ARMY, MARINE CORPS, NAVY, AIR FORCE

TADIL J

INTRODUCTION TO TACTICAL DIGITAL INFORMATION LINK J AND QUICK REFERENCE GUIDE

FM 6-24.8
MCWP 3-25C
NWP 6-02.5
AFTTP(I) 3-2.27

AIR LAND SEA APPLICATION CENTER

JUNE 2000

MULTISERVICE TACTICS, TECHNIQUES, AND PROCEDURES

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
00 Jun 2000	N/A	-

Title and Subtitle Introduction To Tactical Digital Information Link J and Quick Reference Guide (TADIL J)	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) HQ TRADOC Attn: ATDO-A Fort Monroe, Va 23651-5000	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es)	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)

Distribution/Availability Statement
Approved for public release, distribution unlimited

Supplementary Notes
The original document contains color images.

Abstract

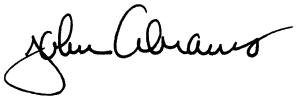
Subject Terms

Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU

Number of Pages
96

FOREWORD

This publication has been prepared under our direction for use by our respective commands and other commands as appropriate.



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PREFACE

1. Scope

This publication introduces Tactical Digital Information Link (TADIL) J. It is a guide for warfighters who have limited or no experience or background in TADIL J and who need a quick orientation for supplemental or in-depth information. The term *TADIL J* is used throughout the publication as United States (US) standard terminology, though TADIL J is known as *Link 16* by the North Atlantic Treaty Organization (NATO).

The document provides a description of each US tactical data system (TDS) that currently implements TADIL J. TDS descriptions include command and control (C2) and noncommand and control systems (for example, fighter aircraft) and their nomenclatures, capabilities, and limitations. Planning and operations considerations, network design and requests, architecture examples, and other general operational information are included.

2. Purpose

This document applies to the operating forces of the US Army (USA), US Navy (USN), US Marine Corps (USMC), US Air Force (USAF), and anyone else desiring a basic understanding about TADIL J. It is a US unilateral-only document but it includes NATO and US allied information where appropriate. The information in this publication has been extracted from multiple sources, including allied, joint, and Service directives, standing operating procedures and handbooks, and related defense contractor system reference documents. These references are listed in Appendix F and in the References section.

This publication is intended primarily for use by warfighters at the tactical/ execution (unit) level who need to be familiar with or operate in a TADIL J environment. Preparation of this document was in a joint forum and information contained has been coordinated with respective Service doctrine commands and centers.

3. Application

This multiservice publication is approved for use by the USA, USMC, USN, and USAF. This publication provides unclassified guidance for TADIL J planning and operations and their roles in the multi-TADIL world; thus giving readers an understanding of TADIL J's impact on plans and operations. It assists warfighters in locating TADIL J reference manuals and points of contact, which in turn maximizes combat effectiveness.

4. Implementation Plan

a. Participating Service command offices of primary responsibility (OPRs) will review this publication, validate the information, and, where appropriate, reference and incorporate it in Service manuals, regulations, and curricula as follows:

b. **Army.** The Army will incorporate the procedures in this publication in US Army training and doctrinal publications as directed by the Commander, US Army Training and Doctrine Command (TRADOC). Distribution is in accordance with DA Form 12-99-R.

c. **Marine Corps.** The Marine Corps will incorporate the procedures in this publication in US Marine Corps training and doctrinal publications as directed by the Commanding General, US Marine Corps Combat Development Command. Distribution is in accordance with MCPDS.

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e. **Air Force.** Air Force units will validate and incorporate appropriate procedures in accordance with applicable governing directives. Distribution is in accordance with AFI 33-360.

5. User Information

a. The TRADOC-MCCDC-NWDC-Air Force Doctrine Center (AFDC) Air Land Sea Application Center (ALSA) developed this publication with the joint participation of the approving Service commands. ALSA will review and update this publication as necessary.

b. This publication reflects current joint and Service doctrine, command and control organizations, facilities, personnel, responsibilities, and procedures. Changes in Service protocol, appropriately reflected in joint and Service publications, will likewise be incorporated in revisions to this document.

c. We encourage recommended changes for improving this publication. Key your comments to the specific page and paragraph and provide a rationale for each recommendation. Send comments and recommendations directly to—

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NWP 6-02.5 — Navy Warfare Development Command, Newport, Rhode Island

AFTTP(I) 3-2.27 — Air Force Doctrine Center, Maxwell Air Force Base, Alabama

30 June 2000

TADIL J

Introduction to Tactical Digital Information Link J and Quick Reference Guide

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EXECUTIVE SUMMARY
TADIL J
Introduction to Tactical Digital Information Link J and Quick Reference Guide

Introduction

This publication provides multiservice procedures for TADIL J operations. It includes:

- An overview of TADIL J basic terminology and operational considerations.
- System capabilities and limitations.
- Network design and network architecture examples.
- General guidelines for identifying common problems and situations.
- The functions of TADIL J in different types of operations.

Overview

The All Services Combat Identification Evaluation Team (ASCIET) final report for 1996 stated "TADIL J/Link-16 Tactics, Techniques, and Procedures (TTPs) are immature." The Joint Requirements Oversight Council (JROC) tasked the Air, Land, and Sea Application (ALSA) Center to publish TADIL J multiservice TTPs to answer this deficiency. ALSA convened a working group of subject matter experts, 28 April to 1 May 1998, to analyze the requirements, research the material, and draft an initial product.

As this is prepared, TADIL J fielding and system implementation is immature and incomplete. Research conducted by the working group to scope the JROC task confirmed written deficiencies in TADIL J tactics and some techniques. However, procedures for TADIL J are adequately addressed in existing documents. These procedural documents include the Chairman Joint Chiefs of Staff Manual (CJCSM) 6120.01A, "Joint Multi-TADIL Operating Procedures (JMTOP)," published 24 Oct 97 (after the ASCIET findings of 96). It was an in-depth planning, employment, and operations manual that covered some techniques. The JMTOP is an evolving document originally containing material for TADILs A, B, and J. The current version (July 1999) also incorporates TADIL C, Army Tactical Data Link-1 and Interim Joint Tactical Information Distribution System (JTIDS) Message Standard (IJMS). The classified Joint Tactical Air Operations (JTAO) Interface Interoperability Handbook (also called the "Purple Book"), published by US Army Forces Command (FORSCOM) and last dated 1 Jun 95, is also widely recognized by operators as an excellent reference document. LOGICON documents, "Understanding TADIL Planning and Operations – A Guidebook for Operators, Planners, and Managers," dated Oct 1996 and "Understanding Link 16 – A Guidebook For New Users," dated September 1996, are excellent introductory level texts for link planning, employment, and operations. While many excellent references are available there is no comprehensive index or reference to catalog these for an operator.

The working group decided that to best meet the JROC tasking and to answer the operational need, two-companion documents are required. The first is an easily carried, widely distributed introduction to TADIL J and comprehensive QRG to familiarize the TADIL J novice with capabilities and systems of the TADIL J world. This guide would permit its users to function in a TADIL J environment at a rudimentary level and to provide direction for more comprehensive in-depth study if required. The working group has focused its effort on producing this document from the most current data available.

The companion document should be an in-depth manual developed as the fielding and systems implementation of TADIL J matures across the Services and multi-national environment. This document should be a joint publication much like Joint Publication 3-09.3, “Joint Tactics, Techniques, and Procedures for Close Air Support” and should address the multi-TADIL environment. This companion document remains to be developed.

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Chapter I

SYSTEM OVERVIEW

1. Description

Tactical digital information link (TADIL) J is an improved data link used to exchange near real time information. It is a communication, navigation, and identification system that supports information exchange between tactical command, control, communications, computers, and intelligence (C4I) systems. The radio transmission and reception component of TADIL J is the Joint Tactical Information Distribution System (JTIDS) or its successor, the Multifunctional Information Distribution System (MIDS). These high-capacity, ultra high frequency (UHF), line of sight (LOS), frequency hopping data communications terminals provide secure, jam-resistant voice and digital data exchange. JTIDS/MIDS terminals operate on the principal of time division multiple access (TDMA), wherein time slots are allocated among all TADIL J network participants for the transmission and reception of data. TDMA eliminates the requirement for a net control station (NCS) by providing a nodeless communications network architecture.

a. Network Capacity. More specifically, the capacity of a TADIL J network is apportioned among multiple *virtual circuits* on which messages dedicated to a single function are transmitted and received during specific time intervals.

(1) Network Participation Groups (NPGs) . These circuits, or functional groups, are known as NPGs and are the functional building blocks of a TADIL J network (see paragraph 2e).

(2) JTIDS Units (JUs). Participants in a TADIL J network, called JUs, are assigned to NPGs. The JU's mission and capabilities dictates the NPG to which a JU is assigned. JUs are designated as either command and control (C2) or non-C2.

(a) C2 JUs. A C2 JU is a JTIDS/MIDS-equipped platform, which, by virtue of its mission, is capable of directing the activities of other platforms that exercise C2 authority.

(b) Non-C2 JUs. A non-C2 JU is a JTIDS/MIDS-equipped platform with limited or no capability to direct the activities of other platforms. TADIL J gives each unit the capability to transmit its own crypto secure location and identification as a precise participant location and identification (PPLI) platform. JTIDS/MIDS also provides a navigation capability to mobile units.

b. Features. TADIL J features include the following:

(1) TDMA.

(2) Nodeless architecture.

(3) Net time reference (NTR).

(4) Encrypted message and transmission.

(5) NPGs.

(6) Jam resistance.

(7) UHF LOS.

(8) Multiple-access modes.

(9) Stacked net and multinet operations.

(10) Cryptographic isolation.

(11) Multiple data rates/data interleaving.

(12) Dynamic network reallocation.

c. Message Types.

(1) Fixed format (J-series) messages.

(2) Free text messages.

d. Operational Use.

(1) Surveillance.

(2) Electronic warfare (EW).

(3) Mission management (MM)/weapons coordination (WC).

(4) Air control.

(5) Fighter-to-fighter net.

(6) Secure voice channels.

(7) Navigation.

(8) Positive friendly identification.

(9) Network management.

e. System Capabilities and Limitations. The quick reference charts in Appendix A describe the systems that operate with TADIL J in each Service.

2. Communications

a. TDMA Scheme. TADIL J uses a network design that assigns unique time slots for transmission of data to each JU, thus eliminating the requirement for an NCS. This

TDMA scheme provides 12-second frames divided into 1536 time slots to be used for data transmission. To preclude jamming by a narrow band jammer, the transmission frequency of the terminal is changed for each pulse. This frequency-hopping pattern defines a *net*. The capability is also used to provide simultaneous, noninterfering communications for multinetwork architecture. This means that each of the many possible nets is using the same 51 frequencies in a different hopping pattern to communicate over a single JTIDS network.

b. Nodeless Architecture. A node is a unit required to maintain communications. In TADIL A/Link-11, for example, the NCS is a node. If the NCS ceases operation, the link goes down. In TADIL J, there are no critical nodes. Time slots are preassigned to each participant and the link functions regardless of the participation of any particular unit. The closest thing in TADIL J to a critical node is the NTR.

c. NTR. A TADIL J-equipped unit is assigned NTR duty and acts as the single time source for time synchronization of all units entering the TADIL J network. The NTR is needed to start up a network and for a new unit to synchronize with and enter a network. After a network has been established, however, it continues to operate for hours without an NTR.

d. Encrypted Message and Transmission. Both the message and the transmission are encrypted. The message uses an encryption device for message security (MSEC), and the transmission is encrypted using a time-based transmission security (TSEC). For a unit to receive another unit's transmission, they must both be assigned the same TSEC cryptovariable. For a unit to decrypt the data contained in that transmission, they must both be assigned the same MSEC cryptovariable. See Appendix B for JTIDS cryptographic variable requirements.

e. NPGs. The time slots of each frame are allocated to particular functions. The functional groups are called NPGs. Because an NPG is defined by its function, the types of messages transmitted on it are also defined. Each of the transmit time slots is assigned an NPG which it supports. NPGs are either being used or are assigned. Some NPGs are being used by specific Services, but the NPGs are still reserved for joint use. The US Navy (USN) uses NPG 14 for indirect PPLIs to forward units to TADIL J. The US Air Force (USAF)/US Marine Corps (USMC) correctly use NPG 7 surveillance for indirect PPLIs of forwarded units. The US Army (USA) currently uses NPGs 15, 16, and 25, although they are still reserved for joint use if needed. NPGs are shown in Figure I-1.

f. Jam Resistance. TADIL J has the capability to operate in a hostile electromagnetic environment. The TADIL J waveform was developed to provide significant performance enhancements against optimized, band-matched jammers. To preclude jamming by a narrow band jammer, the transmission frequency of the terminal is changed for each pulse (77,000 hops per second) through 51 discrete UHF frequencies. The frequency-hopping pattern is pseudorandom and is determined by the TSEC.

g. UHF LOS. The JTIDS/MIDS terminal operates between 960 and 1215 megahertz (MHz). The disadvantage of employing these UHF frequencies is their possible conflict with identification friend or foe (IFF) navigation aids and their limit to LOS communications.

NPG 1	Initial entry
NPG 2	Round-trip timing-addressed
NPG3	Round-rip timing-broadcast (RTT-B)
NPG 4	Network management
NPG 5	PPLI A - (C2 units)
NPG 6	PPLI B - (non-C2 units)
NPG 7	Surveillance
NPG 8	Mission management - (mission types) (USN uses for engagement status)
NPG 9	Air control
NPG 10	EW
NPG 11	Unassigned
NPG 12	Voice A - (either 2.4 or 16 kilobits per second [kbps])
NPG 13	Voice B - (either 2.4 of 16 kbps)
NPG 14	USN for indirect PPLIs (used for forwarding TADIL A, B units to TADIL J)
NPG 15	Reserved for future joint use
NPG 16	Reserved for future joint use
NPG 17	Unassigned
NPG 18	WC
NPG 19	Fighter-to-fighter net
NPG 20	Non-C2 to non-C2
NPG 21	Engagement coordination
NPG 22	Unassigned (UK Composite A [NPGs 4, 8, & 9])
NPG 23	Unassigned (UK Composite B [NPGs 7 and 10])
NPG 24	Unassigned
NPG 25	Reserved for future joint use
NPG 26	Unassigned
NPG 27	Joint PPLI
NPG 28	Unassigned
NPG 29	Free text (residual messages)
NPG 30	Interim JTIDS message standard (IJMS) P message, position
NPG 31	IJMS T message, track report
NPG 400 to 511	USA needlines

Figure I-1. Network Participation Groups

(1) To extend TADIL J communications, the signal must be relayed by another JTIDS/MIDS terminal or forwarded on a different TADIL. To preclude interference with IFF, TADIL J does not use frequencies between 1008 and 1053 MHz and 1065 and 1130 MHz.

(2) When operating within 200 miles of the continental US or its territories, the Federal Aviation Administration (FAA) imposes restrictions on the pulse density that JTIDS/MIDS can transmit. This is another safeguard to prevent navigation interference. This FAA restriction creates an operational interoperability problem in other countries.

(3) Regarding air traffic control, other countries generally follow suit with US Government (FAA) policies/decisions. Some future concerns are with air restrictions over Japanese and Korean air space, the Australian use of JTIDS, and the USN installing JTIDS in their Airborne Early Warning Ground Environment Integration Segment (AEGIS) Systems. See Chapter II for frequency request information.

(4) The range between JTIDS participants is limited by LOS propagation due to the frequency the terminal uses. To insure information can be exchanged beyond LOS, terminals can be designed as relays in the network design. This allows a terminal that receives information to relay the information back on a different net.

h. Multiple Access Modes.

(1) Dedicated Access. During the design of a TADIL J network, time slots may be assigned to a single user and only this user transmits in those time slots. Slots not needed by the user go unused. Terminals in separate geographic areas can reuse dedicated time slot blocks. This assignment of specific time slots to a single user is called *dedicated access*, and it guarantees time slots for the user to transmit data.

(2) Contention Access. During the design of a TADIL J network, each time slot may be assigned to multiple users. This assignment of specific time slots to multiple users is called *contention access*. Each user independently and randomly selects a time slot from the pool and transmits. When not transmitting, the user listens to all time slots in the pool. Multiple transmissions in the same time slot can occur. If multiple users transmit simultaneously, only those units closest to the transmitting terminal receive the data. Contention access is used for RTT-B, PPLI, fighter-to-fighter, and secure voice functions.

i. Stacked Net and Multinet Operations. Increased communications capacity is obtained through the use of stacked net and multinet operations in which different groups of participants transmit in the same time slot, each on different nets.

(1) Stacked Net Operation. A stacked net operation involves having an NPG occupy the same slots on consecutive nets. Independent groups of JUs that have no common members are assigned to different net numbers. In a stacked net structure, the blocks of time slots used have the same set number, initial slot number, and recurrence rates, but different net numbers.

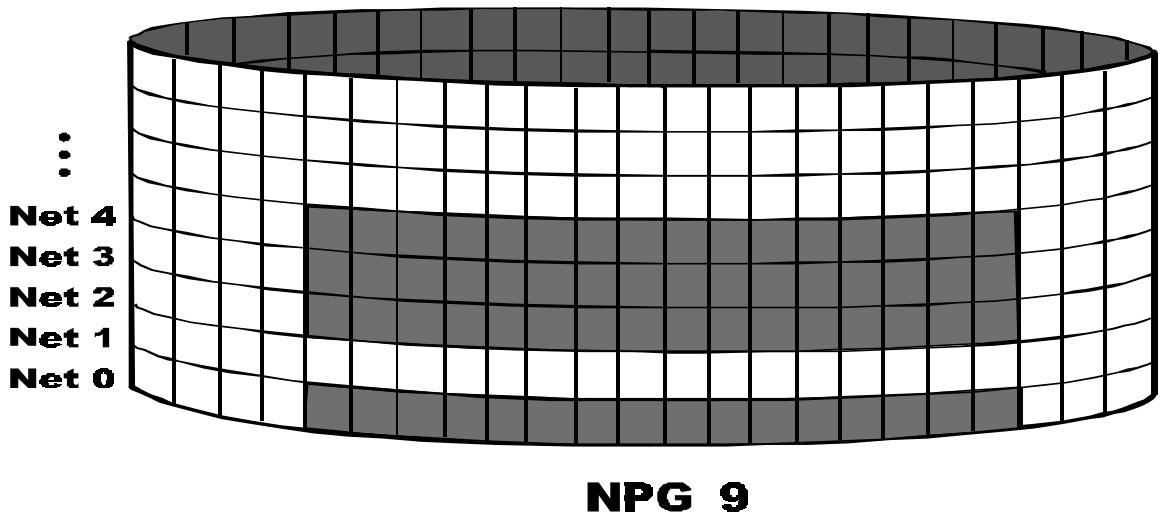
(2) Multinet Operation. In a multinet operation, different NPGs that do not have common participants use some of the same time slots on different net numbers. In multinet structures, the time slots used on different NPGs may overlap, but different net numbers and/or crypto keys prevent interference. See Table I-1.

A stacked net is created by assigning the same time slots to the same NPG with the same TSEC parameter, but with different net numbers. See Figure I-2.

j. TADIL J Message Standard. TADIL J uses specially formatted messages (and free text) to convey information. These message formats, called *J-series messages*, are composed of sets of fields, each of which is composed, in turn, of prescribed numbers of bits that may be encoded into predetermined patterns to convey specific information.

Table I-1. Stacked Nets

Time Slot Block	NPG	Net #	MSEC	TSEC	Participants
A-8-10	9	0	1	1	CV + 8 F-14Ds
A-8-10	9	2	1	1	E-2C + 8 F-14Ds
A-8-10	9	3	1	1	E-2C + 4 F-14Ds
A-8-10	9	4	2	1	E-3A + 8 F-15s



Note: The 16 time slots of time slot blocks A-8-10 are actually interleaved, not contiguous.

