

2.2 KEY ELEMENTS OF SYNTHETIC ENVIRONMENTS

STOW is represented by real-world forces, simulators or virtual systems, and models or constructive systems. A new and different, indeed, key element of the synthetic battlefield environment is the use of live forces and systems connected by distributed networked computers that pass locating data and Naval message traffic in a fashion similar to that done in real-world operations. JMCIS and the Highly Dynamic (HYDY) airplane are examples of live systems being networked into the synthetic battlefield environment. The use of live systems in a synthetic environment will provide a higher level of fidelity than ever before technologically experienced. Examples of virtual elements to be included are Army CSRDF (Crew Station Research & Development Facility) at San Jose, California; Unmanned Aerial Vehicle (UAV) at US Army Missile Command Huntsville, Alabama; and Navy TACDEW at Fleet Combat Training Center Pacific San Diego, California. Examples of constructive wargames driven by large computers include Army BBS, Navy RESA and ENWGS, Marine Corps MTWS, and Air Force AWSIM. It is the intent of STOW to evolve increasingly away from constructive systems and increasingly toward the use of live forces to maximize fidelity.

Examples of force locations to be networked are the Army National Training Center at Fort Irwin, California; the Naval Air Station Fallon, Nevada; the US Marine Corps at Camp Pendleton, California; and Nellis Air Force Base, Nevada.

The Defense Simulation Internet (DSI) is the backbone for synthetic battlefields. It is being developed by ARPA and DISA (Defense Information Systems Agency), supported by DMSO (Defense Modeling and Simulation Office). Important types of data that are passed over the network include protocol data units (PDUs) which are defined in an IEEE standard (1). The goal is to transition the DSI into a core component of DISA's Defense Information Systems

Network (DISN) by 1995, with a data rate capacity of at least 45 megabits per second. Eventually the DISN will evolve into the global grid of the next century, a multigigabit communication system capable of supporting actual warfighting operations at all echelons. The DSI will provide multilevel secure connectivity to over 50 locations worldwide, including Europe and the Pacific. All combat forces will be able to enter the synthetic battlefield from their home stations through the DSI.

2.3 DEMONSTRATIONS

The ADS program consists of two main elements: development of advanced technologies required to enable the synthetic battlefield and a sequence of advanced technology demonstrations (referred to generically as ATD#1 or specifically as STOW). The progression will be from demonstrating at the joint task force level in FY94 to the theater level in FY97, transitioning to the operational system in the post year 2000 timeframe.

3.0 NAVAL TACTICAL COMMAND SYSTEM - AFLOAT (NTCS-A) VARIANT OF JOINT MARITIME COMMAND INFORMATION SYSTEM (JMCIS)

3.1 FUNCTIONALITY

3.1.1 Overview

JMCIS supports the C2I mission requirements of joint, Navy, and Marine Corps commanders, as well as facilitating information exchange with national, joint, and theater level command authorities. JMCIS provides timely, accurate, and complete all-source information management, display, and dissemination capabilities, through extensive external communications interfaces, all source data fusion, and analysis and decision making tools.

JMCIS 2.0 is aimed at providing enhanced support to power projection in the littoral zone in direct response to recent redirection in U.S. Navy strategy. Recent conflicts in the Balkans, Somalia, and Iraq emphasize the need for increasing support to forces ashore, including the monitoring and control of assets moving in and between the land, air, and sea zones of operation. JMCIS 2.0 builds on the success and lessons learned in both recent real world operations and exercises, where the ability to be interoperable with Joint forces was recognized as a high priority.

JMCIS uses an open system architecture based upon DoD's Common Operating Environment. The software operates on a variety of Unix-based workstations. The system is composed of a number of components described in subsections 3.1.2 and 3.1.5 through 3.1.14, that can be selectively utilized depending on the C2I mission.

Early STOW interfaces to JMCIS will use the NTCS-A variant. Ultimately, both afloat and ashore variants of JMCIS will be interfaced to STOW.

Subsection 3.1.2 describes the core system of JMCIS. Subsections 3.1.3 and 3.1.4 describe the use of the NTCS-A variant of JMCIS in the current Composite Warfare Commander concept and the newer Expeditionary Force concept. The remaining subsections describe optional applications of the NTCS-A variant of JMCIS.

3.1.2 Unified Build

The core system used by JMCIS is the Unified Build software. The Unified Build is the fundamental building block for all Navy tactical command control applications software and is based on the JOTS II core software. This concept allows a well-documented, tested, and certified core upon which to base JMCIS applications. JMCIS 2.0 consists of the Unified Build, applications, and segments, i.e. optional applications.

Core software modules include the Tactical Data Base Manager 2.0 (TDBM) for tracking and correlation, Chart 2.0 for graphics introducing seamlessly integrated digital maps to our screens, Incoming and Outgoing Communications Managers (ICM/OCM), file management services, specific device drivers, the user interface, and the help system.

3.1.3 Use of NTCS-A by the CWC

The functionality of NTCS-A is most fully used in a full-up LAN configuration (section 3.3) in a carrier battle group by a composite warfare commander (CWC). The CWC is usually the officer in tactical command (OTC) of battle group operations (although they may be separate entities at the command level). Subordinate to this officer are several warfare area commanders, in particular the following.

- CWC: Composite Warfare Commander,call sign AB, usually on the carrier
- AAWC: Antiair Warfare Commander, AW, often CO of an NTDS missile ship (cruiser) or Aegis cruiser
- ASUWC: Antisurface Warfare Commander, AS, often CO of a destroyer or DESRON
- ASWC: Antisubmarine Warfare Commander, AX, often CO of a DESRON
- SWC: Strike Warfare Commander, AP
- AREC: Air Element Coordinator, AR
- SEWC: Space and Electronic Warfare Commander, AE
- LEC: Logistics Element Coordinator, AL
- SEC: Supporting Element Coordinator, subordinate to the ASWC
- SC: Supporting Coordinator, subordinate to the ASWC and ASUWC.

The relationships among these commanders are shown in figure 3-1.