Figure I-2. Stacked Nets

(1) To satisfy the information exchange requirements of the Service systems that implement TADIL J, a new TADIL J message standard was developed. This new message standard is designed to support five distinct environments: air, land (ground), surface (maritime), space, and subsurface.

(2) TADIL J provides for both an information exchange and a network management capability. Each TADIL J message and its transmission and reception rules are defined in Military Standard (MIL-STD) 6016, *Department of Defense (DOD) Interface Standards, TADIL J Message Standard*. Figure I-3 contains a list of TADIL J messages. In addition to fixed format, voice and free-text messages are also included.

3. Employment

Employment considerations include surveillance, EW, MM, air control, fighter-to-fighter nets, secure voice channels, mobile platforms, and positive friendly identification.

a. Surveillance. Messages that support the surveillance function fall into three general areas: *track and track amplifying information, track management information, and positional references*, which include points, strobes, and fixes.

(1) Tactical data systems (TDSs) that support surveillance normally use active sensors, such as radar or IFF, or receive position information and status directly from TADIL C or TADIL J participants. These TDSs generate near real-time track reports that are exchanged with JTIDS on the surveillance NPG. In addition to active sensors, some systems with other types of sensors, for example, signal intelligence, infrared, and electro-optical, can also generate real-time track reports and transmit on the surveillance NPG.

Network Management
- J0.0 Initial Entry
- J0.1 Test
- J0.2 Network Time Update
- J0.3 Time Slot Assignment
- J0.4 Radio Relay Control
- J0.5 Repromulgation Relay
- J0.6 Communication Control
- J0.7 Time Slot Reallocation
- J1.0 Connectivity Interrogation
- J1.1 Connectivity Status
- J1.2 Route Establishment
- J1.3 Acknowledgment
- J1.4 Communication Status
- J1.5 Net Control Initialization
- J1.6 Needline Participation Group Assignment

Precise Participant Location and Identification
- J2.0 Indirect Interface Unit PPLI
- J2.2 Air PPLI
- J2.3 Surface PPLI
- J2.4 Subsurface PPLI
- J2.5 Land Point PPLI
- J2.6 Land Track PPLI

Surveillance
- J3.0 Reference Point
- J3.1 Emergency Point
- J3.2 Air Track
- J3.3 Surface Track
- J3.4 Subsurface Track
- J3.5 Land Point or Track
- J3.6 Space Track
- J3.7 Electronic Warfare Product Information

Antisubmarine Warfare
- J5.4 Acoustic Bearing and Range

Intelligence
- J6.0 Intelligence Information

Information Management
- J7.0 Track Management
- J7.1 Data Update Request
- J7.2 Correlation
- J7.3 Pointer
- J7.4 Track Identifier
- J7.5 IFF/SIF Management
- J7.6 Filter Management
- J7.7 Association
- J8.0 Unit Designator
- J8.1 Mission Correlator Change

Weapons Coordination and Management
- J9.0 Command
- J10.2 Engagement Status
- J10.3 Hand Over
- J10.5 Controlling Unit Report
- J10.6 Pairing

Control
- J12.0 Mission Assignment
- J12.1 Vector
- J12.2 Precision Aircraft Direction
- J12.3 Flight Path
- J12.4 Controlling Unit Change
- J12.5 Target/Track Correlation
- J12.6 Target Sorting
- J12.7 Target Bearing

Platform and System Status
- J13.0 Airfield Status Message
- J13.2 Air Platform and System Status
- J13.3 Surface Platform and System Status
- J13.4 Subsurface Platform and System Status
- J13.5 Land Platform and System Status

Electronic
- J14.0 Parametric Information
- J14.2 Electronic Warfare Control/Coordination

Threat Warning
- J15.0 Threat Warning

National Use
- J28.0 U.S. National 1 (Army)
- J28.1 U.S. National 2 (Navy)
- J28.2 U.S. National 3 (Air Force)
- J28.2 (0) Text Message
- J28.3 U.S. National 4 (Marine Corps)
- J28.4 French National 1
- J28.5 French National 2
- J28.6 U.S. National 5 (NSA)
- J28.7 UK National
- J29 National Use (reserved)
- J30 National Use (reserved)

Miscellaneous
- J31.0 Over-the-Air Rekeying Management
- J31.1 Over-the-Air Rekeying
- J31.7 No Statement

Figure I-3. TADIL J Message Catalog

(2) Units that support surveillance without integrated sensors generate non-real-time tracks. These tracks can be recognized by their track quality (TQ) of zero. TADIL J provides for air, land, surface, subsurface, and space tracks. In addition, points, lines, and areas are also exchanged on the surveillance NPG along with amplifying track information and nonparametric EW product information. Other messages that support management functions, such as data update requests, correlation messages, pointers, and IFF difference report, are also exchanged on the surveillance NPG.

b. EW. TADIL J supports the cooperative exchange of EW threat emitter information between link participants. It supports both EW parametric and control/ coordination messages.

c. MM. Link participants use NPG 8 (principally C2 platforms) to issue and exchange MM messages. C2 and non-C2 platforms transmit engagement status messages. These include command, electronic protect, WC, engagement status, platform and system status, and controlling unit report messages. WC provides the means for commanders in authority to direct various phases of weapon systems employment against targets, as well as to direct other C2 actions. Data link participants use NPG 18 for issuing and exchanging WC messages to include pairings (commits) and hand over of aircraft symbologies.

d. Air Control. Air control provides a capability for a C2 JU to control non-C2 JUs. Air control is divided into two components that are configured as a stacked net: the up-link and the back-link. Each net is assigned to a specific C2 JU and the fighters being controlled. The controlling unit provides mission assignments and vectors to fighter aircraft on the time slots assigned to the up-link. Air control back-link provides a capability for a non-C2 JU to report tracks detected with its weapon system sensors. For example, a controlled fighter may detect a target with onboard sensors and report the target position to the controlling JU. The controlling JU attempts to correlate the target report with those tracks it holds, and for new targets it generates a new track report

e. Fighter-to-Fighter Net. Fighters exchange sensor target information and aircraft status among themselves on the fighter-to-fighter net, which is usually configured as a stacked net, with each fighter group assigned time slots on one of the nets. The maximum fighter flight size is dependent on the net access designed into the network. The USN normally uses dedicated access, and flight size can be 2, 4, or 8 fighters per net. The USAF normally uses contention access, which provides flexibility in flight size. Dependent on network design, a controller may access a fighter-to-fighter net.

f. Secure Voice Channels. TADIL J provides two (voice groups A and B) secure digitized voice channels. It is usually configured as a stacked net and has data rates of 2.4 or 16 kilobits per second (kbps). Voice clarity is enhanced when using 16 kbps voice, but time slot usage is significantly increased. Note that voice circuits remain active when the terminal is set to the *data silent* mode of operation. TADIL J voice is not currently used by some platforms.

g. Navigation. TADIL J provides a mobile platform a relative position derived from other TADIL J units and can be used to improve a unit's positional accuracy (see paragraph 4g on relative navigation [RELNAV]).

h. Positive Friendly Identification. Each JU periodically transmits a PPLI report, which provides crypto-secure location and identification for the platform. In addition to position and positive identification, each platform may provide status information such as fuel, weapons inventory, and mission assignment tasking. This capability is one of the most important benefits of TADIL J. The capability of all link participants to frequently provide comprehensive position, identification, and status information is a considerable improvement over other links and has significant capability to reduce or prevent fratricide.

4. Data Link Advantages

TADIL J message sets provide enhanced capabilities to report information with a higher degree of precision than is available with TADILs A or B. See Figure 1-4.

a. Unlimited Participants. TADIL J is not limited to a set number of participants. Each participant, or JU, is assigned an octal five-digit-unique address. Link addresses 00001 to 00177 are equivalent to TADIL A and B addresses 001 to 177. Therefore, to accommodate multilink communication, joint operating procedures specified in Chairman, Joint Chiefs of Staff Manual (CJCSM) 6120 require that C2 JUs always be assigned addresses below 00177. Non-C2 JUs use only addresses 00200 through 77776.

b. Track Numbers (TNs). TADIL J employs a five-character alphanumeric TN within the range 00001 to 77777 or 0A000 to ZZ777. For TN allocation and assignment purposes, participants must remember that TADIL A TNs 0200 to 7777 are considered to be the same TNs as the TADIL J TN addresses 00200 to 07777. As a convention, units that initiate tracks on both TADILs A and J should use their TADIL A track block as their TADIL J track block to prevent confusion on track identification.

c. TQ Values. TADIL J uses TQ values that range from 0 through 15. A specific positional accuracy range, as specified in MIL-STD 6016, defines each TQ value. The highest TADIL J TQ value requires better than 50-foot accuracy. By comparison, the highest TADIL A/B TQ value is 7 and is defined by each platform.

d. Track Identification. Track identification is reported on TADIL J as an environment, identification, platform, platform activity, specific type, or nationality. For an example, see Figure I-5:

e. Platform Status. In conjunction with PPLIs and reports, a JU can report its own status. This report can include information such as equipment status, ordnance inventory and variant, radar and missile channels, fuel available for transfer, gun capability, and estimated time of arrival and departure to and from station.

REFPOINT	Reference point designator – type, latitude/longitude, date time group (dtg)
LINK	Communication link to which message sets apply
PERIOD	Operational period of the network – start/stop dtg
INETWORK	Selected network and network participation group (NPG) design options
JCRYPDAT	Crypto data – crypto variable logic label (CVLL)(s) & assigned key short title(s), secure data unit (SDU) location
JSTNETS	Establishes net stacking – NPG number, usage
JUDATA	Joint tactical information distribution system (JTIDS) unit (JU) assignments – JU address, participant type and sequence number, transmission mode, track numbers, terminal output, user type, initial entry identification, secondary JU address, track number block
DUTY	Duties/roles – NTR, initial entry JTIDS unit, etc.
JOPTION	NPG design option sequence number - assigned tothe platform
JSDULOC	SDU location – CVLL/SDU location
AMPN	Used to provide information to clarify the preceding set.
NARR	Used to provide additional information on more than one set.
JUFILTER	Use this set to provide TADIL J transmit filter data.
FLTRLINE	Use this set to describe TADIL J line filters.
JDEFAULT	Use this set to provide multifunctional information distribution system TADIL J default network data.
JTRNMODE	Use this set to provide multifunctional information distribution system TADIL J network.

Figure I-4. TADIL J Message Sets

Environment	Air
Identity	Friend
Platform	Fighter
Platform Activity	Combat Air Patrol
Specific Type	FA-18
Nationality	Canada

Figure I-5. Track Identification

f. Information Exchange. The TADIL J message standard allows information to be exchanged with greater precision than previously available on TADILs A and B. Significant improvements are attained in position reports through exchanges in latitude and longitude, course, speeds, altitudes, and lines of bearing. TADIL J messages allow reporting of multisegmented lines, as well as areas of all shapes and sizes.

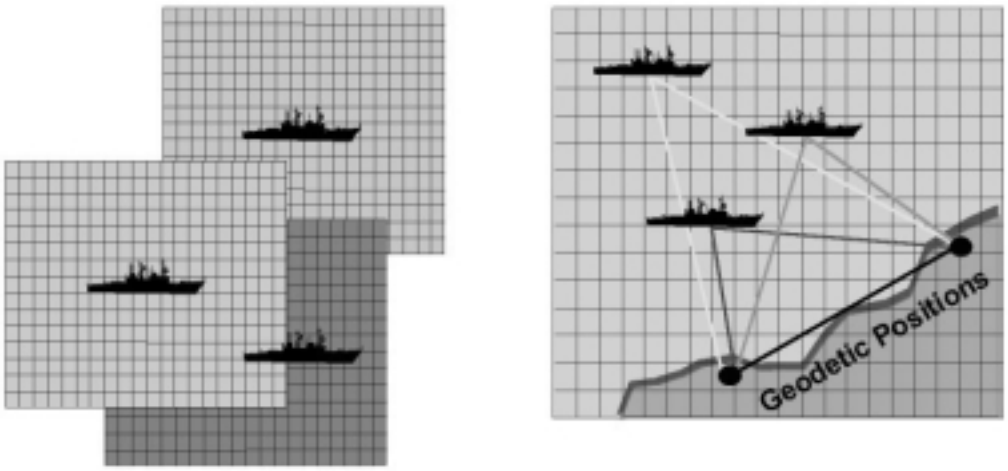
g. RELNAV. RELNAV, an automatic function of the terminal, is used to determine the distance between platforms by measuring the arrival times of transmissions and correlating them with reported positions. Terminals on a network need this information to maintain time synchronization. RELNAV is in constant operation in all terminals and its data can be used to improve a unit's positional accuracy. If two or more units have independent, accurate knowledge of their geodetic positions, RELNAV can provide all units in the network with accurate geodetic positions. As a result, the precise geodetic position of every unit can be maintained constantly by every other unit. See Figure I-6.

(1) Geodetic Positioning. TADIL J messages implement a three-dimensional geodetic coordinate system using latitude, longitude, and altitude. This allows positions to be reported anywhere in the world, subject only to display and data base limitations. The geodetic grid (GEOGRID) is WGS-84 and positional accuracy of all positions within this grid are based upon external fixing available to link participants. The GEOGRID is always active. See Figure I-7.

(2) Relative Grid (RELGRID). In addition to the GEOGRID, the RELGRID may be activated. This grid is a flat plane similar to the TADIL A grid. It is 1024 by 1024 and tangent to the GEOGRID at the grid origin. Coordinates in the RELGRID are x, y, z from the grid origin. The RELGRID functions separately from the GEOGRID and at time may provide better location information. The RELGRID requires that each unit enter the same grid origin and that a network functionary role called the navigation controller (NC) be assigned to one unit. (Note: The NC must be an aircraft. If an aircraft is not available and the RELGRID is desired, both an NC and a secondary NC must be assigned.)

h. EW. TADIL J allows greater exchange of EW parametric information and a wider range of EW control than was provided in legacy data links. EW JUs exchange parametric data and orders on NPG 10. However, EW product information may be transmitted over either NPG 10 or NPG 7.

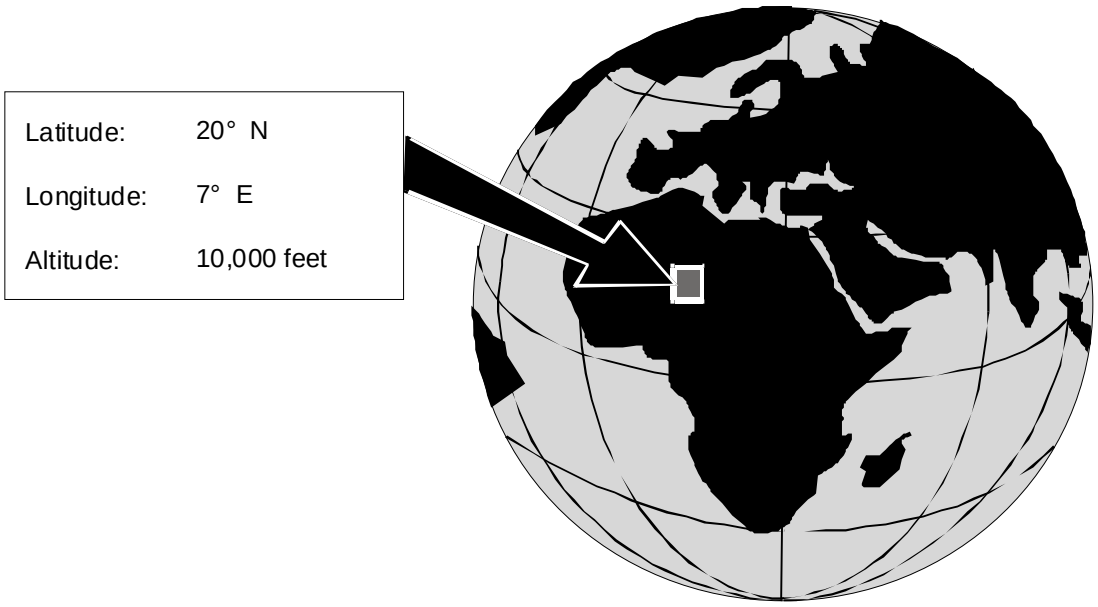
i. Land Points and Tracks. TADIL J messages add land as a track environment. Land points are normally used to mark the geodetic position of stationary units or objects such as surface-to-air missile (SAM) sites, military headquarters, bridges, and so forth. Land tracks can also represent the position of mobile land vehicles such as trucks, tanks, artillery, and so forth.



In TADIL-J relative positions are measured with respect to the unit designated as the navigation controller.

If two units know their geodetic positions, RELNAV can provide geodetic positions for all units.

Figure I-6. Relative Navigation



Note: With three-dimensional geodetic positioning, a location anywhere in the world can be reported.

Figure I-7. Geodetic Positioning

Chapter II

ARCHITECTURE

1. Network Design

The joint interface control officer's (JICO's) primary responsibilities functions include determining the data link architecture and network design parameters needed to connect the various operational units in the proposed operation. The interface control officer (ICO)/JICO considers force composition, projected track loading, and communications and connectivity requirements. Based on these considerations, the ICO/JICO coordinates with the JTIDS Network Design Library (JNDL) and service network design facilities (NDFs), when applicable, to select a network from the joint/ Service library or to develop a network request to identify these requirements to an NDF. Network design consists of identifying a set of information exchange requirements among tactical platforms, selecting different types of NPGs to support each function, and allocating each NPG a portion of the network capacity appropriate to its needs. Appendix C provides a list of network design facilities.

2. Parameters

Two types of parameters are defined at the design phase: network parameters and platform unique parameters.

a. Network Parameters. Network parameters are universal to all JTIDS units to ensure compatibility. These common values define the organization of the NPGs, their net assignments and time slot block assignments, cryptovariable logical label assignments, and relay functions.

b. Platform-Unique Parameters. Correct platform-unique parameters are needed to successfully complete initialization data for individual JTIDS units, enabling each to enter and operate properly on TADIL J. These parameters include transmit-and-receive time slot assignments for individual platforms and other unique data such as relay assignments.

3. Network Completion

Once the network is completed and accepted by the requesting command, the network is provided to the Service NDFs. The respective Service NDF then provides initialization loads for its Service platforms.

4. Pulse Deconfliction

Pulse deconfliction is a term that refers to the geographical area coordination of JTIDS use to ensure compliance with pulse density restrictions. Chairman, Joint Chiefs of Staff Instruction (CJCSI) 6132.01A requires all military users to comply with deconfliction requirements levied by the US Government. Pulse density restrictions can be described as the number of pulses emitted within a given geographical area. The biggest factor contributing to pulse density restrictions is the potential for interference

with radio navigation systems. The JTIDS deconfliction server (JDS) is an internet-based, data base application that allows TADIL J units to comply with pulse density restrictions as they coordinate training opportunities. JDS allows network planners and users 24-hour access to a list of all scheduled TADIL J activity. Using JDS, units can easily find potential training opportunities and avoid interfering with other planned networks. JDS is currently available on the internet within the JNDL web site at [www.forscom.army.mil/interop/JNDL/JNDL_index.htm]. A defense switching network dial up capability is planned for the future.

a. JDS Access. The JDS administrator at the JNDL controls access to the JDS through the use of user names and passwords. Access to the JDS requires completion of the access request form. The JNDL issues either a deconfliction coordinator-level password or a JDS viewer-level password. A deconfliction coordinator schedules TADIL J activity into the JDS. All units may obtain a viewer-level password. The user name/password security configuration is not sufficient to handle classified information. The JNDL staff handles all classified events off-line, manually deconflicting them with unclassified events.

b. JDS Client System Recommendations. Users can access JDS through Microsoft Internet Explorer 4.01 or higher with 128-bit security or Netscape Navigator 2.0 or higher. However, only JAVA-enabled 4.0 versions of either can access the next JDS version, which requires a Pentium 133 personal computer with 32 megabytes of random access memory or greater and a direct network connection to the internet. If a modem connection must be used, it should be at least 33.3 kbps.

c. JDS Functions. The JDS allows deconfliction coordinators to schedule JTIDS activity for a specific time frame in a specific geographic area while checking for potential time slot duty factor (TSDF) conflicts. The minimum information required for scheduling includes the point of contact's (POC) name and phone number, the 9-character network name, and the location, duration, and TSDF. Once scheduled, the event information is available to all deconfliction coordinators and JDS viewers through various prescripted data base queries. The information may be modified, updated, or deleted as necessary, but only by the original scheduler.

d. Joint TSDF Calculator. The TSDF calculator is available to both deconfliction coordinators and JDS viewers. This calculator is designed to help units determine the TSDF being used in a network. The user selects a preloaded network from the list provided. The calculator takes the user to a screen where he selects the number and type of participants and other options. The calculator then totals and displays both the total TSDF and the highest single user TSDF for the configuration the user has specified.

e. JNDL Web Site Features. In addition to the JDS, the JNDL web site contains:

(1) The on-line JTIDS/MIDS network design request form.

(2) The JTIDS/MIDS network design catalog.

(3) A schedule of JTIDS/MIDS-related training at the joint multi-TADIL school.

(4) A discussion forum for JTIDS/MIDS users.

(5) A glossary of JTIDS/MIDS terms.

(6) Reference documents.

(7) Links to other JTIDS/MIDS web sites and Service NDFs.

5. Frequency Assignments

Frequency assignments are required for all TADIL J operations. A frequency assignment may vary because it covers a specific geographic area. The first thing one must do before submitting a JTIDS/MIDS frequency assignment request is to identify the requirements. Figure II-1 lists the minimum requirements to include in the frequency assignment request.

6. Architecture Examples

Figures II-2, II-3, and II-4 provide three examples of architectures. They show examples of how an architecture might be linked, but are not representative of a complete or existing JNDL.

Location (for example, warning, restricted, airborne early warning orbit areas or the latitude and longitude for a specific geographic area).

POC (name, location, phone, e-mail address).

Duration (for example, 3-28 February 0800 – 2000). Note: The location and duration should be loosely tied together to facilitate more effective pulse deconfliction (for example, point A to point B within 100 nautical miles either side, 26-28 February. This enables the request to remain at the UNCLASSIFIED level.)

Required TSDF percentage for network and maximum for any one platform (100/50)

Stop Buzzer POC

Platforms (e.g. F-14, F-15, E-3, and AEGIS)

JTIDS/MIDS voice requirements

Figure II-1. Minimum Requirements for JTIDS/MIDS Frequency Assignment Request

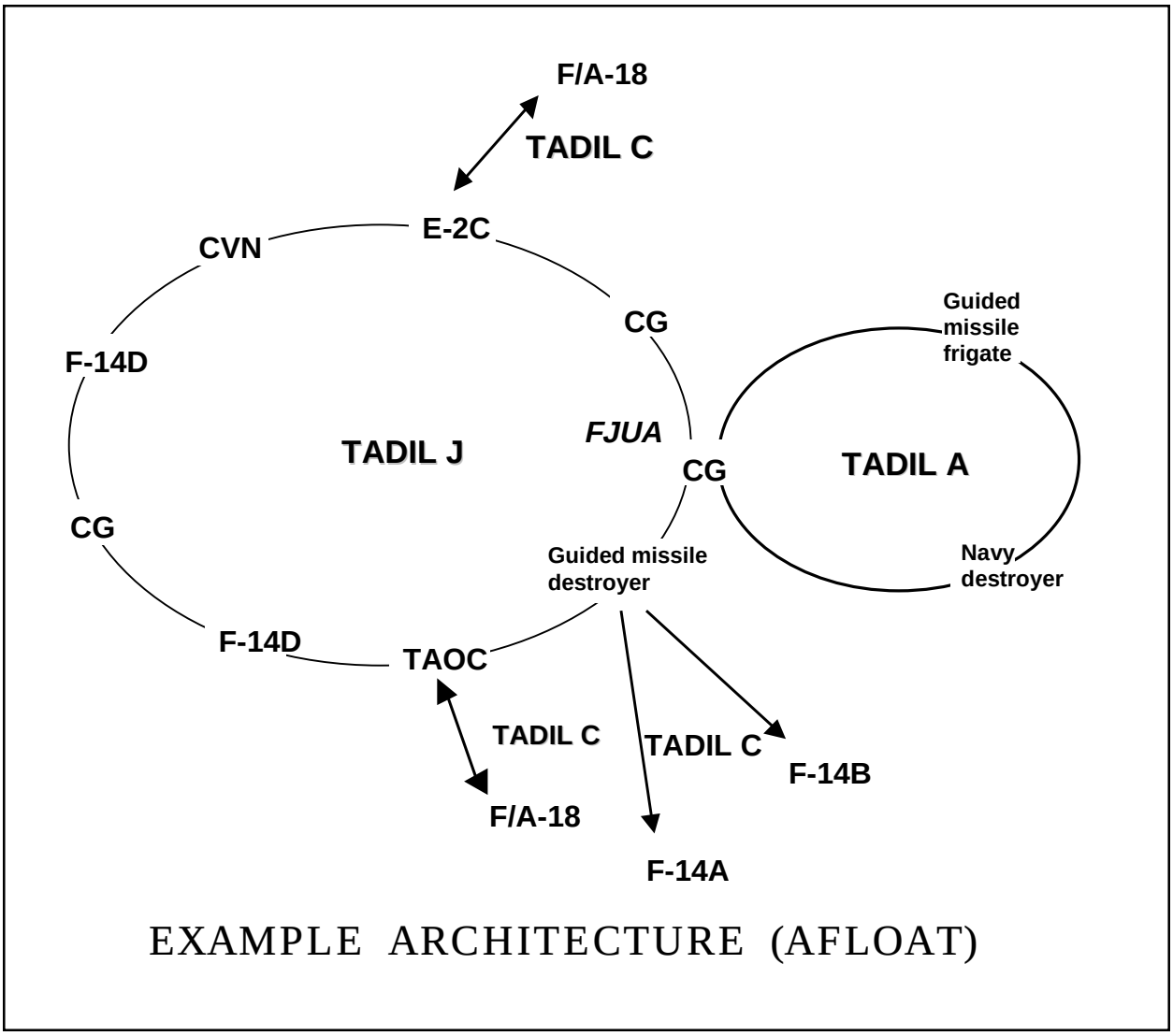


Figure II-2. Navy Architecture Afloat

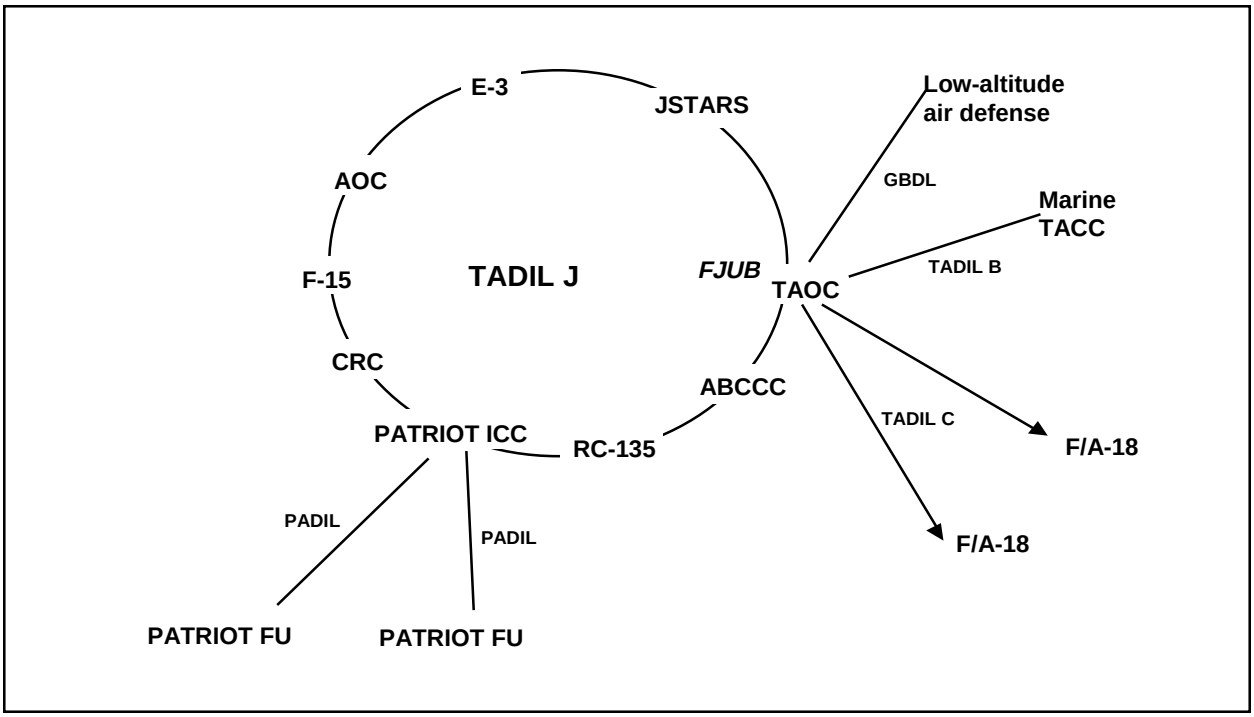


Figure II-3. Joint Architecture Ashore

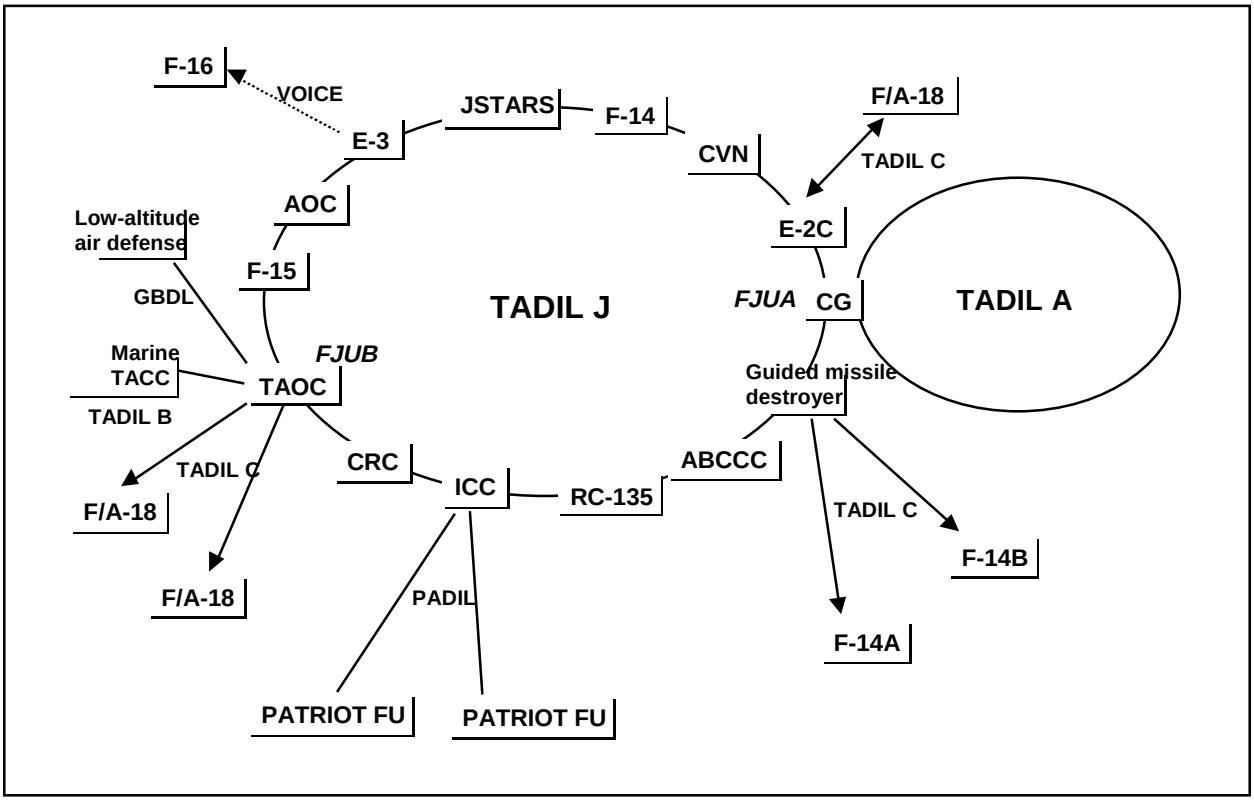


Figure II-4. Combined Theater Architecture

Chapter III

OPERATIONS

1. Multilink Operations

With the introduction of TADIL J, all operations will be multilink, consisting of units operating on various combinations of TADIL C, TADIL A,/B and TADIL J. Multilink participation must be planned and performed in a manner that provides a common tactical picture (CTP) to all units. In the multilink environment, those platforms capable of forwarding data accomplish the necessary information transfers between different links performing surveillance. Despite employing a variety of equipment, configurations, and capabilities, TADIL J must integrate with existing communications links in order to optimize the overall performance of the command, control, and communications (C3) function. This requires expansion of both link planning and link control functions in order to take advantage of the full potential of TADIL J capabilities.

a. Multilink Advantages. The advantages of TADIL J show how it can both complement and improve the other links.

(1) Multiple Functions. Because TADIL J supports multiple functions, it frees existing radios for other uses, i.e., UHF radios used to support air control data and voice.

(2) Additional Secure Voice Channels. TADIL J can provide two additional secure voice channels per platform (each allowing 126 circuit selections) that can be allocated to multiple groups requiring secure voice. This frees both crypto devices and radio frequency (RF) equipment. Consequently, the communications planner has additional resources with which to provide secure voice connectivity and for other uses.

Table III-1. USN Multilink Planning

Feature	TADIL A	TADIL C	TADIL J
Data Functions	Surveillance, position, EW, MM/WC	Air control	Surveillance, position, EW, MM/WC, air control
Voice Functions	No	No	2 secure voice 126 nets/voice
Spectrum	HF/UHF	UHF	UHF spectrum L-band
Throughput	1.8 Kbps	3.8 Kbps	54.0 Kbps
System Throughput	1.8 Kbps/net 4 nets possible	3.8 Kbps per net	Potential of 1 megabits per second
Access Protocol	Polling	Command/response	TDMA
Relative Navigation	No	No	Yes
Jam Resistance	No	No	Yes
Secure	Yes	No	Yes
Extended LOS	HF only	No	Yes via relay

(3) Unique Waveform. Since its unique waveform (spectrum) limits over-the-horizon detection, hinders exploitation, and complicates enemy jamming strategies, TADIL J-capable forces should be deployed to counter threat electronic strategies. For example, TADIL J forces can be deployed toward an expected jamming axis, thereby limiting the jamming effectiveness. Communication alternatives include data on TADIL J with voice on UHF in order to achieve maximum data (track) throughput.

(4) Higher Communications Loading. TADIL J terminal throughput supports higher communications loading, allowing more information to be shared by participants. Increased throughput or capacity allows significantly expanded track loads, while the TDMA architecture provides quicker track updates that are not tied to a net cycle time.

(5) Improved Computer Display System. TADIL J system throughput allows tacticians and planners to "select" the connectivity groups that have information necessary to meet mission requirements. This improves the computer display system (CDS) and operator efficiency.

(6) TDMA Protocol. TADIL J TDMA access protocol allows programming link capacity to meet differing tactical needs. UHF back-to-back radio relays could be eliminated. Relayed air control could extend fighter tactics while still maintaining a data back link.

(7) Inherent Navigation Capability. TADIL J inherent navigation capability improves gridlock and shipboard gridlock system operation, reduces target acquisition time, and enhances cooperative tactics.

(8) Data Forwarding Capability. The introduction of TADIL J with data forwarding impacts TADIL A platforms in the following ways:

(a) TADIL A operations are improved by moving units to TADIL J and thus reducing the number of polls in the net cycle.

(b) Major track holders are on TADIL J aircraft carriers (CV), AEGIS, and E-2C airborne early warning (AEW) aircraft.

(c) All TADIL J tracks are reported to TADIL A units during one poll of the data forwarder.

(d) The data forwarder automatically reports F-14Ds on TADIL C, whether controlled or uncontrolled.

(e) Tracks/participating units (PUs) appear from TADIL J units (CVs, guided missile cruisers [CGs], E-2Cs, F-14Ds, laboratory sites) that are not in the polling sequence.

(f) Filtering may be required to prevent overloading the TADIL A platform's CDS with too many racks.

(g) The gridlock reference unit may be a TADIL J platform.

b. TADIL A Characteristics. TADIL A employs netted communications techniques and a standard message format (M-series) for exchanging digital data information among airborne, land-based, submarine and shipboard tactical data system (TDS). TADIL A communications are conducted on either the high frequency (HF) or UHF bands. The following explains TADIL A-associated equipment and its various functions:

(1) TADIL A Computer/Module. Shipboard TADIL A system control may be provided by the AN/UYK-43 or the AN/UYK-7 computer. The major function of the AN/UYK-43 computer is to execute the shipboard TDS program; the TADIL A module of the TDS program provides controls. The AN/UYK-7 is a dedicated TADIL A computer. The TADIL A computer/module is capable of—

(a) Providing tactical ownership sensor information to data link participants.

(b) Receiving and processing incoming tactical information from data link participants.

(c) Maintaining a tactical database.

(d) Performing TADIL A and TADIL C management.

(e) Performing identification functions.

(f) Performing weapons selection and management.

(g) Controlling the data console displays.

(2) TADIL A Data Terminal Set (DTS). The TADIL A DTS converts digital information from the TDS database, via the KG-40A, to audio tones, which are modulated, converted to RF, and transmitted by either HF or UHF radios to various platforms for processing. For live TADIL A operations, the DTS operates in what is considered to be half-duplex mode. Normal TADIL A operations consist of unit-assigned duties such as NCS and picket station (PKT). Both NCS and PKTs are considered PUs in the link, and each has a specific address number assigned to it. Addresses for PUs range from 001 through 076 in the octal numbering format for a total of 62 available addresses. The NCS is the unit responsible for polling each PKT unit by interrogating its PU address each net cycle; this is called the roll call mode. To perform net protocol functions, the DTS is considered a front-end processor because it does not require the TDS to be interfaced to perform its functions such as net protocol. However, the DTS does not transmit the TDS message data unless it is properly interfaced with the TDS computer.