For each of these commanders, there are selected segments of NTCS-A providing support for the decision process. These are described in subsections 3.1.5 through 3.1.14.
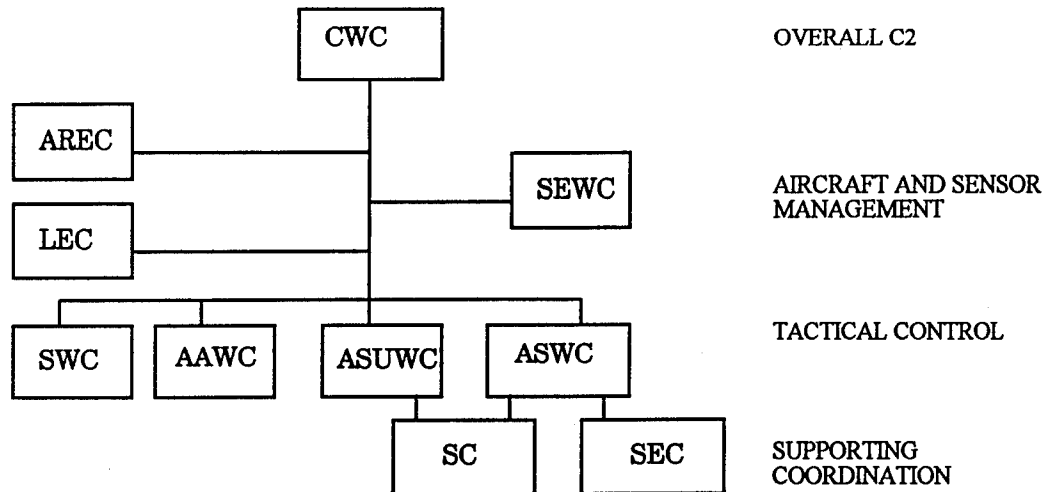
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                     └──────┘  └──────┘           COORDINATION
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Figure 3-1. Composite Warfare Command structure.

3.1.4 Naval Expeditionary Force Concept

It should be noted that the CWC concept is currently under review by the Naval Doctrine Command, motivated by changes in Naval strategy brought about by the modified world order and subsequent defense drawdowns. These changes are the following :
- Bipolar rigidity to multipolar complexity,
- Warfighting on the sea to joint ops from the sea, and
- Focus on littorals.

Traditional capabilities of strategic deterence and sealift will be maintained, however. These thrusts have prompted the emergence of the Naval Expeditionary Force concept, which is a structure somewhat different from the CWC concept. Naval expeditionary forces are cohesive, task organized Navy-Marine Corps teams operating forward, capable of a broad range of options that can be initiated from the sea. Such options range from forward presence, humanitarian, and peacekeeping operations to employment in regional conflict. Naval expeditionary forces are one of the basic building blocks for maritime and joint options used by the National Command Authority.

The Naval Expeditionary Task Group (NETG) represents the low end force and the Naval Expeditionary Task Force (NETF) represents the high end. The NETG capabilities are power projection, battlespace dominance, command control and surveillance, and organic sustainability. The NETF capabilities are similar, but in larger scale for extended domination of the battlespace, expecting sustainment for air operations for 24 hours per day and 400-500 sorties per day. The NETG and NETF candidate command organizations are shown in Figure 3-2. All warfare commanders, except the Sea Warfare Commander, will be Blue/Green integrated staffs.
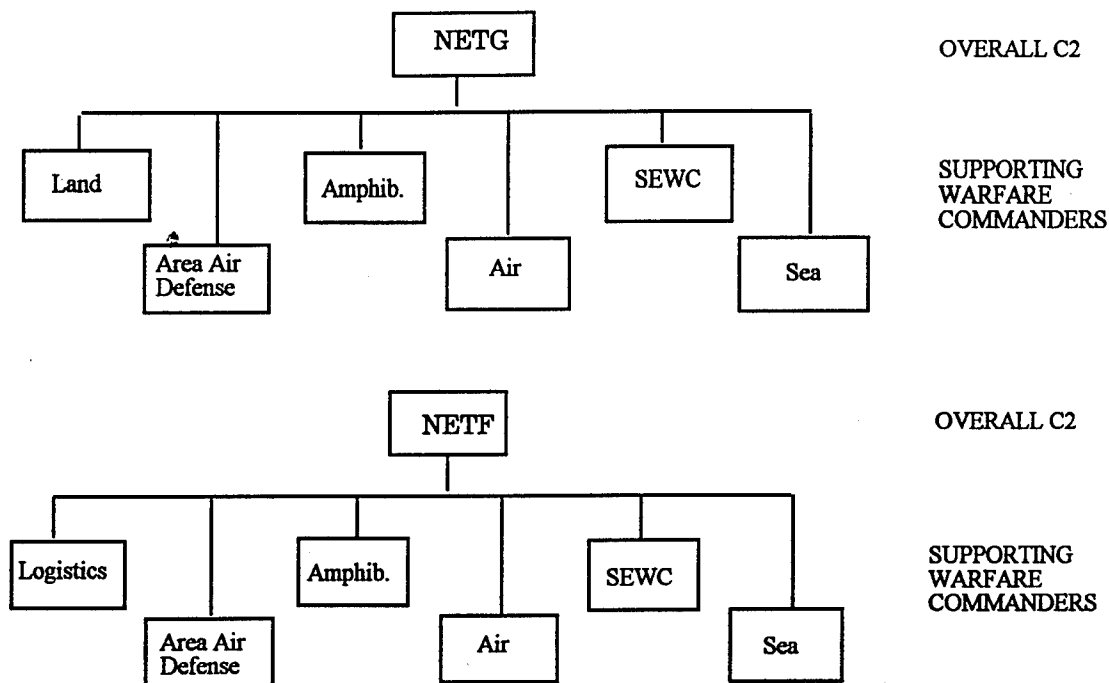
Figure 3-2. NETG and NETF candidate command organizations.

JMCIS will, as its name implies, increasingly incorporate joint capability to support Naval expeditionary forces. Currently JMCIS in a joint capacity can support:

- Land Warfare Commanders (JFLCC/JFMCC) with the Strikeplot module (section 3.1.10) and the Marine Corps product XPLRS
- Air Warfare Commanders (JFACC) with the Air Force product CTAPS (section 3.1.13) and the current air TDAs
- SEWCs with the SEWC module (section 3.1.9)
- Sea Warfare Commanders (JFNCC/CWC/CATF/URG) with most of the other NTCS-A functions
- Intelligence (JIC) with NIEWS (section 3.1.12).

JMCIS will continue to support all the above warfare commanders plus in the future will support:

- Logistics with Naval Tactical Command Support System (NTCSS)
- Amphibious Commanders with the Amphibious TDA
- Intelligence with Ship's Signals Exploitation Equipment (SSEE)
- OSIS Baseline Upgrade (OBU).

Other functionality supported by JMCIS is Operations Support System (OSS) for ashore commanders, NTCS-A Integrated Tactical Environmental System (NITES), Battle Group Passive Horizon Extension System (BGPHES), and Navigation Sensor System Interface (NAVSSI).