(3) TADIL A Radios. TADIL A transmitters and receivers provide point-to-point connectivity between widely separated participants. The radios can be a transmitter/receiver combination in which the transmitter and receiver are separate, independent functions. A transceiver is a radio that has interdependent components in one unit that provide both the transmit and receive functions. Two types of radios are used for TADIL A: HF and UHF. Link-capable radios require different setup parameters and sometimes-different internal components than needed by a standard voice radio. The

primary differences include faster transmit-to-receive switch timing, keyline interface, audio bypass set at +/- 20 kilohertz (kHz) for data vice +/- 5.5 kHz for voice, and automatic gain control attack/release timing.

c. TADIL C Characteristics. TADIL C uses a command and response protocol and the principle of time division multiplexing to derive apparently simultaneous channels from a given frequency. It connects two points (or units) by assigning a sequence of discrete time intervals to each of the individual channels. At any given time, a unit transmits, receives, or idles on a single point-to-point circuit. TADIL C is the USN primary air intercept control (AIC) tool, as well as the basis for the automatic carrier landing system. A major capability of TADIL C is the ability to receive and display targets downlinked by fighter aircraft from beyond the controlling unit's radar horizon. TADIL C also has the ability to uplink targets from the controlling unit to the fighter aircraft and provides target-vectoring data to the fighter aircraft. TADIL C is used on both USN surface combatants and E-2C AEW aircraft. Both may act as controlling units. The TADIL C system provides the TADIL J operator/user with the means to conduct AIC operations with non-TADIL J-capable aircraft. The TADIL C interface between the advanced combat direction system (ACDS)/command and decision system and the command and control processor (C2P) allows TADIL C host software to conduct TADIL J air control operations.

d. Multilink Platform Capabilities. Initial employment of TADIL J in the USN includes CVs, selected CGs, E-2C Group II, and F-14D aircraft upgrades. These units have retained their TADIL C and TADIL A capabilities and can conduct various types of multilink operations. Additionally, Model 5 ships, the E-2C, and the F-14D have upgraded their CDS databases to be operation specification (OPSPEC) 516 compliant, giving them TADIL J data registration.

(1) Model 4. Model 4 (Block 0) refers to the existing combat direction system (CDS) aboard AEGIS and naval tactical data system (NTDS) ships. Their CDS software conforms to OPSPEC 411 and 404 (Model 4, TADIL A and Model 4, TADIL C). See Table II-2.

(a) All combat displays and controls are existing TADIL A/TADIL C-compatible displays. The CDS generates and receives M-, V-, and R series messages via an "NTDS Fast" interface to the C2P.

(b) All messages transmitted or received over any of the links are routed through the C2P. Outgoing M, V, and R messages generated by the CDS are either pipelined to the TADIL A and TADIL C DTS or translated into appropriate J-series messages for TADIL J. TADIL J messages are further mapped to appropriate NPGs for transmission.

(c) Incoming messages are similarly pipelined to the CDS from TADIL A and TADIL C. TADIL J messages are translated from TADIL J to M, V, and R. During translation, both the expanded message content and enhanced data registration accuracy of TADIL J are lost. The original link source of the messages cannot be determined or displayed by the operator. The C2P uses a direct tap from the ship's navigation system to make grid translations.

Table III-2. Model 4 Systems

Multilink Capability	Model 4/ Block 0	Model 5/ Block 1	E-2C Group II	F-14D
TADIL A surveillance/TADIL C air control	X	X	X	
TADIL J surveillance/TADIL C air control	X	X	X	
TADIL J surveillance/TADIL C air control	X	X	X	
Data forwarding	X	X	-	
TADIL J/A surveillance broadcast			X	X
TADIL J air control	X	X	X	X
TADIL C air control	X	X	X	X
Simultaneous TADIL-J/C air control	X	X	X	
TADIL J fighter-to fighter advisory	-	X	X	X
OPSPEC 516 databases	-	X	X	X

(2) Model 5. Model 5 system's Block 1 refers to the upgrading of the CDS (aboard AEGIS and NTDS ships) to comply with OPSPEC 516 (Model 4, TADIL J). This converts their data registration system and enables it to be consistent with the TADIL J messages. (Note: E-2C Group II and F-14D have already made this conversion.)

(a) All combat displays and controls are upgraded to take advantage of the expanded information contained in the J series messages. The CDS generates and receives J series messages via an interface to the C2P.

(b) All messages transmitted or received over any of the links are routed through the C2P. Outgoing J messages are either pipelined to TADIL J or translated into appropriate M-, V-, and R-series messages for TADIL A and TADIL C. TADIL J messages are mapped to the appropriate NPGs for transmission. On TADIL A and TADIL C, the single TADIL J message (from the CDS) may result in as many as 8 messages.

(c) Incoming messages are similarly pipelined to the CDS from TADIL J. TADIL A and TADIL C messages are translated to TADIL J. The C2P receives navigation information from the CDS and does not have direct access to the ship's navigation system.

(3) E-2C Group II Aircraft. The Group II L-304 computer program maintains a normalized database that allows it to generate TADIL J and TADIL A messages for transmission on surveillance to be OPSPEC 516 compliant. All displays and controls are upgraded to take advantage of the expanded information contained in the J-series messages. The mission computer can use either the GEOGRID or the RELGRID of JTIDS RELNAV for data registration. E-2C surveillance, air control, and identification (PPLI) functions are distinct in all modes. Group II can control up to 20 aircraft on a combination of TADIL C and TADIL J while transmitting surveillance on either TADIL J or TADIL A. It can act as a relay for TADIL A or, if operating exclusively on

TADIL J, relay TADIL J surveillance data. Additionally, the E-2C can monitor fighter-to-fighter target sorting and provide weapons-free/tight instructions on that net. In all modes it continues to transmit and process PPLI information.

(4) F-14D Aircraft. The JTIDS Class II terminal has been integrated into the F-14D as part of the overall avionics upgrade. The aircraft uses the OPSPEC 516 data registration and has new displays and controls that are fully TADIL J capable. This allows it to take full advantage of both the TADIL J expanded messages and the improved navigation accuracy. The F-14D has retained TADIL C capability and can perform either TADIL C or TADIL J air control. Currently, F-14D software limitations prevent the simultaneous operation of fighter-to-fighter (on TADIL J) and air control. Host limitations also prevent the processing of surveillance information. The F-14D does not process track data received on the surveillance NPG, but is capable of performing automatic "transparent" relay of the surveillance NPG. The F- 14D receives track data from the E-2C via the air control NPG. Selected track data may also be exchanged between F-14Ds via the fighter-to-fighter NPG.

2. Joint Service Operations

Joint and combined operations with other JTIDS-equipped platforms impose unique requirements due to differences in both hardware/software implementation and in operating procedures. The USAF does not support the use of design option files or dynamic air control. The USA does not support 16 kbps voice and platforms equipped with Class I terminals that do not exchange TADIL J messages. In order to achieve interoperability, current USN and USAF networks contain special provisions that support all mixes of USN and USAF C2 and non-C2 units. True joint Service networks that take full advantage of the multinet capability of JTIDS are planned for the future. These networks are envisioned to contain both Service-unique and common NPGs.

a. Airborne Warning and Control System (AWACS) E-3 Sentry Aircraft. The E-3 Sentry is an AWACS aircraft that provides all-weather surveillance and C3 needed by commanders of NATO air and US defense forces. It is the premier air-battle C2 aircraft in the world today. The entire E-3 fleet is going through the single largest upgrade in its history. The Block 30/35 Modification Program includes a computer upgrade, a radar system improvement, new ES measures, a passive detection system, global positioning system (GPS), and TADIL J AN/URC-107 (V5) Class 2H radio sets. A USAF Test System 3 AWACS aircraft, based at Boeing Field in Seattle, Washington, is used to support the testing of the AWACS enhancements. The retrofit completion date for the entire fleet of 32 AWACS aircraft is estimated to be in 2001.

b. F-15 Aircraft. F-15s are equipped with the TADIL J AN/URC-107 (V6) Class 2 radio sets. Pilots of TADIL J-equipped F-15Cs have greatly enhanced situational awareness (SA), enabling use of daytime tactics at night and in low visibility while reducing the potential of fratricide. A description of air control operations can be found in the E-2C air control section (see paragraph 4). Twenty-five F-15s are equipped with TADIL J AN/URC-107 (V) Class 2 radio sets. Twenty are stationed with the 390th Fighter Squadron (Mountain Home, Idaho). The other five are part of the 57th Test Group located at Nellis Air Force Base (AFB), Nevada, and are used for tactics development. The remainder of the F-15 inventory is slated to receive the lower cost MIDS Fighter Data Link radio set.

c. JSTARS E-8 Aircraft. JSTARS is a joint USA and USAF program with the USAF as the lead service. The JSTARS E-8 is a wide-area surveillance aircraft similar to the Boeing E-3 AWACS. While AWACS is used primarily for air-to-air surveillance, JSTARS is a long-range, air-to-ground surveillance system designed to locate, classify, and track ground targets in all weather conditions. Its primary sensor is a multimode radar system with a phased-array radar antenna in a 26-foot canoe-shaped radome attached to the bottom of the fuselage. The aircraft is equipped with 18 operator consoles, each of which has more computing power than an entire E-3. The E-8C communication suite is designed for communications with upper-level echelon and other surveillance aircraft and for guiding fighter/bombers aloft onto newly detected targets. Its radios include UHF Have Quick, VHF single-channel ground and airborne radio system (SINCGARS), HF long-range radios, and the TADIL J Class 2 radio set.

d. Army Terminals.

(1) Class 1 Terminal. Army Patriot missile batteries use a Class 1 terminal similar to the AWACS terminal. The Patriot system receives tracks from AWACS via IJMS. The Army terminals do not include an encoder and thus cannot perform voice communication via TADIL J.

(2) Class 2 Terminal. The USA has developed a repackaged version of the Class 2 terminal known as the Class 2M. It includes an integrated radio terminal and digital data processing group (DDPG) and has a volume of 1.25 cubic feet. It is designed to be carried on the back of a high-mobility, multipurpose, wheeled vehicle (HMMWV) and in mobile communications centers. It is a single-box configuration (line replacement unit/ weapon replacement assemblies) with the radio terminal and DDPG functions integrated together.

(3) Equipment Configurations. The Army primarily uses three basic TADIL J equipment configurations: the Class 2M radio terminal, the dedicated JTIDS relay unit (DJRU), and the NCS JTIDS. This equipment provides Army units multimission, multiforce, and multinational data link capabilities. The forward area air defense (FAAD), theater high-altitude area defense, and Patriot C2 systems are the primary users. Appendix D provides detailed information on Army Tactical Data Link-1 (ATDL-1).

(4) Adaptable Surface Interface Terminal. The Army also uses the adaptable surface interface terminal (ASIT), a reconfigured version of the AF ASIT. The Army ASIT is equipped with the Class 1 AN/URQ-33 Hughes improved terminal (HIT). The HIT provides access to surveillance data transmitted on the IJMS network from air- and ground-based surveillance systems. Army systems are being upgraded with MIDS as they become available.

e. Marine Terminals. The JTIDS Module (JM) is a standard 5-788 shelter secured to and transported by an M1097 HMMWV, Huey variant. The Marine air control squadron uses the JM, in conjunction with the tactical air operations module (TAOM), to provide TADIL J capability to the tactical air operations center (TAOC).

(1) The radio terminal set, AN/TSC-131 (JM), gives the USMC a TADIL J-capable MACCS. The JM is a shelter that contains a Class 2 terminal and its support equipment, including antennas and cryptographic equipment. The JM features triservice tactical

communications-compatible output and is a mobile, rapidly deployable subsystem of a host platform.

(2) Fully equipped TAOMs provide TADIL A, B, C, and J capabilities, as well as NATO Link-1 and ATDL-1 interoperability. The USMC (Phase 3) advanced tactical air command center (TACC) can participate on TADILs A, B, and J and NATO Link-1 and provide forwarding between those TADILs.

f. NATO AWACS E-3 Aircraft. NATO AWACS aircraft have JTIDS bilingual Class 2 terminals and upgraded 68030 computer processing units. TADIL J is the NATO standard system for digital communication (standard NATO Agreement 5516). Appendix E provides more information on NATO systems.

3. Battle Group Surveillance

Multilink operations over both TADIL A and TADIL J allows the battle group surveillance function to enhance situational awareness by providing a comprehensive and consistent tactical picture to all members of the battle group.

a. Participants. The potential mix of participants may include the following:

(1) TADIL A only units.

(2) TADIL A/TADIL J platforms with TADIL A database (Model 4 C2P).

(3) TADIL A/TADIL J with TADIL J databases (Model 5 C2P).

(4) TADIL A/TADIL J with both TADIL A and TADIL J databases (E-2).

(5) E-3 AWACS with a TADIL J database.

b. Data Forwarding. Any C2P-equipped ship can perform the data forwarding function. All commands are exchanged between TADIL A and TADIL J, including track data, track management, force orders, and so forth. The forwarding JU—TADIL J to TADIL A (FJUA)— is the only unit active on both TADIL A and TADIL J. The C2P maintains a normalized database that enables reporting tracks with either full TADIL J or TADIL A precision. The C2P translates tracks from the TADIL J grid and its own ship position in TADIL J to the TADIL A grid and its own ship position.

(1) To prevent redundant tracks and the data forwarding of tracks already reported on the opposing link, each C2P must be capable of correlating forwarded TADIL A tracks with local tracks and report only tracks that are held with higher TQ. Similarly, the TADIL A PUs must be capable of correlating forwarded tracks (those translated from TADIL J to TADIL A by the data forwarder) with local tracks in order to prevent redundant or multiple track reporting of the same track.

(2) The data forwarder translates TADIL A PUs into indirect PPLIs and reports them to all TADIL J platforms in the JTIDS geodetic and relative-coordinate systems. To convert in the other direction, TADIL J PPLIs appear as special point friendlies. The

TN of the F-14D is its JU number. TADIL J F-14Ds without an air controller appear as if the data forwarder is controlling them.

(3) The data forwarder assumes that any platform that is transmitting PPLIs is a participant on the TADIL J surveillance NPG. Therefore, it does not forward its tracks onto TADIL J. As a result, if a platform is operating on TADIL J air control and TADIL A surveillance, the TADIL A tracks will not be forwarded. Data forwarding rules are shown in Figure III-1.

c. TQ. TADIL A employs TQ numbers that range between 0 and 7 in order to determine track reporting responsibility. TQ is determined by sensor accuracy, elapsed time since previous sensor update, velocity of track, and own unit current geodetic position quality. TADIL J employs TQ numbers that range between 0 and 15. TADIL J quality values support the additional precision of measurement conveyed by the additional bits provided in TADIL J data fields. Other TADIL A tracks (unknown, hostile, and so forth) are converted into TADIL J surveillance tracks by the data forwarder. A TADIL J TQ is attached to the TADIL A track.

4. Battle Group Air Control

The air control function of TADIL J is similar to that of TADIL C. C2 units (ships and E-2C aircraft) exercise control over fighters, providing both tactical information and direction.

a. Parallel Operations. TADIL C can operate in parallel with TADIL J. The TADIL J circuit is functionally divided into an up-link, where the controller broadcasts or addresses messages to all fighters, and a back-link on which the fighters respond with track information or other appropriate information to the C2 unit. MM/WC and PPLI functional circuits are used in conjunction with the control circuit.

b. Air Control Hand-Over. TADIL J air control includes the capability to digitally hand over aircraft between air controllers, although most are voice-coordinated. On TADIL J, the fighter switches net numbers when changing air controllers. TADIL J air control requires a single JTIDS terminal using separate NPGs to perform air control and voice functions. To perform a hand-over, the new controller sends a request to change control to the current controller. The JU number of the new controller is passed up to the F-14D. The F-14D then generates a request for control that is sent to the new

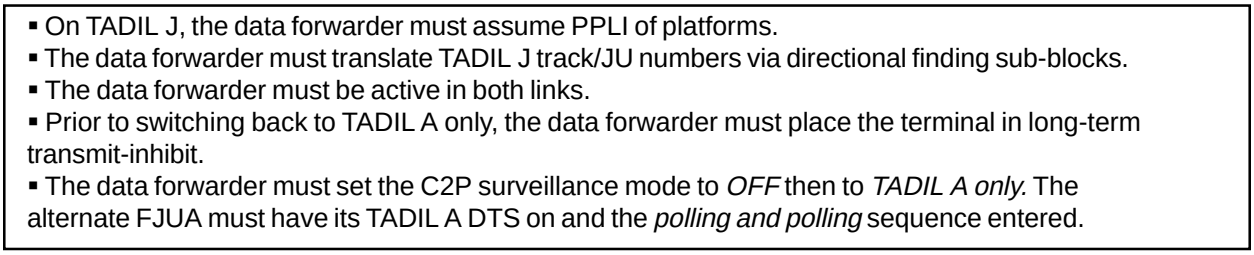


Figure III-1. Data Forwarding Rules

controller. The new air controller sends the F-14D new back-link time slots after the new controller receives a WILCO (will comply) from the F-14D. During this process, the primary receipt messages are sent receipt-compliance (R-C). R-C messages require each terminal to exchange machine receipts as well as WILCOs. To improve the probability of reception, each R-C message is sent multiple times until the other terminal complies. OPSPEC 516 defines the number of times each message is sent. When the process is complete, the F-14D radar intercept officer sets his JTIDS mode switch from passive to active intercept. Fighters in the fighter-to-fighter mode cannot be brought under control.

5. Joint Interface Control

The JICO concept was established to overcome joint and combined interoperability deficiencies related to management of the joint force multi-TADIL networks. Incorporated into joint exercises, it has been effective in managing the complexity of the electronic battlefield, thereby improving the joint force commander's (JFC's) ability to engage hostile forces and prevent fratricide. The United States Joint Forces Command (USJFCOM) oversees the JICO program.

a. The JICO. The JICO is an operational expert who understands joint warfighting. The JICO reports to the commander designated by the JFC. The JICO must have a strong background in joint data link employment and sufficient technical knowledge to manipulate complex link architectures in order to maximize the combat effectiveness of joint and combined forces in dynamic operations. The multi-TADIL network and its interfaces with other networks constitute the theater joint data network (JDN). The JDN distributes data necessary to develop the CTP and single, integrated air picture. Acting with authority delegated by the JFC, the JICO serves as the JDN manager to provide JDN inputs for a complete and seamless CTP for C2 throughout all phases of the campaign. A multi-service working group developed the functions and tasks of the JICO for both planning and executing the multi-TADIL networks. For planning, the JICO compiles information, develops and validates the multi-TADIL architecture, coordinates development of the operational tasking data link (OPTASKLINK), and conducts dynamic planning. Execution duties include initiating and maintaining the multi-TADIL architecture and associated voice circuits, resolving track management issues, and modifying the architecture as necessary. Monitoring of the link is accomplished via data link status information. Specifically, the JICO monitors the status of JUs assigned the various network roles to ensure they are active. JUs automatically report their status (active, inactive, or limited) via the network participation status (NPS) indicator (available at the C2P) in the PPLI message. The JICO monitors the NPS indicator of' network JUs to determine when a JU assigned a critical function (NTR, NC, relays, etc.) is no longer in active status and can no longer function in that capacity. To facilitate the link-monitoring process, JUs that exit the network should notify the JICO by an alternate means (such as voice).

b. The JICO Cell. Members of a cell, of which the JICO is the officer-in-charge (OIC), perform the functions of the JICO. A JICO cell can be established for each joint task force (JTF). The cell consists of the OIC and members necessary to support continuous operations. To enable the rapid stand-up of new cells for contingency response and to allow for rotation and surge requirements of existing cells, regional and

component commands need to be staffed with qualified JICOs and have all necessary equipment. Members of the JICO cell continuously monitor the multi-TADIL architecture, ensure connectivity, and resolve interoperability and track management issues. To ensure JICO personnel maintain proficiency, their training program should include participation in joint and combined exercises. USJFCOM has overall responsibility to staff, train, and equip JICO cells.

6. Operating Considerations

To illustrate the complexity of planning and executing TADIL J operations, some of the many operating considerations that must be taken into account are listed in Figure III-2. Details of these considerations are beyond the scope of this document, but all are covered in the Joint Multi-TADIL Operating Procedures (JMTOP).

7. Link Troubleshooting Considerations

Many problems may occur when initializing and operating data links in a multi-TADIL environment. Most problems encountered with TADIL J occur during the link initialization and net entry phase of operations. Evaluations of live TADIL J operations have determined that most problems with initializing and operating the link are due to operator error. Premission planning and coordination with other participants precludes many errors. Figure III-3 shows the four basic considerations when troubleshooting problems with TADIL J.

Accurate OPTASKLINK message	Operating mode and power
Correct network design loads (NDLs)	NTR unit
Surveillance options	NC and secondary NC
Air control options	IEJU responsibilities
Fighter-to-fighter options	TSDF computed and followed
Grid origin	Correct crypto keymat
Stacked net designations	Crypto day
Air control nets	Airborne relays and relief-on-station procedures
Voice A and B nets	Interference protection feature settings
Fighter-to-fighter nets	Special instructions • Filtering • Data registration
Link duty assignments	Deconfliction
JU address and track block assignment	National/international restrictions integrated in architecture
User sequence and platform type	

Figure III-2. TADIL J Operating Considerations

1. Time.

- Remember that GPS time is normally used for TADIL J operations.
- Ensure that the agency performing NTR establishes network time for all participants.
- Ensure the time differential with the NTR is no more than 6 seconds.
- Ensure time is on internal, or if not, that it is getting to the terminal.

2. Crypto.

- Verify with the OPTASKLINK that the current crypto keymat is being used.
- Verify the crypto day being used (Day 0 or Day 1).

3. Connectivity.

- Confirm LOS to the NTR or to an active initial entry JTIDS unit (IEJU).
- Confirm establishment of proper connections between the TADIL J terminal, antenna, and power supply, and so forth.
- Confirm that the terminal/antenna is not in a dummy load.

4. Initialization Parameters.

- Confirm the NDL in use.
- Confirm NTR or normal transmits. Always refer to system-/platform-specific troubleshooting guides.

5. Synchronization.

- If not in fine synchronization, confirm transmission of round trip timing (RTT) messages.

Figure III-3. Troubleshooting Considerations

Appendix A

SYSTEM CAPABILITIES AND LIMITATIONS

The following quick reference charts represent the systems that operate with TADIL J in each Service. Additional TADILs are listed if applicable to the system to increase interoperability knowledge among system users and planners. Each chart reflects the existence or nonexistence of JTIDS voice. TADIL J is enhanced with JTIDS voice although this capability uses time slots that are not available for other TADIL J functions.

TADIL J-Capable Air Force Systems					
F-15C/D Eagle					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
DCA, OCA	2002	MIDS FDL	No	J, IJMS	N
Description/Capabilities	The F-15 C/D is a USAF single-seat, all-weather, air-superiority fighter (AFTTP 3-1, Vol 4)				
Limitations	Two UHF radios. MIDS FDL terminal not used for relay.				
Special Considerations	None.				

F-15C/D Eagle					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
DCA, OCA	One squadron fielded	JTIDS Class 2	2.4	J, IJMS	N
Description/Capabilities	The F-15 C/D is a single seat USAF all-weather, air superiority fighter.				
Limitations	Two UHF radios. Not used for relay.				
Special Considerations	None.				

F-15E Strike Eagle					
Missions	**Initial Operational Capability (IOC)**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
AI, CAS, DCA, OCA	2000	MIDS FDL	No	J, IJMS	N
Description/Capabilities	The F-15E is a two-seat, tactical aircraft equipped with modern weapon and navigational systems.				
Limitations	Two UHF radios. Not used for relay.				
Special Considerations	None.				

F-16 Fighting Falcon					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
AI, CAS, CSAR, DCA, OCA, SEAD	2006	Block 30: EPLRS Block 40/50: IDM, MIDS low volume terminal	No	(AFAPD, IDM, SADL (Block 30), J	N
Description/Capabilities	The F-16 is a single-seat, single-engine fighter that performs multiple missions.				
Limitations	One UHF radio. One VHF radio.				
Special Considerations	None.				

TADIL J-Capable Air Force Systems (Continued)					
F-22 Raptor					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
DCA, OCA	2004	Integrated modular avionics	No	J (receive only)	N
Description/Capabilities	The F-22 is a twin-engine, single- seat, air-superiority fighter intended to replace the F-15C. The F-22 primarily supports air-to-air missions; however, can also be configured for an air-to-ground (strike) role.				
Limitations	Two UHF radios.				
Special Considerations	None.				

Air Operations Center (AOC)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
Theater C2	Fielded	JTIDS Class 2, MIDS	2.4/16	A, B, J, ATDL-1	N
Description/Capabilities	The AOC is the senior deployable air operations element of the TACS. It functions as the JFACC or commander AF operations center. It is the primary element involved in force management. The AOC includes the facilities and personnel necessary to accomplish the planning, coordinating, deconflicting, directing and coordinating of theater air operations. One of the primary functions of the AOC is the planning, production, distribution, and execution of the air tasking order and airspace control order (AFTTP 3-1 Vol 26). The other primary function of the AOC is monitoring current execution of air operations. TADIL J is used to provide real-time C2, surveillance, PPLI and management information in support of tactical situational awareness for this function. The AOC also expects to use TADIL J to transmit track, threat and C2 messages in support of time-critical targeting.				
Limitations	The continental US numbered AF AOCs are presently equipped differently; 12th AF and 8th AF do not have JTIDS terminals; 9th AF has some limited JTIDS capability.				
Special Considerations	Implementation of the JTIDS capability within the AF modular control equipment units is in progress and could take from one to two years to complete.				

Control and Reporting Center/Control and Reporting Element (CRC/CRE)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	Fielded	JTIDS Class 2	2.4/16	A, B, C, J, ATDL-1	Y
Description/Capabilities	The CRC and CRE are the ground radar elements of the TACS. CRCs and CREs are tailored to the specific mission requirements in the area of operations.				
Limitations	None.				
Special Considerations	None.				

E-3 Airborne Warning and Control System (AWACS) B/C Sentry					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	Fielded	Block 20/25: Class 1 Block 30/35: Class 2H	2.4 (20/25) 2.4/16 (30/35)	A, C, IJMS, J (Block 30/35 only)	N
Description/Capabilities	The E-3 is an airborne C2 platform that supports quick reaction deployments, battle management, and other aerospace operations to include AI, DCA, ES, OCA, and CSAR and link management for the JFACC and commander-in-charge.				
Limitations	TADIL C is one-way only. The E-3 cannot be a forwarder.				
Special Considerations	Concurrent TADIL A, IJMS, and TADIL J operations capable. USAF calls J voice extended range voice for electronic countermeasures resistance voice.				

TADIL J-Capable Air Force Systems (Continued)					
EC-130-E Airborne Battlefield Command and Control Center (ABCCC)					
Missions	**Initial Operational Capability (IOC)**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	Fielded	JTIDS Class 2, EPLRS	No	AFAPD, J, IJMS, SADL	N
Description/Capabilities	The ABCCC is an airborne C2 platform that provides a worldwide, rapid response to situations requiring C3I for the employment of air-to-ground airpower. It operates as an airborne element of the TACS, functioning as an extension of the AOC (for combat operations) and as a limited ASOC.				
Limitations	None.				
Special Considerations	EPLRS/SADL currently installed on only one aircraft.				

RC-135 Rivet Joint					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
EW	Fielded	JTIDS Class 2	2.4/16	A, J, IJMS	N
Description/Capabilities	The RC-135 Rivet Joint aircraft provides real-time, long- range electronic surveillance of the theater battlespace by detecting, locating, and identifying air, surface, and land platforms and radars and other emitters based on land, aircraft, or ships.				
Limitations	National asset				
Special Considerations	None.				

E-8 Joint Surveillance Target Attack Radar System (JSTARS)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
Joint surveillance, targeting, battle management C2.	Fielded	JTIDS Class 2	No	SADL, J, IJMS	N
Description/Capabilities	The E-8 is employed in theaters of operation to provide real-time battlefield targeting of time-sensitive moving and stationary ground targets. The system uses a side looking, electronic scanned, and pulse Doppler radar.				
Limitations	None.				
Special Considerations	Support to JTF commanders, corps commanders, or other supported commanders as directed. The JFC determines the most effective use of JSTARS based on the situation and the concept of operations. JSTARS is also capable of supporting air operations to include AI, CAS, OCA and other special missions spanning the range of military operations.				

TADIL J-Capable Army Systems					
Air Defense Systems Integrator (ADSI)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
Air Defense C2	Fielded	Class 2M	No	J/serial J, A, B, forward area air defense (FAAD), ATDL-1	Y
Description/Capabilities	Main feature is a communications suite that acts as a data link router. Based on an open architecture design, different data link capabilities may be added and deleted with a change of an integrated circuit card. Many variants of the ADSI exist and versions may vary greatly from unit to unit and Service to Service. Deployed with the Army Air Missile Defense Command and the Army air defense brigade.				
Limitations	Nonstandard configurations, widely varying capabilities.				
Special Considerations	No voice capability; for Patriot requires an octal 1000 track block field.				

Patriot Information Coordination Center AN/MSQ-116					
Missions	**Initial Operational Capability (IOC)**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
Air and missile defense	Fielded	Class 2M	No	A, B, J, ATDL-1, Patriot data information link	Y
Description/Capabilities	Integrates the tactical pictures from subordinate fire units. This picture is fused and decisions are made directing engagements by unit. Serves as the data link interface from Army air defense into the theater data link structure.				
Limitations	Requires an octal 1000 track block**.**				
Special Considerations	Subordinate fire unit radars are phased array fire control radars. Patriot tracks each and every radar return within its surveillance volume, which if unfiltered or unchecked at the receiving end, may saturate surveillance radar system based track capacities. Additionally, Patriot has no manual track correlation capability and may be unaware of the saturation it creates. The Patriot may initiate filters, which help but do not eliminate the problem.				

Forward Area Air Defense (FAAD)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
Air and missile defense	Fielded	Class 2M	No	J (limited), FAAD data link, B	N
Description/Capabilities	Serves as the gateway between forward air defense units (Stinger) and the joint TADIL architecture. Deployed at division air avenue command and control and FAAD battalion air battle management operations centers.				
Limitations	Limited transmit capability on TADIL J.				
Special Considerations	None.				

TADIL J-Capable Navy Systems					
Aircraft carrier (CV)/aircraft carrier (nuclear propulsion) (CVN) Advanced Combat Direction System (ACDS)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
All NPGs	Fielded	Class 2H	Yes	A, B, C, J	Y
Description/Capabilities	Uses a TDS computer, C2P, JTIDS terminal and antennas. Is a primary carrier battle group C2 platform. Can support primary Navy warfare areas. Integrates 3-dimensional (D) air picture from various sensors into the TADIL J surveillance picture.				
Limitations	USN Class 2H terminals are not bilingual, and therefore, cannot interface with IJMS. Unable to manually assign system track number (STN). C2P message packing is limited to packed 2.				
Special Considerations	Models 4 and 5 are host software programs for TADIL implementations in the USN. Model 4 is based on TADIL A and loses granularity in translating to/from TADIL J. Model 5 is based on TADIL J and implements full granularity. CVN (ACDS) operates both Model 4 and 5.				

AEGIS, Guided Missile Cruiser (CG)/ Guided Missile Destroyer (DDG)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
AW, C2W, STW, SUW, USW),	Fielded	Class 2H	Yes	A, C, J	Y
Description/Capabilities	Uses a TDS computer, C2P, JTIDS terminal and antennas. Primary area air defense commander/rear air defense commander platform. Can support primary Navy warfare areas. Integrates 3-D air picture from various sensors into the TADIL J surveillance picture; long-range surface-to-air missile capable.				
Limitations	USN Class 2H terminals are not bilingual, and therefore, cannot interface with IJMS.				
Special Considerations	Models 4 and 5 are host software programs for TADIL implementations in the USN. Model 4 is based on TADIL A and loses granularity in translating to/from TADIL J. Model 5 is based on TADIL J and implements full granularity. AEGIS operated 11 Model 4 and 38 Model 5 platforms in fiscal year 98.				

E-2C Group II Navy Upgrade					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	Fielded	Class 2H	Yes	A, C, J	N
Description/Capabilities	Uses an L-304 computer with an extra speed processor connected to a JTIDS terminal				
Limitations	Cannot receive free text messages. Cannot process TADIL A and TADIL J simultaneously. USN Class 2H terminals are not bilingual, and therefore, cannot interface with IJMS.				
Special Considerations	Limited to 3 JTIDS initialization loads, which limits airborne flexibility.				

Amphibious Landing Ship Assault (LHA)/ Amphibious Landing Ship Dock (LHD)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
AW, anti-mine warfare, C2W, CSAR, mine warfare, STW,	Fielded	Class 2H	Yes	A, C, J	Y
Description/Capabilities	Amphibious assault combatant. C2 platform used primarily to support amphibious operations. Integrates 3-D air picture from various sensors into the TADIL J surveillance picture.				
Limitations	USN Class 2H terminals are not bilingual, and therefore, cannot interface with IJMS. Unable to manually assign STN.				
Special Considerations	Models 4 and 5 are host software programs for TADIL implementations in the USN. Model 4 is based on TADIL A and loses granularity in translating to/from TADIL J. Model 5 is based on TADIL J and implements full granularity. LHAs operate Model 4 software and LHDs operate Model 5 software.				

TADIL J-Capable Navy Systems (Continued)					
Submarine (Nuclear Propulsion)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
STW, SUW, USW,	Fielded	Class 2H	Yes	A, J	N
Description/Capabilities	Operates a stand-alone workstation; not integrated with the platform weapons system. Submarines are primarily data users and not data providers although they can provide data if required.				
Limitations	USN Class 2H terminals are not bilingual, and therefore, cannot interface with IJMS.				
Special Considerations	Intermittent participation.				

F-14D Tomcat					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
AW, STW, SUW	Fielded	Class 2H	Yes	C, J	N
Description/Capabilities	An all weather, supersonic, multi-mission, air superiority fighter. Can be configured for airborne intercept, surface attack, and aerial reconnaissance missions.				
Limitations	USN Class 2H terminals are not bilingual, and therefore, cannot interface with IJMS.				
Special Considerations	F-14A/B is not TADIL J capable.				

TADIL J-Capable Navy and Marine Systems					
F/A-18C/D/E/F Hornet					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
AI, CAS, CSAR, DCA, OCA, SEAD	2003	MIDs low volume terminal	Yes	J	Y
Description/Capabilities	The F/A-18 is a single-seat, twin-engine fighter that performs multiple missions.				
Limitations	Two UHF/VHF/high frequency (HF) airborne radio communication-210 radios.				
Special Considerations	None.				

TADIL J-Capable Marine Systems					
Marine Tactical Air Command Center (TACC)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	Fielded	Class 2H	No	A, B, J, NATO Link-1	Y for A, B, J
Description/Capabilities	The TACC is the senior agency within the MACCS. The TACC is comprised of two cells. The communications suite consists of HF, VHF FM, and UHF radios. The multiple source correlation system is used to interface TADILs A, B and J into the TACC.				
Limitations	No organic satellite or multi-channel communications equipment; link-1 is receive only; no live sensor inputs.				
Special Considerations	None.				

Tactical Air Operations Center (TAOC) AN/TYQ-23 (V1)					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	Fielded	Class 2H	No	A, B, C, J, ATDL-1, NATO Link-1	Y
Description/Capabilities	The TAOC is the air defense agency within the MACCS. The TAOC consists of 6 shelters with 4 operator positions each. Communications consists of HF, VHF (FM) and UHF. The system is supported by four air search radars, (two long-range 3D and two medium- range 2D). The functions of the TAOC include command coordination, weapons control, surveillance and traffic management.				
Limitations	No organic satellite or multichannel communications equipment.				
Special Considerations	When conducting TADIL J operations, the TAOC requires an additional participating unit (PU)/reporting unit for forwarding requirements.				

TAOC AN/TYQ-23 (V4), Tactical Air Operations Module (TAOM) (V4), AN/TYQ-82 Tactical Data Communications Platform					
Missions	**IOC**	**Terminal Type**	**JTIDS Voice**	**TADILs**	**Forwarder (Y/N)**
C2	1999	Class 2H	Yes	A, B, C, J, ATDL-1, ground based data link, NATO Link-1	Y
Description/Capabilities	The TAOC is the air defense agency within the MACCS. The TAOC consists of 6 shelters with 4 operator positions each. Communications consists of HF, VHF (FM) and UHF. The system is supported by four air search radars, (two long-range 3D and two medium-range 2D). The functions of the TAOC include command coordination, weapons control, surveillance and traffic management.				
Limitations	No organic satellite or multichannel communications equipment.				
Special Considerations	None.				

Appendix B

JTIDS CRYPTOGRAPHIC VARIABLE REQUIREMENTS

1. Terminals

A Class 2 JTIDS terminal, AN/URC-107 (V) 1, consists of the receiver/transmitter (R/T), an associated antenna system, a high-power amplifier, a digital processing group (DPG), a battery pack (BP), and a secure data unit (SDU).

a. R/T Unit. The R/T unit provides all radio and intermediate frequency processing for JTIDS TDMA functions. The R/T interfaces with the DPG.

b. DPG. The DPG is the central unit of the JTIDS terminal and consists of two major components—the digital data processor (DDP) and the interface unit (IU).

(1) DDP. The DDP contains the network interface computer program (NICP). It performs all the real time R/T control and signal processing for TDMA message transmission and reception. The NICP also encodes transmitted messages and decodes received messages. The NICP performs all network functions.

(2) IU. The IU contains the subscriber interface computer program (SICP) and is attached to the front of the DDP. It provides a standard interface to the DDP and a tailored interface to the host platform. Its primary function is to process the necessary transfer of data between the DDP and the host platform. The IU central processing unit stores and executes the SICP functions.

c. BP. A BP provides emergency power to maintain critical data, including the crypto key oscillator power and system initialization data during brief power interruptions. The BP also maintains crypto key and initialization data when the terminal is in STANDBY mode.

d. SDU. An SDU KGV-8 is mounted on the front panel of the IU. Two connectors provide the electrical interface between the SDU and the IU. The SDU stores the crypto key required to implement secure communications functions. If the SDU is detached from the IU, any stored key erases and terminal operation cease.

(1) Variations. SDUs that are currently fielded are KGV-8 (E-2), KGV-8A, KGV-8B, and KGV-8C. On KGV-8 (E2) and KGV-8A, a connector called the key fill port is located on the outside of the SDU and allows the crypto key to be loaded. Some terminal configurations use a remote fill cable and control cable permanently attached to the SDU to load the crypto key. With the introduction of the KGV-8B, a newly developed embedded cryptographic module that employs a new data standard, DS-101, was implemented. It supports keying with the data transfer device (DTD) and a JTIDS personal computer (PC) with JTIDS-specific software installed for use with a new type of key material which is encrypted (black). The USN will retrofit the KGV-8B in place of earlier SDUs. The “B” version eliminates the load control unit (LCU) and introduces the DTD AN/CZY-10.

(a) The KGV-8B requires the KYK-13 and LCU for key loading.

(b) The KGV-8B has storage capacity for eight keys and is loaded using DTD. It can be loaded with either red (normal unencrypted) or black (encrypted) keys and does not require a keyer control panel (KCP) or USN LCU for loading keys.

(2) Employment. SDU employment is shown in Figure B-1.

2. Key Distribution

TADIL J crypto key distribution and handling are essentially the same as traditional procedures for crypto, except for long-term electronic storage, multiple segments of keys in the DTD, and the requirement to load two days crypto into the SDU at one time. Use of the LCU or KCP is required for the KGV-8 (E2) and KGV-8A. All models of the KGV-8 can use the same key material short titles. In addition, the KGV-8B can also use the encrypted versions of those short titles.