3.1.5 Tracking and Correlation

NTCS-A 2.0 contains an embedded ELINT correlator in TDBM, which allows in-depth correlation and tracking of both at-sea and land targets. The ELINT correlator contains an embedded Hull-to-Emitter Correlation (HULTEC) tactical decision aid (TDA).

TDBM also contains an attribute correlator.

In NTCS-A 2.0 there is a new Track-to-Track Correlator (TTC) as a segment allowing a multihypothesis, multisource means of track management and decision analysis through automated correlation of ELINT, Link, and OTH (Over-the-Horizon) tracks.

3.1.6 Mapping

One of the most noticeable enhancements in NTCS-A 2.0 is the introduction of standard DMA (Defense Mapping Agency) digital chart products and imagery on the network. Examples of available maps include ARC Digitized Raster Graphics (ADRG), Compressed Aeronautical Charts (CAC), and Digital Terrain Elevation Data (DTED).

3.1.7 VIP

The Video Interface Processor (VIP) provides a video switching capability allowing selected ships spaces to view NTCS-A workstation activity from other selected spaces on a large screen display.

3.1.8 NIPS

The NTCS-A Intelligence Processing Services (NIPS) implementation includes full integration of a central data server on the NTCS-A LAN to support core JOTS services and optional applications such as the Strikeplot segment, the Space and Electronic Warfare Commander (SEWC) segment, and the NTCS-A Imagery Exploitation Workstation (NIEWS). NIPS uses Sybase to access a number of data bases, such as the

- IDB (Integrated Data Base),
- NID (Naval Intelligence Data),
- NERF (Naval ELINT Reference File), and
- EPL (ELINT Parameters List)

to provide weapon and sensor data for both friendly and threat platforms.

A significant 2.0 enhancement is the introduction of NIPS automated message handling capabilities on all NTCS-A workstations. This powerful new functionality allows a giant step toward a paperless message environment.

3.1.9 SEWC

This optional application module is specifically designed for the Space and Electronic Warfare Commander and provides tactical decisions aids to support planning for EMI deconfliction, communications, EMCON, countermeasures, and ESM.

3.1.10 Strikeplot

The Strikeplot application offers the operator the ability to view the overland tactical picture on a power projection oriented workstation. This application brings together TDBM's wet or dry track data, installation databases from NIPS, digital maps, overlay of weapons rings, and site identification.

3.1.11 TIMS

NTCS-A 2.0 improvements to the Tactical Information Management Services (TIMS) include enhanced Automatic Status Boards (ASTABS), an extended airplan system including Air Tasking Order (ATO) message formatting, improved CASREP processing, preparation of briefing slides, and a weapon inventory database.

Most significant, however, is the availability of selected NIPS or JOTS services on a TIMS PC. This capability expands access to the NTCS-A message handling, intelligence data base, and TDBM track data base to all TIMS users.

3.1.12 NIEWS

NIEWS functions as the imagery server to the NTCS-A LAN. NIEWS receives, catalogs, stores, and distributes digital imagery on the LAN and allows detailed imagery exploitation of all available imagery products. Hardcopy is available of both the digital imagery and threat data overlaid on digital maps.

3.1.13 CTAPS

For joint air strike planning and support, JMCIS 2.0 has an X-Windows interface to the Air Force Contingency TACS (Tactical Air Control System) Automated Planning System (CTAPS). Additionally, Air Tasking Order Express (ATOX) permits reception, review, and tactical plotting of sequences of ATO messages from CTAPS sites for forwarding to other USN JMCIS sites.

3.1.14 Tactical Decision Aids

NTCS-A provides over 30 tactical decision aids (TDAs) supporting several warfare areas. Some TDAs are NTCS-A 2.0 applications and some are NTCS-A segments. The following paragraphs list the NTCS-A 2.0 applications TDAs followed by the NTCS-A 2.0 segment TDAs ordered by warfare area.

NTCS-A Application TDAs

- Quick CPA (Closest Point of Approach)
- Quick Intercept
- Two Track Analysis
- Track History Analysis
- Timelate Statistics
- Limit Lines
- Status Boards
- Moboard (Maneuvering Board) Overlay
- Crossfix
- CAP Engagement
- HULTEC Database
- IREPS (Integrated Refractive Effects Prediction System)
- SAR (Search and Rescue)
- Sat (Satellite) Database
- Sat (Satellite) Vulnerability
- Calculator
- Coordinate Conversion

NTCS-A Segment TDAs by Warfare Area and Developer ASW
- NAWC: Raymode, Raytrace, Area Search, Surveillance Intercept Coverage,Barrier Analysis, Target Transit Search
- NUWC: ASWTDA
- INRI: Waterspace Management

AAW
- NAWC: ThreatSector/Axis, Chainsaw/Tanksaw, Vector Logic, CAP/Ship Stationing

EW
- NRL: OPDEC
- NRaD: SEWC

Logistics
- NRL: Battle Group Logistics Coordinator Support System (BGLCSS)

Coast Guard
- EECEN: Man Overboard, Five Closest, Emitters, Own Ship History
- INRI: SAR Planner

3.2   COPERNICUS ARCHITECTURE AS A SUBSET OF C4I FOR THE WARRIOR

The Copernicus architecture is the means by which the NTCS-A variant of JMCIS obtains, fuses, displays, and extends threat and friendly locating data and friendly OPNOTE data. It is the interactive framework that ties together the command control process of the Navy tactical commander afloat, the JTF commander, the numbered fleet commander, and others with the CINCs ashore. C4I for the Warrior is the analogous joint overarching framework by which JMCIS information will be coordinated horizontally and vertically to prosecute any mission in the battlespace (2). In this section, both Copernicus and C4I for the Warrior will be discussed in order to provide an understanding of the global transfer and fusion of information of which the NTCS-A variant of JMCIS is a part.

The Copernicus architecture and C4I for the Warrior are both C4I architectures to replace our current systems and investment strategies that provide a programmatic basis for construction over the next decade. The four pillars of Copernicus are:

- Tactical Command Centers (TCC),
- Tactical Data Information Exchange Systems (TADIXS),
- CINC's Command Complex (CCC), and the
- Global Information Exchange Systems (GLOBIXS).

The analogous extension in C4I for the Warrior is

- TCC,
- Joint Tactical Information Exchange Systems (JTIXS),
- CINCS' Command Complex (CCC), and the
- Global Grid.

The TCC is the collective set of nerve centers of tactical units, whether carriers, submarines, Marine Air/Ground Task Forces, Army or Air Force forces, or Joint Task Forces (JTFs) in the joint model. NTCS-A resides in a TCC, in particular on a LAN distributed among the command and information spaces aboard a carrier or smaller combatant.

The TADIXS are a series of tactical virtual nets. Copernican TADIXS are not to be confused with the existing TADIXS A and B circuits. Rather, Copernican TADIXS are virtual networks of variable duration (minutes to days) depending on the information exchange load. They should be considered information networks sharing communications circuitry over a broad menu of bearer services from HF and VHF to UHF, SHF, and EHF military satellites, as well as commercial satellites. In C4I for the Warrior, the TADIXS are extended to include all joint information exchange systems, collectively referred to as JTIXS.

The CCC is a virtual network imposed over metropolitan area networks in Oahu, Hawaii; Norfolk, Virginia; and Naples, Italy. The CCC will tie together existing command and staff organizations and proposes to construct two new ones--a Space and Electronic Warfare (SEW) Center and a research center. Viewed from the afloat perspective, the CCC provides a means to manage the information flow for the tactical commander, with sufficient doctrinal and technological flexibility to allow each commander to decide how much and what kind of

information he wants. In C4I for the Warrior, the CCC takes on an expanded meaning including Component CINCS, anchor desks, and a JTF gateway.

GLOBIXS are global, virtual networks imposed on the Defense Communications System (DCS) or commercial systems. GLOBIXS tie together existing shore sensor nodes, analytic nodes, and other selected activities into communities of like interests. They are by definition joint in construction, and some will be combined. All GLOBIXS connect to the CCC. In C4I for the Warrior, the concept is extended to include similar strategic, operational, and tactical nets.

Architectural goals of Copernicus (3) include

- Technological, organizational, and doctrinal flexibility to accommodate open ocean operations, prolonged regional conflict, and crisis action,
- An investment strategy with force-planning criteria to scale down in post-Cold War, jettison outdated programs, and ensure new programs are part of an overall blueprint,
- Centralized architectural development and oversight with standardized technological components and consolidated, operational, tactical networks,
- Decentralized development of mission-specific, multimedia, global networks within the blueprint to maximize experience down-echelon,
- Analogous command centers ashore and afloat that share a consistent tactical picture, and connect Navy to the joint and allied picture,
- Marriage of national assets to tactical applications, the accommodation of SEW,
- A new logistics strategy - PIM - to keep the leading edge of technology in the Fleet while reducing the Navy ILS and maintenance tail,
- An end to domination of the Navy communications by the message format, that is, an approach to true office automation,
- Both functional and technological consolidation of military SATCOM bandwidth and an affordable high-data rate alternative to it, and
- Better security through MLS in the intelligence fusion process, elimination of hardcopy cryptographic key (i.e. Over-the-Air Rekeying (OTAR) and Over-the-Air Transfer (OTAT)), and establishment of a Navy-wide secure RDT&E network.

3.3 HARDWARE REQUIRED

3.3.1 Workstations as LAN Building Blocks

Depending on the functionality required, the NTCS-A hardware configuration can vary greatly. The main workstations used as components of the NTCS-A LAN are the following:

- DTC-2: C3 Computer Systems version of the Sun 4/300 Series workstation
- TAC-3: Hewlett Packard 750 Series workstation
- PC: 486 PC with approximately 4 MB RAM.

The DTC-2 is additionally fitted with 32MB RAM, graphics cards, two 500 MB hard drives, and a 150 MB tape drive. The TAC-3 is additionally fitted with up to 128 MB RAM, graphics cards, a 1.3 GB hard drive, and a DAT drive. (Often the exact hardware on each machine varies.) Both use a Unix operating system, the Berkeley Unix on the DTC-2 and the AT&T System 5 Unix on the TAC-3.

3.3.2 NTCS-A LANs

To represent the NTCS-A system at one end of the spectrum, it is possible to run the Unified Build on a single DTC-2 and populate this with traffic from OTCIXS.

To represent NTCS-A at the other end of the spectrum, it is possible to have a full-up CV LAN configuration such as that fielded on USS Kitty Hawk for the initial NTCS-A 2.0 build in November 1992. That LAN included 11 TAC-3s, 9 DTC-2s, and approximately 25 486 PCs. On that LAN, it was required that the TIMS Server and the NIPS CDBS (Central Data Base Server) be TAC-3s because of heavy processing requirements. (Other TAC-3s were used to support SCI requirements and ANAPS(analyst applications)). NTCS-A OATs (optional application tapes, now renamed segments) were distributed as requirements dictated and space permitted among the remaining DTC-2s and TAC-3s. The PCs were all connected to the TIMS Ethernet LAN running from the TIMS server.

3.4 INPUTS AND OUTPUTS

The NTCS-A variant of JMCIS receives inputs from a number of sources. Listed below are the links transmitting data to NTCS-A (along with the message formats accepted by NTCS-A).

- OCTIXS (OTH-G, USMTF)
- TADIXS A (OTH-G)
- FLTBDCST (OTH-G, USMTF)
- ACDS Block 0 (Link 4A, Link 11)
- TADIXS B (OTH-G, Tabular)

- Navigation (SRN19, SRN25, CVNS, SINS, LORAN C, SPA25G,
- MX200, WRN6, WSN5)
- TTY (Link 14)
- ROTHR
- NAVMACS
- ACDS Block 1 (Link 4A, Link 11, Link 16).

Outputs from NTCS-A are on the following links (with associated message formats).

- OTCIXS (OTH-G)
- TADIXS A (ATO Format 26)
- Fleet Broadcast (OTH-G)
- HIT Broadcast (OTH-G)

3.5 CURRENT DEPLOYMENT

NTCS-A is deployed (4) currently in the Fleet on over 250 Naval ships and shore sites, including FCTCLANT; FCTCPAC; Fleet Mobile Operational Command Center (FMOCC); NRaD; and NSWC Fallon, Nevada.

4.0 JMCIS INTERFACE WITH STOW

4.1 THROUGH RESA

The Research, Evaluation, and Systems Analysis (RESA) model was written as the Warfare Effectiveness Simulator (WES) at NRaD in 1976 and has the capability of simulating all aspects of Naval warfare, including geographic locations of threat and friendly platforms; organic sensor detections; wide-area surveillance detections such as overhead sensors, SOSUS, and ROTHR; and engagements of air, surface, and subsurface platforms. As such, RESA provides a constructive model capable of populating the JMCIS system in the absence of live message traffic using the RESA Message Generator (RMG). In selected scenarios of the Synthetic Theater of War, RESA is the Naval warfare generator passing contact messages to JMCIS and JMCIS displays the tactical picture and provides tactical decision aids to assist the subordinate commanders and ultimately the CWC/OTC in warfare decisions.