3. Secure Data Unit Functions

a. Message Transmission. The terminal provides the plain text message to the SDU that encrypts the message and provides the encrypted message to the terminal DPG. The DDP draws a pseudorandom sequence pattern from the key located in the SDU. This pattern provides the pseudorandom frequency-hopping pattern, the time jitter, and the frequency spreading to the JTIDS terminal for antijam, low probability of exploitation and low probability of intercept operations. The SDU provides a pseudorandom code bit stream to the terminal to encrypt the message for TSEC.

b. Message Reception. The terminal accomplishes uncovering of the message (TSEC) with the position reference code stream obtained from the SDU. It then passes the message to the SDU for MSEC decryption and obtains the plain text message from the SDU for exchange with the host system.

c. Common Variable Mode (CVM). In the CVM, the terminal to generate the pseudorandom sequence for TSEC operations, and to provide MSEC, uses one cryptographic variable (key). The operator selects a network design and a single crypto variable logic label (CVLL) is assigned for both MSEC and TSEC operations. This is the common means of operation.

USN	KGV-8 (E2) KGV-8B
USAF	KGV-8A
USMC	KGV-8A and KGV-8C
USA	KGV-8B

Figure B-1. SDU Employment

d. Partitioned Variable Mode (PVM). In the PVM, the terminal to generate the pseudorandom sequence for encryption of the message (MSEC) uses one cryptographic variable (key). A separate cryptographic variable is used to generate the pseudorandom sequence for transmission of the message.

e. PVM Relay (Blind Relay). Messages received for PVM relay are TSEC-uncovered, error corrected and coded, and then TSEC-covered for retransmission. These messages are not MSEC decrypted.

4. Secure Data Unit Setup

The JTIDS terminal can use up to four pairs of crypto keys (today/next day), which reside in eight SDU memory locations. The SDU (KGV-8) provides—

a. Pseudorandom frequency-hopping pattern.

b. Pseudorandom noise-spreading encryption.

c. Pseudorandom jitter time (STD and P2SP packing modes).

d. Message encryption

5. Cryptographic Variable Logical Label

Each TADIL J network design has a network description that specifies the number and use of cryptographic variables used within the network design. Cryptographic variables are used to establish crypto nets and are assigned reference labels called CVLL. Circuits or groups of circuits called NPGs are established to operate by using predetermined MSEC and TSEC cryptographic variables. Each NPG is assigned two CVLLs during network design. The planned SDU location of the crypto keys corresponding to the CVLLs is also established for each network platform participant. The CVLL is a seven-bit number ranging from 1 to 127.

6. Cryptographic Net Isolation

Configuring the JTIDS terminal's cryptographic variables creates crypto net isolation between networks or network users. Differences in terminal loads isolate that terminal from all other terminals with differing crypto loads. Use of cryptographic variables to establish isolation of single or multiple units can provide NPG isolation, blind relays, multinetting of functions (frequency division multiple access), and multiple networks.

a. Blind Relays. Units designated as *blind relays* can receive and retransmit information on assigned NPGs, but are unable to decode the information. Decoding is accomplished by providing the TSEC key list to the relaying unit, but denying the relay unit the MSEC key list.

b. Multinetting. Several transmission waveform parameters, including the frequency-hopping pattern of a network, are pseudorandomly selected based upon the

encryption key. This allows two NPGs to use the same time slots because each NPG uses a different frequency-hopping pattern. Different frequency-hopping patterns ensure that, at any moment in time, the groups would not interfere with one another. This frequency multiple access expands system capacity beyond any single-terminal capacity.

c. Multiple Networks. When two or more user groups are geographically collocated, i.e., within line-of-sight, isolation between the groups can be achieved by using different crypto keys. This ensures that TADIL J units use different frequency-hopping patterns, even if each network uses the same TADIL J network design.

7. Daily Cryptographic Rekey Standard

The US and NATO adopted a convention that stipulates that Class 2 JTIDS terminals are to be rekeyed once a day. Class 2 JTIDS terminals can be loaded with crypto keys sufficient for two days of operation, with an automatic capability to roll over, i.e., switch from today's key to tomorrow's key at a preset time. Unless otherwise stipulated in the OPTASKLINK message, encryption devices are rekeyed at 2400 Zulu.

a. Cryptographic Period Designator (CPD). JTIDS Class 2 terminals have eight memory locations to store crypto keys in the SDU (KGV-8). These memory locations are numbered "0" through "7".

(1) For a normal (24-hour) crypto period, memory locations are assigned in pairs designated as "0 and 1", "2 and 3," "4 and 5," and "6 and 7." Accordingly, locations 0, 2, 4, and 6 represent one set of concurrently operating locations called the even locations and are given the CPD of "0." Locations 1, 3, 5, and 7 are referred to as the odd locations and are assigned the CPD of "1."

(2) To load two days' keys into the SDU, the operator must determine whether the key goes into the even location or the odd location. A convention has been accepted by the US and NATO which defines 1 January 1985 as an odd or O day. Each subsequent day is defined as odd or even based on this convention.

b. Cryptographic Rollover. At the end of a crypto period, all of the keys that have been in use, i.e., odd or even, are automatically erased in the SDU and the current CPD is changed. During the next crypto period, the terminal selects the complimentary set of keys in the other memory locations for the same time slot assignment. The CVLL used in the current and next crypto period is the same to permit operation across the crypto period boundary without a requirement to reinitialize time slot assignments.

8. Key Loading Devices

a. KYK-13 Electronic Transfer Device. A hand-carried, battery-operated electronic transfer device capable of storing up to six keys.

b. KOI-18 General Purpose Tape Reader. The KOI-18 is a battery-powered device that reads an eight-level punched tape and converts the information to a serial output that can be loaded into a KYK-13 or DTD.

c. LCU. A USN-unique device for loading specific SDU memory locations of the KGV-8 (E-2) and KGV-8A. It is used in conjunction with the KYK-13 transfer device.

d. Key Control Panel. A USA device similar to the LCU.

e. AN/CYZ-10 DTD. A hand-held portable computer used to store and transfer keys. The DTD can store up to 1,000 keys and is authorized for long-term storage. It can be used to transfer keys into other DTDs or directly into the KGV-8 (E-2) or KGV-8B. The DTD can accept black keys from a computer using JTIDS PC application software. A key load status log data base and an audit trail data base, internal to the DTD, automatically keep track of the different crypto keys loaded into and from the DTD. Either database can be reviewed by the DTD user or uploaded into a PC for storage and viewing.

Appendix C

NETWORK DESIGN FACILITIES

JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM NETWORK DESIGN LIBRARY

Headquarters US Army Forces Command
ATTN: AFOP-TJ
Building 1283
Anderson Way, SW
Fort McPherson, Georgia 30330-6000

Message Address: CDRFORSCOM GN/AFOP-JT// FT MCPHERSON

POC	DSN Phone	CommercialPhone	Electronic Mail
LtCoI Bayer or John Cary	367-4636	(404) 464-4636	bayerw@ftmcphsn-emh1.army.mil
Mr. Neil Hesser	367-3146	(404) 464-3146	hessern@ftmcphsn-emh1.army.mil
Mr. Steve Frolen	367-4744	(404) 464-4744	frolens@ftmcphsn-emh1.army.mil
FAX Nonsecure	367-3148	(404) 464-4608	

SERVICE NETWORK DESIGN FACILITIES

US Army
PEO AMD
P.O. Box 1500
ATTN: SFAE-AMD-TSD
Huntsville, AL 35807-3801

Message Address: PEO MISSILE DEFENSE //ALIISFAE-AMD-TSD-C4//
HUNTSVILLE AL 35807-3801

POC	DSN Phone	Commercial Phone	Electronic Mail
Duty phone	645-5398	(205) 955-5398	md.redstone.army.mil
FAX Nonsecure	645-4446	(205) 955-4446	

US Air Force
Headquarters Air Combat Command
AF JTIDS Network Design
XOYG
205 Dodd Blvd. Suite 101
Langley AFB, VA 23665-2789

Message Address: HQ ACC LANGLEY AFB, e-mail: af.jtids@langley.af.mil

POC	DSN Phone	Commercial Phone
MSGT David White	574-8328/29	(757) 764-8328/29
FAX Secure	574-8461	
FAX Nonsecure:	DSN: 574-8460	

US Navy
NCCOSC/NRaD
Code 331
53560 Hull Street
San Diego, CA 92152-5001

Message Address: NCCOSC/NRaD Div. Det, SAN DIEGO CA/452N45211451 2/I

POC	DSN Phone	Commercial Phone	Electronic Mail
Mr. Robert Nydam	553-0525	(619) 553-0525	nydam@manta.nosc.mil
Ms. Kelly Sobon	553-3887	(619) 553-3887	ksweeney@manta.nosc.mil
Mr. Dan Slack	553-3980	(619) 553-3980	
		(619) 294-8743	slack@nosc.mil
FAX Nonsecure		(619) 553-6165	

US Navy Center for Tactical Systems Interoperability (NCTSI) Code 21
53690 Tomahawk Drive Suite A125
San Diego, CA 92147-5082

Message Address: NCTSI SAN DIEGO CA//NO1//

POC	DSN Phone	Commercial Phone	Electronic Mail
CMD D.W. Daugherty	553-7332	(619) 553-7332	daughert@nosc.mil
Mr. Mike Gregory	553-7297	(619) 553-7297	gregory@manta.nosc.mil
LCDR David Leingang	553-7298	(619) 553-7298	liengang@manta.nosc.mil
LCDR Jesse Prothro	553-7223	(619) 553-7323	
Duty phone number	553-9327	(619) 553-9327	
FAX Secure	553-7294	(619) 553-7294	
FAX Nonsecure	553-9366	(619) 553-9366	

US Marine Corps
Marine Corps Tactical Systems Support Activity (MCTSSA)
Air Defense Systems Division (AD-09)
Marine Corps Base, Camp Pendleton, CA 92055-5171

Message Address: MCTSSA CAMP PENDLETON CA/ADSD/AD-0911

POC	DSN Phone	Commercial Phone	Electronic Mail
Mr. Daniel Nygren	365-2585	(760) 725-2585	daniel.nygren©mctssa.usmc.mil
Duty phone number	365-2617	(760) 725-2617	
FAX Nonsecure	365-9512	(760) 725-9512	

Appendix D

ARMY TACTICAL DATA LINK-1

1. General Description

Army Tactical Data Link-1 (ATDL-1) is a dedicated, point-to-point, duplex, digital data link employed to exchange real-time tactical data between a C2 land unit and a surface-to-air missile (SAM) system or between multiple SAM systems. Units that exchange data via ATDL-1 are designated supporting units (SUs).

2. Operational Characteristics

a. Communications Medium. ATDL-1 can be transmitted over landlines (wire or fiber optic cable), single-channel radios, or multichannel radios. Multichannel radios may be established within LOS, use troposcatter techniques for over-the-horizon communications, or employ satellite communications. Both ends of the ATDL-1 link must use a compatible communications system. US forces employ two basic communications systems: the direct current (DC) digital form and the quasi-analog form.

(1) The USMC tactical air operations center (TAOC) and battery command post (BCP), the Army Adaptable Surface Interface Terminal (ASIT) and joint TADIL A distribution system, and the Air Force control and reporting center (CRC) use the quasi-analog transmission design (TD), which uses TD 1089 or TD 1316 modulator/ demodulator (modems).

(2) USA air defense artillery (ADA) C2 systems operate using a quasi-analog form. Transmission and reception of ATDL-1 data, however, is accomplished using DC digital form and bulk encryption. Conversion is accomplished using an air defense interface to convert analog signals to digital signals (or vice versa) for transmission and receipt over the mobile subscriber equipment (MSE) net. Data transmissions are bulk-encrypted by the MSE. USA ADA units that directly interface with USAF or USMC C2 facilities provide the necessary communications equipment for both ends of the ATDL-1 link. MSE provide bulk encryption. NATO or allied agencies provide no point-to-point (line) encryption devices. USAF, USMC, or, when available, USA signal units must provide any required encryption devices where MSE connectivity cannot be established with USA ADA C2 systems due to unit locations, range, communications equipment (radio, satellite communications).

b. Communications Architecture. SAM units that use ATDL-1 can be linked together to form a chain (round-robin) or use a single forwarding unit as a hub with multiple units tied through the hub. The round-robin mode permits data to be circulated within three Hawk batteries using ATDL-1 formatted messages. It is used only in the absence of higher echelons. In the normal mode, ATDL-1 communications require a separate, dedicated link between each SU that simultaneously transmits and receives data on two channels—one dedicated transmit line and one dedicated receive line. When data messages are not being transmitted, each unit transmits a continuous standby signal to maintain time synchronization.

c. Data Encryption. ATDL-1 is normally operated in the secure mode using encryption devices provided by the tactical unit. The configuration of encryption devices at both ends of the ATDL-1 links must be compatible. Configuration of encryption devices may be accomplished by means of *strapping* (physical) or *initialization* (electrical). The configuration means used are dependent on the tactical data system (TDS) configuration. When MSE communications are used to provide the ATDL-1 link, secure mode operations are accomplished through bulk encryption of data transmissions by the MSE nodes. NATO or allied ADA C2 units provide the necessary equipment for data compatibility with USAF or USMC C2 facilities. When ATDL-1 is transmitted over landlines (wire or fiber-optic cable), single-channel radios, or multichannel radios, KG-30 (analog) or KG-84 (digital) single-channel data encryption devices are used. Both the KG-30 and KG-84 use two key cards; one for transmitted data and one for received data. Encryption keys for the KG-30, KG-84, and KG-94A/KG-194A are loaded with KYK-13 or KOI-18 devices.

d. Data Rates. ATDL-1 can be transmitted at 600, 1200, or 2400 bits per second (bps). If the quasi-analog transmission scheme is used, the audio signals are modulated using frequency shift keying.

e. Message Standard. ATDL-1 uses a B-series message and transmits the data in an 81-bit message frame, which consists of a start group, seven data groups, and a check group. ATDL-1 messages are defined in Military Standard (MIL-STD) 6013.

f. Coordinate Reference Convention. ATDL-1 units exchange positional information on units, tracks, strobes, and points by transmitting an *X* and a *Y* coordinate that is measured from the SU's system coordinate center (SCC). An SU's location is reported to other interfaced units by transmitting its *X* and *Y* coordinates measured from the data link reference point (DLRP). Once an SU's position is known, all positional information received from that SU is displayed in relation to the SCC.

g. Transmission Structure.

(1) Test Message. Once the ATDL-1 link has been initialized, a test message is transmitted. The continuing operational status of the link depends upon the exchange of the B-series ATDL-1 test message. This is a special message that is transmitted on a periodic basis by both ATDL-1 TDSs. Failure to receive this message for a specific period of time causes the ATDL-1 link to lose its operational status. When the link status drops to less than operational, all data exchange ceases except for the idle pattern (no information signal) and the ATDL-1 test message.

(2) Idling Condition. Once the link is established and no information is to be transmitted, the system automatically assumes an idling condition. The idle signal consists of alternating marks and spaces (1 0 1 0) and is continuously transmitted by each unit on the ATDL-1 link. This signal permits the two modems to remain in time synchronization and is interrupted only for transmission of a data message, termination of the link by operator action, or equipment malfunction. The modem indicates when a good idle pattern is received. This standby signal, or idle pattern, always starts with a (1) and ends with a (1) bit set to distinguish it from the beginning of a start code.

(3) Data Message. ATDL-1 uses an 81-bit message frame that consists of—

(a) Start Group - Nine bits; all set to (0).

(b) Data Group - Seven data groups of nine bits, each immediately following the start group, with the first bit of each data group set to (1) and the next eight bits consisting of the B-series message.

(c) Check Group - One check group completes each transmission frame and comprises one fixed bit, followed by eight check bits.

(4) Contiguous Data Message Grouping. B-series message-transmit rules in MIL-STD 6013 for ATDL-1 require transmission of multiple message sets. These message sets are transmitted as a contiguous set with no requirement for an idle pattern to be transmitted between messages. In a contiguous set, messages are transmitted back-to-back with no time delay between sets. Contiguous message sets occur with message start codes immediately following the last bit of the previous message's check group. It is therefore possible to have extended interruptions of the "no information signal" (idle pattern).

(5) Noncontinuous Data Message. A noncontinuous message set is a group of multiple messages separated by the insertion of a "no information signal," rather than transmission of messages back-to-back. When a "no information signal" (idle pattern) is inserted between messages, the "no information signal" always starts with a (1) bit and ends with a (1) bit.

h. Unit Address. Each unit reporting on the ATDL-1 link is assigned a unique station address. This address or TN is assigned in OPTASKLINK message and consists of two alpha characters that represent the station address and a three-digit octal number, 000 to 777. The first alpha character can be from *A* to *N*, *P* and *Q*. The second alpha character can be from *A* to *H*. A unit operating on multiple ATDL-1 links uses the same address for all links. An SU (fire unit) is assigned a track number (TN) by its reporting unit (RU).

(1) Restrictions. The address *AA000* is used to indicate no statement/unknown. *AA* and *QH* are illegal values for use as station addresses. If the address of the directly tied unit changes, the data link requires reinitialization.

(2) SUs. Units operating on a single ATDL-1 link are designated SUs. C2 units operating on multiple links (ATDL-1 and TADIL B) are designated forwarding reporting units (FRUs). Units operating on TADIL A and/or TADIL B and ATDL-1 are designated forwarding participating units (FPUs). For an FPU, a single two-digit address is used in place of the normal three-digit address for RUs. This restriction is imposed by the TADIL A data terminal set (DTS), which only allows a two-digit octal address from 01 to 76. The ATDL-1 address used by an FRU or FPU is required to be two alpha characters and three octal digits.

i. TNs. An ATDL-1 TN consists of two alphabetical characters and three octal digits. An ATDL-1 TN derives its two alphabetical characters from the station address of the unit initiating the track and a unique three-digit octal number derived from the TN block assigned to the unit. The Hawk BCP/platoon command post reserves TNs *XY001* through *XY006* for the following specific uses where *X* represents the values *A* to *N*, *P* and *Q*, and *Y*. represents the values *A* to *H*.

XY001 and XY002	reserved to report Hawk fire sections.
XY003 through XY004	used to report engaged electronic countermeasure emitters.
XY005 through XY006	used to report center bearings of high-power illuminator sector scan or center bearing of low-altitude simultaneous Hawk engagement zone.

(1) The unique address *AA000* is used to indicate no statement/unknown.

(2) The unique address *QH* is used only as a general address. *QH* is illegal for use as a station address.

j. Link Initialization.

(1) Full Data Transmit (FDT) Mode. Once the operator has designated an ATDL-1 link, it is physically activated. Upon activation, the ATDL-1 standby signal is transmitted along with the periodic ATDL-1 test message. The ATDL-1 test message contains the data link address of the transmitting unit, which provides a capability to perform a loop-back check of the communications path, data path, and encryption path. The FDT mode provides for automatic reporting of all tracks and information as soon as the link is operational.

(2) Limited Data Transmit (LDT) Mode. When an ATDL-1 SU requests to initialize its ATDL-1 link, it may be directed to enter the LDT mode as a means of resolving dual designations prior to activating its FDT mode. Only one unit shall be in LDT mode for a single link. This allows the reception of track reports but inhibits the transmission of local air tracks until an operator or system action is taken to switch to the FDT mode. The unit in the LDT mode shall begin transmitting its surveillance tracks after the operator has determined that all necessary correlations are complete, or a maximum time limit has elapsed since the transition to an operational link state.

(3) Loop-Back Check. ATDL-1 loop-back is performed by patching the transmit output of the ATDL-1 modem into the receive input of the ATDL-1 modem. When the ATDL-1 link is activated in the loop-back configuration, the modem receives its own signal, the ATDL-1 link is activated, and test messages are transmitted by the TDS. The TDS recognizes its data link address contained in the ATDL-1 test message and displays to the operator the status of the loop-back condition. Loop-back can be performed at various points throughout the ATDL-1 link and includes establishing loop-back at the system's own modem or switching the cable connection at the other end of the ATDL-1 link, i.e., at the remote TDS. This provides a positive means of isolating system problems.