The advantages of using RESA as the JMCIS interface with STOW is that RESA can provide the ready-made RMG OTH-G messages with which to populate the JMCIS database. The disadvantage is that RESA, as a constructive model, is not a real-world system and will eventually be transitioned out of synthetic environments such as STOW.

4.1.1 Hardware Interface

At NRaD, RESA and the NTCS-A LAN are in adjacent buildings (RESA Lab, Building 606, and NTCS-A Integration Test Facility (ITF), Lab 350 Building 600). In the RESA Lab, a single NTCS-A terminal is used which serves as FOTC and scrubs the tactical picture before passing to the NTCS-A ITF housing an NTCS-A LAN. RESA and the NTCS-A ITF can be connected in either of two ways, as follows.

1. STUIII. In the RESA Laboratory, RS-232 lines can be connected from the DEC terminal server (attached to the main RESA Vax computers) into the NTCS-A workstation. This in turn is connected to a STUIII secure phone. In the NTCS-A ITF, a STUIII phone is linked by a RS-232 line into the NTCS-A serving as the communications processor (CP). Secure data can then be passed to the NTCS-A LAN via the STUIII connection.

2. Secure Routers and Bridges. In the RESA Laboratory, the DEC terminal server (attached to the main RESA Vax computers) is connected to the NTCS-A terminal which in turn can be connected by routers and bridges between Buildings 606 and 600. This net is run to a terminal server in the NTCS-A ITF and from there by RS-232 line into the NTCS-A CP. Secure data can then be passed to the NTCS-A LAN via this connection.

We will begin with the STUIII interface since it is the fastest and easiest to implement and work toward the secure routers and bridges interface because it frees phone lines in RESA and NTCS-A Laboratories and provides fewer data errors.

4.1.2 Data Interface

Data is passed from RESA via OTH-G message into NTCS-A. From the NTCS-A point of view, data is received from RESA in OTH-G format which is the same format received from live circuits in operational or laboratory settings. The NTCS-A CP processes the messages using the ICM (Incoming Comms Manager) and places the contact data in TDBM (Tactical Data Base Manager). The TDBM Master on the CP distributes data to each TDBM Client on the client workstations on the LAN. Each workstation is then able to display the tactical data and maintain a picture consistent with each other LAN client workstation and with RESA.

Data is also passed from RESA via Link 11 format into NTCS-A and is processed in a manner similar to that of OTH-G messages.

4.1.3 Phased Implementation

In Phase 1 the following types of messages will be passed from RESA into NTCS-A:

- OTH-G CTC   (Contact)
- OTH-G POS   (Position)
- OTH-G OPNOTE   (Operator Note)
- OTH-G RAD/RADB   (Radar Data, Expanded Radar Data)
- OTH-G LOB   (Line of Bearing) Link 11

OPNOTES are text messages permitting operators to exchange test information and providing a way, in addition to OTH-G messages, for FOTC Participants to send recommended track management data to FOTC.

Figure 4-1 shows the hardware hookup to implement this phase. When certification of secure routers and bridges is obtained for Secret data between RESA and NTCS-A laboratories, we may wish to change from STUIIIs to a router and bridge interface.
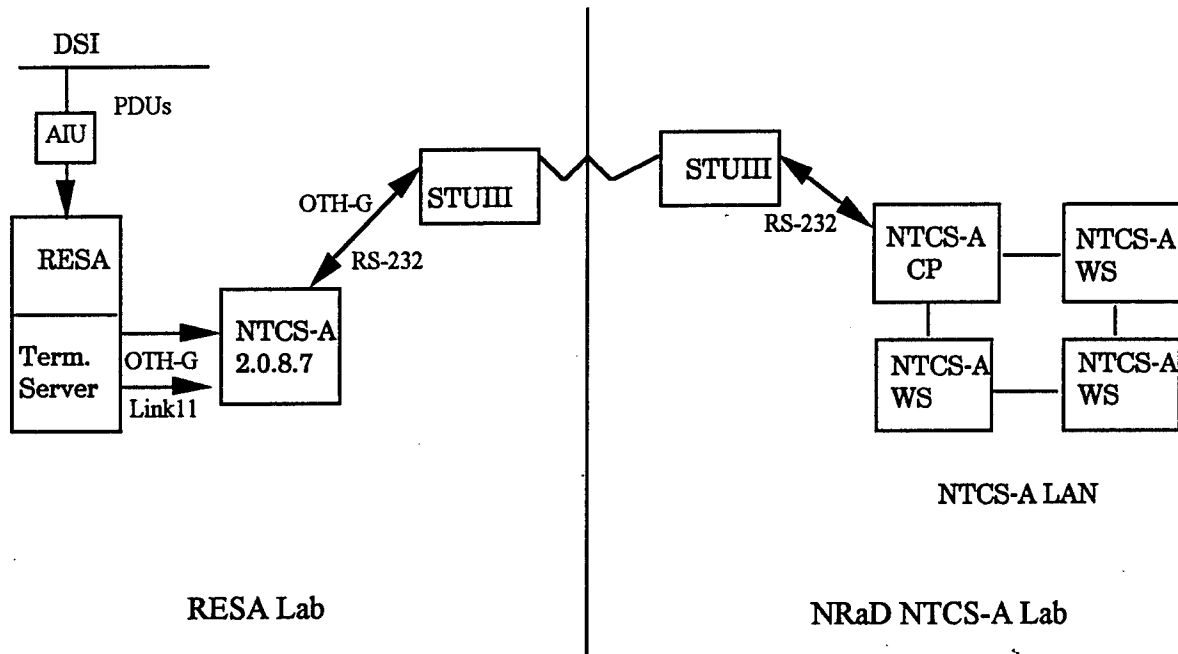
Figure 4-1. Phase I hardware configuration.

In later phases, the following additional functionality will be added.

¥JANAP 128 Format. Transmitting messages from RESA in JANAP 128 format is desirable since all NTCS-A testing for Fleet releases is done on messages packaged in JANAP 128 format. With this format, we can be sure the data is being displayed correctly since it has been extensively tested.

¥Additional Sites. Sites with NTCS-A LANs can be added as FOTC Participants, while NRaD RESA acts as FOTC. Candidate sites are FCTCPAC San Diego, California and Naval Air Station Fallon, Nevada. Figure 4-2 shows the hardware hookup to implement additional sites.
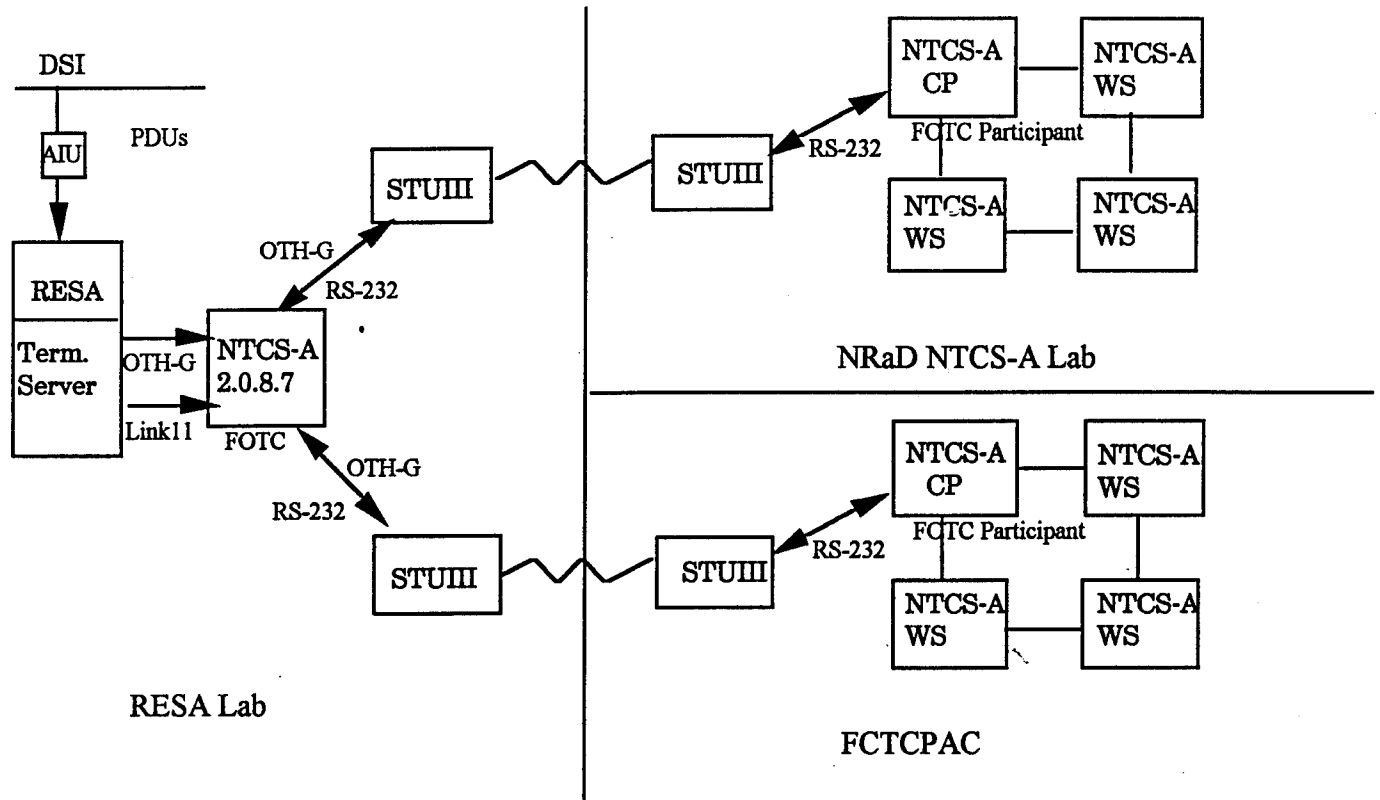
Figure 4-2.   Additional sites hardware configuration.

Track Management Messages.   The following track management messages can be implemented to give the FOTC an automated way to manage NTCS-A tracks:

- Delete Position   (DPOS)
- Delete Line of Bearing   (DLOB)
- Merge   (MRG)
- Delete   (DEL).

The implementation of these messages, along with NTCS-A builds 2.0.10.3 and beyond, requires SIDs (subscriber identifiers), which in turn require the use of the GFCP (generic front end communications processor), the IDS 8648 protocol, and JANAP 128 message formats. The hardware configuration for this implementation is shown in figure 4-3.
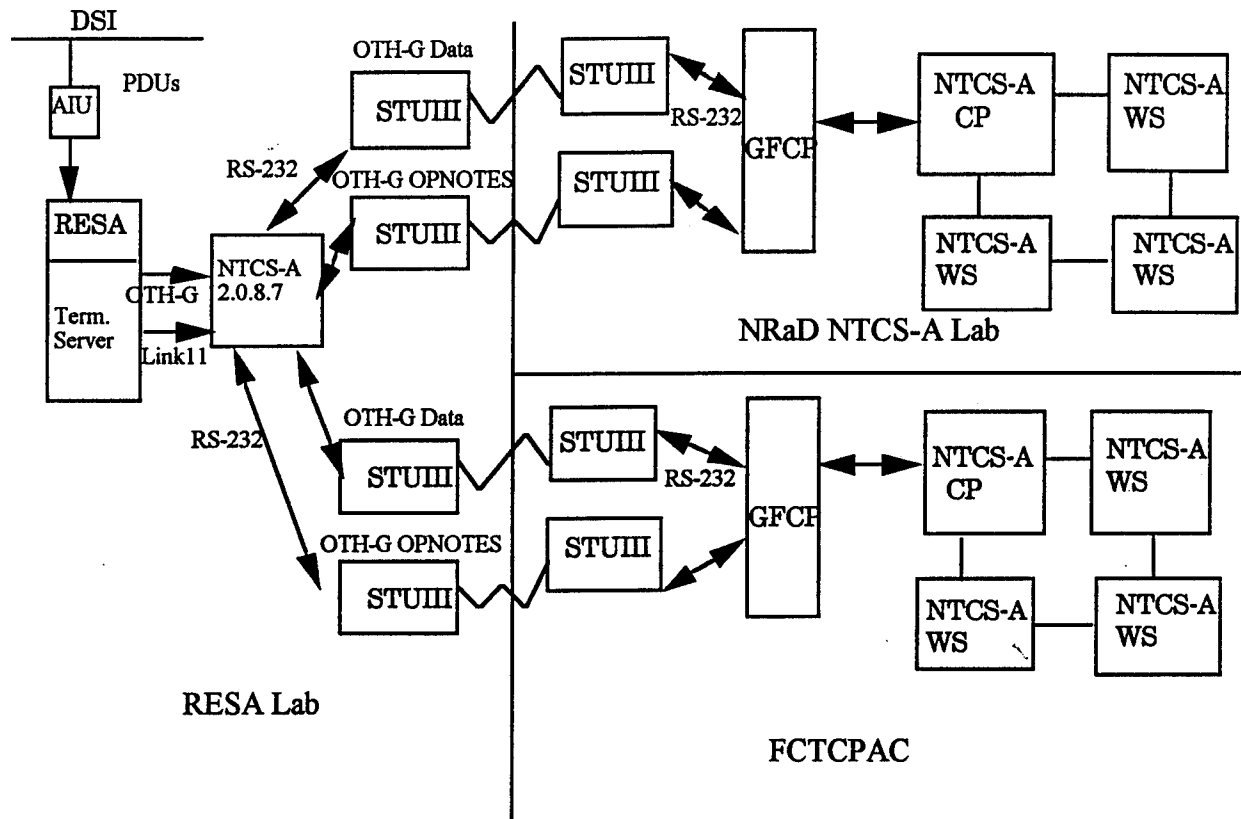
Figure 4-3. Hardware configuration for track management messages.