(4) Automatic Link Initialization. Once valid test messages are received at both TDSs, automatic link initialization occurs. When required information elements have been exchanged, the link becomes operational. Data messages are then transmitted by both TDSs. Failure to receive an ATDL-1 test message for a specified time period causes the link to be removed from the operational status until a valid test message is received. This initiates automatic link reinitialization. The ATDL-1 test message is essential for maintaining an operational ATDL-1 link.

(5) Link States. ATDL-1 has two link states: normal and round-robin.

k. System Employment. USAF, USMC, NATO, and allied C2 and SAM units employ ATDL-1. Table D-1 provides the ATDL-1 capabilities and equipment of each Service system.

3. Planning and Operations

a. US Message Text Formats. Two US message text formats—the tactical operational data (TACOPDAT) message and the OPTASKLINK message—are used for planning operations. The data elements and data fields are contained in MIL-STD 6040

(1) TACOPDAT Message. Information required to establish air defense responsibilities in a tactical area and supplementary orders for a specific area of responsibility are published in TACOPDAT message.

(2) OPTASKLINK Message. Detailed instructions to establish tactical data link communications are distributed in the OPTASKLINK message. The OPTASKLINK message provides tasking, coordinating instructions, and technical parameters for the TDS and data and voice communications systems. The OPTASKLINK message uses the entry lists shown in Table D-2. For ATDL-1, sets 42 through 53 of the OPTASKLINK message are used. These sets were originally designed for TADIL B (Link-11B) but can be used to provide data for ATDL-1 link operations. See Table D-3.

b. Coordination Communications. Under tactical conditions, initial communication between two ATDL-1 units is normally established on single-channel tactical voice radios. These radios provide a means of engineering the communications path; i.e., aligning the directional antennas of the data radios used for ATDL-1 communications. Once multichannel circuits are established, ATDL-1 units begin the coordination function. This includes confirming the OPTASKLINK data in preparation for link initialization, coordinating link initialization over voice circuits, and monitoring the tactical situation. Voice circuits between ATDL-1 units include both engineering and tactical voice circuits.

c. Data Communications. ATDL-1 communications are normally transmitted over tactical radios. If a multichannel radio is used, a directional antenna is normally employed and aimed at the receiving antenna, either LOS, reflected off the troposphere, or relayed by an orbiting satellite. Communications personnel normally engineer ATDL-1 circuits. ATDL-1, when using multichannel radios or multiplexing to provide a duplex circuit for data exchange, provides additional channels that are normally available on data radios for voice communications between directly tied units. Once *directional* communications are established between two units, a voice channel is used to coordinate the initialization of data communications.

d. TDS. While directional communications are being established, the TDS is initialized with OPTASKLINK data and any unique system data required to establish data link communications and conduct operations. At this time, a system may perform internal loop-back checks to verify connectivity between the TDS, encryption equipment, and modems. Once tactical communications are established, the unit is ready to perform an *end-around loop-back*. This is a loop-back check of the entire communications path by patching the modem of the remote unit and receiving its own signal back at its own site. Each unit can perform this end-around loop-back check to adjust system levels and evaluate system performance.

Table D-1. ATDL-1 Systems

Nation	Service	Weapon System/Weapon	TADIL	Equipment
USA	Army	Army Air and Missile Defense Command	A, B, J, fighter data link (FDL), ATDL-1	Air defense system integrator
USA	Army	Brigade fire direction center	A, B, J, FDL, ATDL-1	ADSI
USA	Army	Battalion Patriot (MIM-104)	A, B, J, Patriot Air Defense Information Link (PADIL), ATDL-1	Information control center (AN/MSQ-116)
USA	Army	Battalion FAAD	FDL, B, J	Air battle management operations center (AN/TSQ-182)
USA	Army	Battalion FAAD	FDL, B, J	Air avenue command and control (AN/TSQ-182)
USA	Army	Battery FAAD	FDL	Command post (AN/TSQ-182)
USA	Marine Corps	Tactical air operations center	A, B, C, J, NATO Link-1, ATDL-1	AN/TYQ-23
USA	Marine Corps	Battery command post	ATDL-1	AN/MSW-21
USA	Air Force	Control and reporting element	A, B, C, J, NATO Link-1, ATDL-1	AN/TYQ-23
Denmark *		Hawk MIM-23A/B	NATO Link-1	
Egypt	Army	Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
France		Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
Germany *	Army	Hawk MIM-23A/B	B, ATDL-1, NATO Link-1	
Greece *		Hawk MIM-23A/B		
Iran	Army	Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
Israel	Army	Hawk MIM-23A/B		
Italy *		Hawk MIM-23A/B	B, ATDL-1, NATO Link-1	AN/TYQ-73
Japan		Hawk MIM-23A/B		
Jordan	Army	Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
Korea	Army	Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
Kuwait/Iraq	Army	Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
Netherlands *		Hawk MIM-23A/B	NATO Link-1	
Norway *	Army	NASAM/AMRAAM AIM-120 Hawk MIM-23A/B	NATO Link-1	
Portugal *			NATO Link-1	
Saudi Arabia		Hawk MIM-23A/B	B, ATDL-1	AN/TYQ-73
Spain *		Hawk MIM-23A/B	NATO Link-1	
Sweden		Hawk MIM-23A/B		
Taiwan		Hawk MIM-23A/B		
Thailand		Hawk MIM-23A/B		
Turkey *		Hawk MIM-23A/B	A, ATDL-1, NATO Link-1	
United Kingdom (UK)				

Note: NATO Air Defense Ground Environment (NADGE) participants denoted by *. France and the UK interface with NADGE.

Table D-2. OPTASKLINK Message Entry Lists

List Number	Title	List Number	Title
11	Location	137	Ship type
211	Interface unit designation	513	Aircraft type
551	Duty assignment	941	Data net operations
2506	Link duty		

Table D-3. OPTASKLINK Message Sets

Set	Description	Parameter
42	Link-11B	ATDL-1
43	Period	Start time Stop time
44	Duty	Unit designation Duties assigned to the unit
45	Link RU data	Unit designation Unit call sign RU/SU number TN block NATO track number root for unit reporting tracks Unit location
46	Link connectivity data	First RU/SU number Second RU/SU number Speed of data transmitted 600/1200/2400 bps Type of connectivity Name of cryptographic equipment
47	Unit filter	Unit responsible for active filter Filter direction: transmit or transmit/receive Type of filter area Track filter environment Track filter identity Track filter special conditions: special processing unit/exercise
48	Area	Geographic area of filter
49	Circle	Center of circular filter
50	Rectangle	Location of first corner of rectangular filter Location of second corner of rectangular filter Location of third corner of rectangular filter Location of fourth corner of rectangular filter
51	Boundary	Filter area boundary term Lower limit of filter boundary Upper limit of filter boundary
52	General text	Link filter details Free text
53	Link frequencies	Purpose of link establishment Frequency or control unit designator Radio frequency Priority of circuit Code for specific mission designator Intended purpose of frequency; data/voice

e. Link Operations. Once ATDL-1 data communications are established, the encryption device is prepared. This synchronizes the time signal between units. When the link is activated, the input/output channel of the TDS is initialized, which transmits the initial sequence of messages. The successful exchange of these messages triggers the transmission of track reports, which initializes the two-way exchange of data between SUs. Track data is now exchanged between the systems, depending on the whether the systems are in the FDT or LDT mode. Only one unit shall be in the LDT mode for a single link. The two-way data exchange is maintained as long as valid test messages are exchanged.

Appendix E

NORTH ATLANTIC TREATY ORGANIZATION LINK-1

1. GeneralDescription

NATO Link-1 is a point-to-point, digital data link employed for the automatic data exchange of real-time tactical air defense and control information between land-based air defense and aircraft control units. NATO Link-1 can be used as a one way (simplex) or two-way (duplex) link.

2. Operational Characteristics

a. Communications Medium. NATO Link-1 is normally transmitted over landlines (telephone) but can be transmitted over multichannel radios. Multichannel radios may be established within LOS, use troposcatter techniques for over-the-horizon communications, or employ satellite communications. Both ends of the link must use a compatible communications system.

(1) USMC and USAF TDSs and USN buffers use differential frequency shift keying (DFSK) with transmission design 1316 modulator/demodulator (modems) to interface on NATO Link-1.

(2) Point-to-point (line) encryption devices are not normally used with NATO Link-1, though standards are provided in Annex A of Standardization Agreement (STANAG) 5501.

b. Communications Architecture. NATO Link-1 units are normally fixed land-based centers that are assigned a geographic area of responsibility called an area of operational interest (AOI). Within the AOI, a track production area (TPA) is established. Information exchange is between two adjacent centers for the purpose of cross-telling tracks that transit from one AOI to another. To prevent TPA overlap, a track continuity area (TCA) is established. A TCA is a belt on either side of the common boundary of two TPAs of adjacent centers or some other area positioned to ensure that continuity of tracking is established. All tracks within the TCA are automatically transmitted (cross-told) with the exception of:

(1) Tracks being cross-told in the opposite direction.

(2) Tracks whose cross-telling is inhibited either locally or by request message.

(a) This employment concept is normally supported by a communications architecture using fixed landlines that provide both voice and data communications between adjacent centers. Tactical multichannel radios can be used in place of fixed landlines.

(b) NATO Link-1 communications require a separate, dedicated link between each RU, which simultaneously transmits and receives data on two channels—one dedicated transmit and one dedicated receive line for duplex operations. When data messages are not being transmitted, each unit transmits a continuous standby signal

(idling period) to maintain time synchronization. Land-based USAF and USMC TDSs have a NATO Link-1 capability and can link directly with a NATO site. USN mobile TDSs (ships and aircraft) operate on TADIL A, TADIL J, and Link-14 and use a ground based buffer to forward data to NATO Link-1 or TADIL B.

(c) Airborne early warning (AEW) aircraft are integrated into NATO Link-1 through a data forwarder and have AEW ground target areas designated in which air defense information is forwarded from a ground air defense site to the AEW aircraft.

c. Data Encryption. NATO Link-1 data is not normally encrypted and is normally exchanged between NATO centers over dedicated telephone lines. Due to this limitation, US systems that forward TADIL A, TADIL B, or TADIL J data to NATO Link-1 are required to activate a special processing indicator (SPI) filter to ensure classified data is not compromised when forwarded to NATO Link-1.

d. Data Rates. NATO Link 1 is operated at a basic speed of 1200 bps with alternate speeds of 600 and 2400 bps using a DFSK modulated serial bit stream with a synchronous transmission mode. Phase shift keying may be used by mutual agreement between two adjacent sites.

e. Message Standard. NATO Link-1 uses S-series messages and transmits data in pairs as a single 98-bit data message. Messages fall into various functional groups:

(1) Air surveillance.

(2) Strobe information.

(3) Management.

(4) Test.

(5) Frame filler.

f. Information Exchange Scheme. NATO Link-1 units exchange positional information on strobes, tracks, and points by transmitting X and Y coordinates. Measurements are made with respect to a system coordinate center agreed upon between the transmitting site and the receiving site, if authorized by the proper national configuration manager. The transmitting site transmits information referenced to the system coordinate center of the specific Link-1 interface. Normally a NATO Link-1 site uses the center of its data storage area (DSA) as the coordinate center. A DSA is the maximum area within which an automated air defense facility is able to store tracks in its computers. The DSAs of adjacent air defense facilities must overlap one another.

g. Track Data. Track data is assigned priority for transmission (telling).

h. NATO Track Numbers (NTNs). NTNs consist of two alpha characters and three octal numbers. The alpha characters are assigned from A, E, G, H, J, K, L and M, and the three digit octal numbers range from 001 to 777. When tracks with non-NTNs are forwarded to NATO Link-1, the forwarding unit or buffer is normally assigned a TN block using the prefix AA. This TN prefix indicates to the NATO Link-1 units that the track source is from a data forwarder.

i. Transmission Structure.

(1) Idling Condition. When no information is to be transmitted, the system automatically assumes an idling condition by transmitting a continuous series of binary ones. This signal, or idle pattern, always ends with a (1) bit set to distinguish it from the beginning of a start code; i.e., eight zeros. Transmission of information can be resumed at any time by transmitting a start code. An idling period may occupy an integral number of bit positions.

(2) Data Message. NATO Link-1 uses a 49-bit message that consists of the following:

(a) Start group - One start group begins a message frame. It contains 8 start bits, all set to (0).

(b) Data Group - Fourteen data groups of 8 bits each include 1 single, fixed bit to ensure synchronism, followed by 7 information bits.

(c) Check Group - One check group completes the transmission frame. It contains 1 single, fixed bit, followed by 6 check bits, followed by 1 final bit that completes the transmission frame. This results in an information message of 49 bits comprised of a 6-bit label and 43 information bits.

(3) Message Frame. A message contains 98 message bits divided into two messages, each of which is divided into seven message groups of 7 bits each.

(4) Transmission Frame. A transmission frame consists of 128 transmission bits divided into 16 transmission groups of 8 bits each.

(5) NATO Link-1 Test Message. Label 101110 identifies a test message. It is generated by repeating a pattern consisting of the 6 label bits and a value of zero in bit position 7 in each message group. The test message is transmitted in pairs every 10 seconds (+ or -1 second) each transmit cycle.

j. Link Transmission Cycle. Under normal conditions (all tracks can be told during the cycle), the information on each track is updated at a fixed rate. This rate may be the same as the radar antenna scan rate or 10 seconds. When there are more tracks to be told than can be accomplished in this fixed cycle, the cycle is extended to ensure telling of all tracks with mandatory transmission.

k. Multiple Transmission Operation. The message source synchronizes and staggers start groups on various circuits when necessary to use a number of circuits in parallel between NATO centers. This permits the transfer of tracks within one 10-second cycle and permits interleaved operation of data processing equipment.

l. System Employment. NATO Link-1 is used by the USN, USMC, USAF, and NATO centers. NATO centers include NATO Air Defense Ground Environment, United Kingdom Air Defense Ground Environment, Spanish Air Defense System, Italian System for Point Air Defense, and German Air Defense Ground Environment sites. NATO Link-1 capabilities and the equipment of each US service system are provided in Table E-1.

Table E-1. NATO Link-1 Capabilities

Nation	System	Tactical Data System	Equipment	Link Capabilities
Belgium	NATO Air Defense Ground Environment	Sector Operations Center		
France	Systeme de Traitement et Representation des Informations de Defense	AWACS		Link-1, Link-11, AEGIS
Germany	German Air Defense Ground Environment	Sector Operations Center		Link-1, Link-11, Link-11B, AEGIS
Iceland	Islandic Air Defense System	Sector Operations Center		Link-1, Link-11
Italy	System for Point Air Defense			Link-1, Link-11
Norway	NATO Air Defense Ground Environment	Sector Operations Center		
Netherlands		Sector Operations Center		Link-1, Link-11
Portugal	Portuguese Air Command and Control System	Sector Operations Center		
Spain	Spanish Air Defense System	Sector Operations Center		
UK	Improved United Kingdom Air Defense Ground Environment	Sector Operations Center		Link-1, Link-11, Link-16, United Kingdom AEGIS
US	Joint Tactical Air Operations	USAF-AOC USAF- CRC/CRE USMC-TACC USMC-TAOC USN- Ship Shore Ship Buffer	AN/TYQ-23 AN/TYQ-51 AN/TYQ-23	TADIL-A, TADIL-B, NATO Link-1 TADIL-A, TADIL-B, TADIL-C, ATDL-1, NATO Link-1, TADIL-A, TADIL-B, NATO Link-1 TADIL-A, TADIL-B, TADIL-C, ATDL-1, NATO Link-1 TADIL-A, NATO Link-1 An ADSI is used in the USAFE CAOC at Vicenza, Italy. They receive an IJMS feed from an AF CRC.

m. NATO Link-1 Operation. Each unit reporting on NATO Link-1 is assigned a unique address. This address, or TN, is assigned in the OPTASKLINK message and is two alpha characters and three octal numbers ranging from 001 through 777. A unit operating on multiple NATO Link-1 interfaces uses the same address for all NATO Link-1 links. Units operating on a single NATO Link-1 are designated RUs. Units forwarding between TADIL A, TADIL B, or TADIL J and NATO Link-1 are designated forwarding RUs. Additionally, the USN employs a land-based buffer that forwards between TADIL A or TADIL J and NATO Link-1 or TADIL B. Buffer units forward data

to and from NATO Link-1 and are designated FPUs in US terminology. The TN assigned to a track by a NATO unit specifies track origin as the two-character alphabetical code.

(1) NATO Link-1 Link Initialization. Once an operator designates a NATO Link-1, it is physically activated. Upon activation, the NATO Link-1 test message is transmitted.

(2) Loop-Back Check. NATO Link-1 loop-back is performed by patching the transmit output of the NATO Link-1 modem into the receive input of the NATO Link-1 modem. When the NATO link is activated in the loop-back configuration, the modem receives its own signal and the NATO link is activated. Loop-back can be performed at various points throughout the NATO link. It includes establishing loop-back at the system's own modem, or switching the cable connection at the other end of the NATO link; i.e., at the remote TDS. This provides a positive means of isolating system problems.

(3) Link Initialization. Once the TDS receives valid test messages, link initialization occurs and both TDSs transmit data messages.

n. References. NATO Standing Agreements (STANAG) define the message standard and provide the protocols required for message exchange. NATO allied data processing publications provide standing operating procedures. Since these are dynamic publications, the operator should procure the most recent prior to NATO operations.

3. Planning and Operations

Information required to establish NATO Link-1 communications between centers is distributed in the OPTASKLINK message. The message provides information on the TDS, data filtering, data, and voice communications parameters. For NATO Link-1 sets 12 through 23 of the OPTASKLINK message are used. See Table E-2.

a. Coordination Communications. Under tactical conditions, initial communications between two NATO Link-1 units is normally established on single-channel tactical voice radios. These radios provide a means of engineering the communications path; i.e., aligning the directional antennas of the data radios used for NATO Link-1 communications. Once a multichannel circuit is established, NATO units coordinate over voice circuits to monitor the tactical situation and begin the coordination function, which confirms the OPTASKLINK data in preparation for link initialization. Voice circuits between NATO centers include both engineering and tactical voice circuits.

b. Data Communications. NATO Link-1 communications are normally transmitted over landlines (telephone circuits). If a multichannel radio is used, a directional antenna is normally employed. It is aimed at the receiving antenna, whether LOS, bounced off the troposphere, or relayed by an orbiting satellite. Communications personnel normally engineer NATO Link-1 circuits. When using NATO Link-1 multichannel radios or multiplexing for a duplex circuit data exchange, engineers should provide additional channels, which are normally available on radios for voice communications between directly tied NATO centers. Once communications are established between two units, voice coordination is used to initialize data communications.

Table E-2. OPTASKLINK Message Entry Lists

Set	Description	Parameter
12	Link-1	1
13	Period	Start time Stop time
14	Duty unit designation	Duties assigned to the unit
15	Link RU data	Unit designation Unit call sign RU number TN block NTN root for unit reporting tracks Unit location
16	Link connectivity data	First RU number Second RU number Speed of data transmitted 600/1200/2400 bps Type of connectivity
17	Unit filter	Unit responsible for active filter Filter direction: transmit or transmit/receive Type of filter area Track filter environment Track filter identity Track filter special conditions: SPI/exercise
18	Area	Geographic area of filter
19	Circle	Center of circular filter
20	Rectangle	Location of first corner of rectangular filter Location of second corner of rectangular filter Location of third corner of rectangular filter Location of fourth corner of rectangular filter
21	Boundary	Filter area boundary term Lower limit of filter boundary Upper limit of filter boundary
22	General text	Link filter details Free text
23	Link frequencies	Purpose of link establishment Frequency or control unit designator Radio frequency Priority of circuit Code for specific mission designator Intended purpose of frequency; data/voice

c. TDS. While directional communications are being established, the TDS is initialized with OPTASKLINK data and any unique system data required to establish data link communications and conduct operations. At this time, a system may perform internal loop-back checks to verify connectivity between the TDS, encryption equipment, if used, and modems. Once communications are established, the unit is ready to perform an end-around loop-back, which is a loop-back check of the entire communications path. This is accomplished by patching the modem of the remote unit and ensuring that it receives the signal back at its site. Each unit can perform this end-around loop-back check to adjust system levels and evaluate system performance.