4.2 THROUGH DEFENSE SIMULATION INTERNET (DSI)

The DSI (1) is briefly described in section 2.2 of this report. Another way to populate the JMCIS system for the Synthetic Theater of War is through the DSI. The advantage of choosing this method is that real-world systems rather than a constructive model are used to display contact data. The disadvantage of choosing this method is that it requires development of an AIU to translate PDUs (protocol data units) into OTH-G messages and a filtering scheme to drop inappropriate DSI messages from displaying.

Filtering would depend on the site chosen, and the intent for the use of the display. For example, DSI traffic in its entirety is ground truth data which is not of interest nor required at all sites. As another example, ability to receive selected data requires knowing if the receiver is on, if there is land obstructing the signal, or if the receiver is listening to the correct bands.

4.2.1 Hardware Interface

At this time the closest DSI drop to the NRaD NTCS-A ITF in Building 600 Lab 350 is in the NRaD RESA Lab in Building 606. DSI data are brought to the RESA lab and passed into the Advanced Interface Unit (AIU), a 6840 VME Chassis with four CPU 40 boards. Into the AIU either a port or Ethernet card can be installed, allowing either of the following two interfaces.

1. Using a port card in the AIU, RS-232 lines can be run from the AIU in the RESA Lab into a STUIII secure phone. In the NTCS-A ITF, a STUIII phone is linked by RS-232 line into the NTCS-A CP. Secure data can then be passed to NTCS-A via the STUIII connection.

2. Using an Ethernet card in the AIU, routers and bridges can connect the AIU to the SWAN between Buildings 606 and 600. This net is run to a terminal server in the NTCS-A ITF and from there by RS-232 line into the NTCS-A DTC-2 or TAC-3 serving as the CP. Secure data can then be passed to NTCS-A via the SWAN connection.

4.2.2 Phased Data Interface

Protocol data units (PDUs) representing contact reports are passed from the DSI into the AIU, translated into OTH-G messages in JANAP 128 format, and passed via STUIII or Ethernet into JMCIS and displayed.

This will be implemented in two or more phases. In Phase 1 the AIU will be programmed to accept data from the DSI and translate it into three kinds of OTH-G message lines, namely

(a) Contact   (CTC)
(b) Position   (POS)
(c) OPNOTE.

This will allow JMCIS to display the positions of threat and friendly contacts passed to it over the DSI. It will also permit operator messages to be passed into JMCIS.

In later phases, the AIU will be programmed to accept data from the DSI and translate it into other kinds of OTH-G formats. Candidate formats to be implemented are

(a) Line of Bearing   (LOB)
(b) Radar Data/Expanded Radar Data   (RAD/RADB)
(c) Delete Position   (DPOS)
(d) Delete Line of Bearing   (DLOB)
(e) Merge   (MRG)
(f) Delete   (DEL).

In later phases, the AIU may be programmed to accept data from the DSI and translate it into other formats identical to those accepted from real world links that currently feed NTCS-A

(see section 3.4). Candidate formats are USMTF (US Message Text Format), TADIXS B Tabular, Link 4A, Link 11, Link 14, Link 16, and ROTHR.

4.3 THROUGH OTHER TACTICAL COMMUNICATIONS

Other tactical communications used by the CWC (commanding by use of the JMCIS) include secure voice connectivity to subordinate warfare commanders via C&R nets. Equivalent commanders and higher echelons are also connected to the CWC by secure voice. In STOW, voice capability will be provided to appropriate commanders in the synthetic battlefield to simulate secure voice connectivity. In particular, each composite warfare commander workstation should have its own simulated secure voice connectivity to each other commander and to the ship drivers.

This method of interfacing JMCIS with STOW is not intended to be a stand-alone method, i.e. it will be required to populate JMCIS with contacts using either RESA or the DSI in addition to passing information by secure voice.

4.4 CHOICE OF INTERFACE

Initially, in particular for the STOW Engineering Demonstration in December 1993, RESA will be used to interface NTCS-A with STOW. This is because the mechanism to populate the NTCS-A database, the RESA Message Generator (RMG), is already in place. Additionally, there will be a requirement to simulate secure voice connectivity between NTCS-A, representing the CWC commanders, and RESA, representing the ship drivers, as discussed in section 4.3.

It is an objective of STOW to eventually eliminate all constructive models; so, an alternative interface of JMCIS to STOW is through DSI as discussed in section 4.2.

APPENDIX A. ACRONYMS AND ABBREVIATIONS

AAWC	Antiair Warfare Commander
AB	Alpha Bravo, Call Sign for the CWC
A/C	Aircraft
ACDS	Advanced Combat Direction System
ADS	Advanced Distributed Simulation
AE	Alpha Echo, Call Sign for the SEWC
AIC	Atlantic Intelligence Center
ADRG	ARC Digitized Raster Graphics
AIU	Advanced Interface Unit
AL	Alpha Lima, Call Sign for the LEC
AP	Alpha Papa, Call Sign for the SWC
AR	Alpha Romeo, Call Sign for the AREC
AREC	Air Element Coordinator
ARC	Equal Arc Second Raster Chart/Map
ARPA	Advanced Research Projects Agency
AS	Alpha Sierra, Call Sign for the ASUWC
ASTABS	Automatic Status Boards
ASUWC	Antisurface Warfare Commander
ASWC	Antisubmarine Warfare Commander
ASWM	Antisubmarine Warfare Module
ASWTDA	Antisubmarine Warfare Tactical Decision Aid
ATD	Advanced Technology Demonstration
ATO	Air Tasking Order
AT&T	American Telephone and Telegraph
AX	Alpha Xray, Call Sign for the ASWC
AW	Alpha Whiskey, Call Sign for the AAWC
AWSIM	Air Warfare Simulation
BBS	Battalion/Brigade Battle Simulation
BGLCSS	Battle Group Logistics Commander Support System
BGPHES	Battle Group Passive Horizon Extension System
CAC	Compressed Aeronautical Charts
CAP	Combat Air Patrol
CASREP	Casualty Report
CCC	CINC's Command Complex; CINCS' Command Complex
C&D	Command & Decision
CDBS	Central Data Base Server
CDF	Combat Direction Finding
CDC	Combat Direction Center
C2I	Command Control Intelligence
C4I	Command Control Communications Computers Intelligence

CINC	Commander in Chief
CO	Commanding Officer
COMMIDEASTFOR	Commander Middle Eastern Forces
CP	Communications Processor
CPA	Closest Point of Approach
C&R	Contact and Reporting
CSRDF	Crew Station Research & Development Facility
CTAPS	Contingency TACS Automated Planning System
CTC	Contact
CUDIXS	Common User Digital Information Exchange System
CWC	Composite Warfare Commander
DAT	Digital Access Tape
DCS	Defense Communications System
DDRE	Director Defense Research & Engineering
DEC	Digital Equipment Corporation
DEL	Delete
DESRON	Destroyer Squadron
DIS	Distributed Interactive Simulation
DISA	Defense Information Systems Agency
DISN	Defense Information Systems Network
DLOB	Delete Line of Bearing
DMA	Defense Mapping Agency
DMSO	Defense Modeling And Simulation Office
DOD	Department of Defense
DPOS	Delete Position
DSI	Defense Simulation Internet
DTC-2	Desk Top Computer 2
DTED	Digital Terrain Elevation Data
EECEN	Electrical Engineering Center, Wildwood, New Jersey
EHF	Extremely High Frequency
ELINT	Electronic Intelligence
EMCON	Emission Control
EMI	Electromagnetic Interference
ENWGS	Enhanced Naval Wargaming System
EPL	ELINT Parameters List
ESM	Electronic Surveillance Measures
EW	Electronic Warfare
FCTCLANT	Fleet Combat Training Center Atlantic
FCTCPAC	Fleet Combat Training Center Pacific
FOSIF	Fleet Ocean Surveillance Information Facility
FMOCC	Fleet Mobile Operational Command Center
FY	Fiscal Year
GB	Gigabyte
GLOBIXS	Global Information Exchange Systems
HF	High Frequency

HFDF	High Frequency Direction Finding
HULTEC	Hull-to-Emitter Correlation
HYDY	Highly Dynamic
IAS	Intelligence Analysis System
ICM	Incoming Comms Manager
IDB	Integrated Data Base
IEEE	Institute of Electrical and Electronic Engineers
ILS	Integrated Logistic Support
INRI	International Research Institute
IREPS	Integrated Refractive Effects Prediction System
ITF	Integration Test Facility
JANAP	Joint Army, Navy, Air Force Protocol
JICPAC	Joint Intelligence Center Pacific
JITC	Joint Interoperability Test Center
JMCIS	Joint Maritime Command Information System
JOTS	Joint Operational Tactical System
JTF	Joint Task Force
JTIXS	Joint Tactical Information Exchange System
LAN	Local Area Net
LEC	Logistics Element Coordinator
LOB	Line of Bearing
MB	Megabyte
MLS	Multilevel Security
MRG	Merge
MTWS	Marine Air Ground Task Force Tactical Warfare Simulation
NAWC	Naval Air Warfare Center
NAVMACS	Naval Modular Automated Communications System
NAVSSI	Navigation Sensor System Interface
NETF	Naval Expeditionary Task Force
NET	Naval Expeditionary Task Group
NCCOSC	Naval Command, Control and Ocean Surveillance Center
NCTSI	Naval Center for Tactical Systems Interoperability
NERF	Naval ELINT Reference File
NID	Naval Intelligence Data
NIEWS	NTCS-A Imagery Exploitation Workstation
NIPS	Naval Intelligence Processing System
NITES	Naval Integrated Tactical Environmental System
NRaD	NCCOSC Research, Development, Test and Eval. Division
NRL	Naval Research Laboratory
NSWC	Naval Surface Weapons Center
NTCS-A	Naval Tactical Command System - Afloat
NTCSS	Naval Tactical Command Support System
NTDS	Naval Tactical Data System
NUWC	Naval Undersea Warfare Center
OAT	Optional Application Tape

OBU	OSIS Baseline Upgrade
OCM	Outgoing Comms Manager
OP-094	Chief of Naval Operations Code 094
OPDEC	Operational Deception
OPNOTE	Operational Note
OSIS	Ocean Surveillance Information System
OSS	Operations Support System
OTAR	Over-the-Air Rekeying
OTAT	Over-the-Air Transfer
OTC	Officer in Tactical Command
OTCIXS	Officer in Tactical Command Information Exchange System
OTH	Over-the-Horizon
OTH-G	Over-the-Horizon - Gold
PC	Personal Computer
PDU	Protocol Data Unit
PIM	Position Intended Movement
POS	Position
RAD	Radar Data
RADB	Expanded Radar Data
RAM	Random Access Memory
RESA	Research, Engineering, and Systems Analysis
ROTHR	Relocatable Over-the-Horizon Radar
SAR	Search and Rescue
SATCOM	Satellite Communications
SC	Supporting Coordinator
SEC	Supporting Element Coordinator
SEWC	Space and Electronic Warfare Commander
SHF	Super High Frequency
SSEE	Ship's Signals Exploitation Equipment
SSES	Ship's Signals Exploitation Space
S&T	Science and Technology
STUIII	Secure Telephone Unit III
STOW	Synthetic Theater of War
SWAN	Secure Wide Area Network
SWC	Strike Warfare Commander
TAC-3	Tactical Computer 3
TACDEW	Tactical Advanced Combat Direction and Electronic Warfare
TACS	Tactical Air Control System
TADIXS	Tactical Data Information Exchange Systems
TCC	Tactical Command Centers
TDA	Tactical Decision Aid
TDBM	Tactical Data Base Manager
TFCC	Tactical Flag Command Center
TIMS	Tactical Information Management Services
TRE	Tactical Receive Equipment

TTC	Track-to-Track Correlator
UAV	Unmanned Aerial Vehicle
UHF	Ultra High Frequency
USMTF	US Message Text Format
USN	United States Navy
VHF	Very High Frequency
VIP	Video Interface Processor
VME	Virsa Modula Europa
WES	Warfare Effectiveness Simulator
WS	Workstation
XPLRS	X-Windows Position Locating & Reporting System

APPENDIX B. BIBLIOGRAPHY

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