Appendix F

QUICK REFERENCE GUIDE

This guide contains published service-, joint-, and contractor-developed reference manuals, handbooks, guides, and pamphlets. Some are still in draft stages. The guide also contains the addresses of web sites that provide additional information.

1. Reference Documents

Publication Title	*Air Force Concept of Link-16 Employment (COLE)*		
Publisher	USAF Operational Interoperability Requirements Group, AC2ISRC/C2FT, Langley AFB, VA	**Date**	October 1997 Final Version Revision:
Point of Contact	ASC2A/C2FT, Langley AFB, VA		
Executive Summary (Abstract)	This document presents the COLE for AI, CAS, DCA, OCA, and SEAD missions. The concept discusses information that will be exchanged, how it will be used to support each mission, and the data link architecture that will be employed.		
Abbreviated Table of Contents	Employment OCA DCA AI SEAD and CAS Strike Packages Intelligence Data Link Architecture Integration		
Working Group Opinion			

Publication Title	*Joint Multi-Tactical Digital Information Link (TADIL) Operating Procedures* (JMTOP)*		
Publisher	CJCSM 6120.01B	**Date**	15 July 1999 Revision: B
Point of Contact	Mr. Ken Bray, Joint Interoperability and Engineering Organization (JIEO) Commercial: (703) 735-3525 Fax: (703) 735-3256 e-mail: brayk@ncr.disa.mil		
Executive Summary (Abstract)	This manual provides planning guidance and operating procedures for deployment of Joint TADIL C4I systems within DOD.		
Abbreviated Table of Contents	Chapter 1 Introduction Chapter 2 Joint TADIL Interface Chapter 3 Responsibilities for Interface Chapter 4 Interface Planning Chapter 5 Interface Operating Procedures Chapter 6 Air Control Procedures Chapter 7 Interface Training Procedures Appendix A Classified Supplement Appendix B OPTASKLINK Message Summary Appendix C TADIL A Appendix D TADIL J Appendix E TADIL B Appendix F IJMS Message Specs Appendix G TADIL C Appendix H ATDL-1		
Working Group Opinion	A comprehensive reference manual tailored to the ICO position. Highly recommended for anyone desiring in-depth information pertaining to JMTOP.		

Publication Title	MIL-STD 6016, *DOD Interface Standards, TADIL J Message Standard*		
Publisher	JIEO	**Date**	7 February 1997 Revision:
Point of Contact	Mr. Ken Bray (JIEO) Commercial: (703) 735-3525 Fax: (703) 735-3256 e-mail: brayk@ncr.disa.mil		
Executive Summary (Abstract)	Describes approved standards to achieve TADIL J compatibility and interoperability between C3 systems and equipment of US military forces employed or intended to be employed in joint tactical operations. This publication is complemented by CJCSM 6120.01, *JMTOP,* which provides for planning and common procedures to be used by forces in the joint tactical environment using TADIL J as the basis for information exchange.		
Abbreviated Table of Contents	Chapter 1 Introduction Chapter 2 General Requirements Chapter 3 Definitions Chapter 4 General Requirements Chapter 5 Detailed Requirements for TADIL J Appendix A Minimum Implementation Appendix B Data Element Dictionary Appendix C Data Forwarding Appendix D System Implementation Appendix E Interface Computer Program Repository		
Working Group Opinion	Highly technical document designed for J-series TADIL message implementation programmers/coders.		

Publication Title	*Joint Tactical Air Operations (JTAO) Interface Interoperability Handbook* (Confidential)		
Publisher	US Forces Command (FORSCOM)	**Date**	October 1995 Revision:
Point of Contact	AFOP-JT, Fort McPherson, GA 30330-6000 DSN: 367-4606 Commercial: (404) 752-4606		
Executive Summary (Abstract)	This handbook provides system operators with technical parameters and tactical procedures for exchange of real-time data via a TADIL. These procedures are employed in training, exercises, and combat		
Abbreviated Table of Contents	Section 1 Interface Management and Coordination Section 2 JTAO Interface Systems and Capabilities Section 3 Data Link Operating Procedures Section 4 Data Link Interface Operator Fidelity Drills Section 5 Data Link Digital Messages Section 6 JTIDS Section 7 Joint Theater Missile Defense		
Working Group Opinion			

Publication Title	*Joint Tactical Data Link Management Plan*		
Publisher	DOD Assistant Secretary of Defense for C3I	**Date**	6 June 1996 Revision:
Point of Contact	Dr. Charles Dunhan, Chairman TDLWG DISA/JIEO		
Executive Summary (Abstract)	To provide warfighters with improved battlespace SA through standardized tactical C4I data links.		
Abbreviated Table of Contents	Chapter 1 Overview Chapter 2 Policy Directive Chapter 3 Capabilities Assessment Chapter 4 Data Link Migration and Adoption Chapter 5 Summary and Recommendations Appendixes		
Working Group Opinion	This document sets forth DOD policy on tactical data links. The policy emphasizes getting away from many unique noninteroperable data links to a common joint tactical data link based on the J message (JTIDS) standard		

Publication Title	Navy Pamphlet on *JTIDS*		
Publisher	Naval Command, Control, and Ocean Surveillance Center, RDT&E Division, San Diego, CA 92152-5001	**Date**	Revision:
Point of Contact			
Executive Summary (Abstract)	An entry-level guide for those with no knowledge of JTIDS.		
Abbreviated Table of Contents	Chapter 1 What is JTIDS Chapter 2 How JTIDS is used by the Navy Chapter 3 TADILs and Host Systems Chapter 4 The Navy JTIDS Program		
Working Group Opinion	A pocket-size pamphlet. Good for orienting complete novices.		

Publication Title	*Understanding Link-16: A Guidebook for New Users*		
Publisher	PMW/PMA 159/LOGICON/US Navy Center for Tactical Systems Interoperability	**Date**	September 1996 Revision: 1
Point of Contact	FORSCOM Joint Interoperability Division URL: www.forscom.army.mil/interop LOGICON - (800) 274-1330 or (619) 597-7150		
Executive Summary (Abstract)	An in-depth source to understanding the equipment, signal structure, communications protocol, and operational considerations of Link-16.		
Abbreviated Table of Contents	Chapter 1 Introduction to Link-16 Chapter 2 Shipboard Link-16 Equipment Chapter 3 Airborne Link-16 Equipment Chapter 4 Messages and Interfaces Chapter 5 Building the JTIDS RF Signal Chapter 6 Structuring the Link-16 Network Chapter 7 Link-16 Operations		
Working Group Opinion	Book and compact disc are the same! A great reference manual for the more informed user. Written for the Navy's shipboard and airborne platforms, but can be related to multi-service use.		

Publication Title	*Understanding TADIL Planning and Operations:* *A Guidebook for Operators, Planners, and Managers*		
Publisher	LOGICON/Tactical Systems Division, FORSCOM/NCTSI	**Date**	Revision: October 1996
Point of Contact	(619) 597-7150/(800) 274-1330 FAX: (619) 552-1021 e-mail: guidebook@logicon.com		
Executive Summary (Abstract)	Guidebook for reference and review of the operational aspects of TADILs A, B, C, and J, including planning and execution.		
Abbreviated Table of Contents	Chapter 1 TADIL Interface Chapter 2 Voice Nets Chapter 3 Personnel Responsibilities Chapter 4 Planning Chapter 5 Execution Chapter 6 Self Reporting Chapter 7 Reporting Tracks Chapter 8 Reporting Reference Points, Lines, and Area Chapter 9 Information Management Chapter 10 Intelligence Reporting Chapter 11 USW Chapter 12 EW Operations Chapter 13 WC Chapter 14 Training Appendixes: TADIL A platforms Acronyms and Abbreviations Glossary, Index		
Working Group Opinion	Fourth book in LOGICON TADIL series (Link 4A, Link 11, Link 16). A 400-page detailed introduction for all TADILs (A, B, C, J). Heavy in pictures to aid in understanding. Cannot be read in one sitting.		

Publication Title	*USMC Tactical Data Systems Reference Guide*		
Publisher	Marine Corps Systems Command C4I Directorate, Quantico MCTSSA Headquarters Interoperability Office Camp Pendleton, CA LOGICON Communications Technology Group	**Date**	September 1999 Revision: Version 5.2
Point of Contact	USMC SYSCOM, C4I Directorate, Quantico, VA MCTSSA Headquarters Interoperability Office, Camp Pendleton, CA LOGICON (619) 597-7243/(540) 657-4511		
Executive Summary (Abstract)	Guidebook for reference and review of the operational aspects of TADILs A, B, C, and J, including planning and execution.		
Abbreviated Table of Contents	Types of data links/capabilities TDSs/capabilities Types of message series US and NATO references Glossary		
Working Group Opinion			

Publication Title	*F/A-18 TADIL J Interoperability Reference Book*		
Publisher	Naval Air Warfare Center Aircraft Division Patuxent, MD	**Date**	1997 Revision:
Point of Contact	Rich Simchak (30l) 757-0723		
Executive Summary (Abstract)	Compilation of TADIL-J system information from the USN F/A-18 project office; used as an aid to compatibility/interoperability.		
Abbreviated Table of Contents	Information on each current TADIL-J player unit type.		
Working Group Opinion	Good TADIL-J reference with emphasis on non-C2 implementation differences available to government agencies, including mobile training.		

Publication Title	OPNAV INST C3120.44, *TADIL Standard Operating Procedures*		
Publisher	Chief of Naval Operations (N62)	**Date**	1997 Revision: Change 1
Point of Contact	NCTSI		
Executive Summary (Abstract)	Provides Navywide standard operating procedures for TADILs A, C and J. Complete initialization, operating, and troubleshooting information; some architecture planning information; limited techniques; discussion of platform-unique capabilities and limitations.		
Abbreviated Table of Contents			
Working Group Opinion	Very well done operator and maintainer publication. Accurate but limited discussion of techniques and management procedures. Very limited joint information.		

Publication Title	*Link 16 Communications Planning Users Guide*		
Publisher	PMW 159 Naval Command, Control and Ocean Surveillance Center RDT&E Division Warminster, PA 18974	**Date**	1 November 1998 Revision:
Point of Contact	PMW 159 (703) 602-4335		
Executive Summary (Abstract)	A quick-reference source for Link-16 planning and writing of OPTASKLINK (16)		
Abbreviated Table of Contents	Section 1 Network Design and Naming Convention Section 2 OPTASKLINK Message Preparation and Assignments Section 3 Network Selection and Assignment Section 4 Participant's Assignments Section 5 Participant's Roles Section 6 Network Descriptions		
Working Group Opinion	Well written and easily readable. Examples and "how-to" sections ensure full comprehension. Reasonably simple to complex in detail. Recommended for all knowledge levels		

2. Web Sites Addresses

Organization	URL
DISA TADIL Web Server	http://www-tadil.itsi.disa.mil/welcome.htm
DISA Link 16 Home Page	www.itsi.disa.mil
FORSCOM MAJIC	www.forscom.army.mil/interop/
Joint Network Design Library	www.forscom.army.mil/interop/JNDL/JNDL_index.htm
Link 16 Fleet Support Site	http://link16.nosc.mil (For access password: link16@spawar.navy.mil)
TACS on the Net, USAF JTIDS	www.totn.langley.af.mil
USAF Link-16 Integration Home Page	www.hanscom.af.mil/esc-dia/link16.htm
US Navy Center for Tactical Systems Interoperability	www.nctsi.navy.mil

REFERENCES

Joint

CJCSM 6120.01A, *Joint Multi-Tactical Digital Information Link Operation Procedures (JMTOP),* 24 October 1997.
Military–Standard (MIL-STD)-6016, *DOD Interface Standards, TADIL J Message Standard,* 7 February 1997.
Joint Tactical Air Operations (JTAO) Interface Interoperability Handbook, October 1995.
Department of Defense, *Joint Tactical Data Link Management Plan (JTDLMP),* 6 June 1996.

Marine Corps

USMC Tactical Data Systems Reference Guide Version 5.2, September 1999.
F/A-18 TADIL J Interoperability Reference Book.

Navy

Navy JTIDS Pamphlet.
Understanding Link-16, A Guidebook for New Users, September 1996.
Understanding TADIL Planning and Operations, A Guidebook for Operators, Planners and Managers, October 1996.
OPNAV INST C3120.44, *TADIL Standard Operation Procedures (TSOP).*
Link 16 Communications Planning Users Guide, 1 November 1998.

Air Force

Air Force Concept of Link-16 Employment (COLE) (DRAFT), October 1997.

GLOSSARY

PART I – ABBREVIATIONS AND ACRONYMS

A

AADC	area air defense commander
ABCCC	airborne battlefield command and control center
AC2ISRC	Aerospace Command and Control, Intelligence, Surveillance, and Reconnaissance Center
ACDS	advanced combat direction system (formerly NTDS)
ADA	air defense artillery
ADSI	air defense systems integrator
AEGIS	Airborne Early Warning Ground Environment Integration Segment
AEW	airborne early warning
AF	Air Force
AFAPD	Air Force Application Program Development
AFB	Air Force base
AFTTP	Air Force tactics, techniques, and procedures
AI	air interdiction
AIC	air intercept control
ALSA	Air Land Sea Application
AOC	air operations center
AOI	area of operational interest
ARTC	Airborne Early Warning Ground Environment Integration Segment Training and Readiness Center
ASCIET	All Services Combat Identification Evaluation Team
ASIT	adaptable surface interface terminal
ATDL–1	Army Tactical Data Link-1
AW	air warfare
AWACS	Airborne Warning and Control System

B

BCP	battery command post
BP	battery pack
bps	bits per second

C

C2	command and control
C2P	command and control processor
C2W	command and control warfare
C3	command, control, and communications
C3I	command, control, communications, and intelligence
C4I	command, control, communications, computers, and intelligence
CA	California
CAS	close air support
CDS	computer display system
CG	guided missile cruiser

CJCSI	Chairman, Joint Chiefs of Staff Instruction
CJCSM	Chairman, Joint Chiefs of Staff Manual
COLE	concept of link employment
CPD	cryptograhic period designator
CRC	control and reporting center
CRE	control and reporting element
CSAR	combat search and rescue
CTP	consistent tactical picture
CV	aircraft carrier
CVLL	crypto variable logic label
CVM	common variable mode
CVN	aircraft carrier (nuclear propulsion)

D

D	dimensional
DC	direct current
DCA	defensive counterair
DDP	digital data processor
DDPG	data display processing group
DFSK	differential frequency shift key
DISA	Defense Information Systems Agency
DJRU	dedicated Joint Tactical Information Distribution System relay unit
DL	data link
DOD	Department of Defense
DPG	digital processing group
DSA	data storage area
DSN	defense switching network
DTD	data transfer device
DTG	date time group
DTS	data terminal set

E

ECM	electronic countermeasures
EPLRS	Enhanced Position Location System
ES	electronic support
EW	electronic warfare

F

FAA	Federal Aviation Administration
FAAD	forward area air defense
FDL	fighter data link
FDT	full data transmit
FJU	forwarding Joint Tactical Information Distribution System unit
FJUA	forwarding Joint Tactical Information Distribution System unit – TADIL J to TADIL A
FM	frequency modulation; field manual
FORSCOM	US Army Forces Command
FPU	forwarding participating unit

FRU forwarding reporting unit
FU forwarding unit

G

GBDL ground based data link
GEOGRID geodetic grid
GPS Global Positioning System

H

HF high frequency
HIT Hughes improved terminal
HMMWV high-mobility multipurpose wheeled vehicle

I

ICC information coordination center
ICO interface control officer
IDM improved data modem
IEJU initial entry Joint Tactical Information Distribution System Unit
IFF identification friend or foe
IJMS interim Joint Tactical Information Distribution System message standard
IOC initial operational capability
IU interface unit

J

JDN joint data network
JDS Joint Tactical Information Distribution System deconfliction server
JFACC joint force air component commander
JFC joint force commander
JICO joint interface control officer
JIEO Joint Interoperability and Engineering Organization
JM Joint Tactical Information Distribution System module
JMTOP Joint Multi-Tactical Digital Information Link Operating Procedures
JNDL Joint Tactical Information Distribution System Network Design Library
JSTARS Joint Surveillance Target Attack Radar System
JROC Joint Requirements Oversight Council
JTAO Joint Tactical Air Operations
JTF joint task force
JTIDS Joint Tactical Information Distribution System
JU Joint Tactical Information Distribution System unit

K

kbps kilobits per second
KCP key control panel
kHz kilohertz

L

LCU	load control unit
LDT	limited data transmit
LHA	amphibious landing ship, assault
LHD	amphibious landing ship, dock
LOS	line of sight

M

MACCS	Marine Air Command and Control System
mbs	megabits per second
MCCDC	US Marine Corps Combat Developments Command
MCM	multi-command manual
MCTSSA	Marine Corps Tactical System Support Activity
MHz	megahertz
MIDS	Multifunctional Information Distribution System
MIL-STD	military standard
MM	mission management
MSE	mobile subscriber equipment
MSEC	message security
MTTP	Multi-Service tactics, techniques, and procedures

N

NADGE	North Atlantic Treaty Organization Air Defense Ground Environment
NATO	North Atlantic Treaty Organization
NC	navigation controller
NCS	net control station
NCTSI	US Navy Center for Tactical Systems Interoperability
NDF	network design facility
NDL	network design load
NICP	network interface computer program
NPG	network participation group
NPS	network participation status
NTDS	naval tactical data system
NTN	North Atlantic Treaty Organization track number
NTR	net time reference
NWDC	Navy Warfare Development Command

O

OCA	offensive counterair
OIC	officer-in-charge
OPR	office of primary responsibility
OPSPEC	operation specification
OPTASKLINK	operational tasking data link

P

PADIL	phased-array tracking to intercept of target digital information link

PATRIOT	phased-array tracking to intercept of target
PC	personal computer
PKT	picket station
POC	point of contact
PPLI	precise participant location and identification
PU	participating unit
PVM	partitioned variable mode

R

R-C	receipt-compliance
RELGRID	relative grid
RELNAV	relative navigation
RF	radio frequency
R/T	receiver/transmitter
RTT	round trip timing
RTT-B	round trip timing-broadcast
RU	reporting unit

S

SA	situational awareness
SADL	situational awareness data link
SAM	surface-to-air missile
SCC	system coordinate center
SDU	secure data unit
SEAD	suppression of enemy air defenses
SICP	subscriber interface computer program
SINCGARS	single-channel ground and airborne radio system
SPI	special processing indicator
STANAG	standardization agreement
STN	system track number
STW	strike warfare
SU	supporting unit
SUW	surface warfare

T

TACC	tactical air command center
TACOPDAT	tactical operational data
TACS	Theater Air Control System
TADIL	tactical digital information link
TAOC	tactical air operations center
TAOM	tactical air operations module
TCA	track continuity area
TD	transmission design
TDLWG	TADIL J Working Group
TDMA	time division multiple access
TDS	tactical data system
TN	track number
TPA	track production area

TQ	track quality
TRADOC	US Army Training and Doctrine Command
TSDF	time slot duty factor
TSEC	transmission security
TTP	tactics, techniques, and procedures

U

UHF	ultrahigh frequency
US	United States
USA	United States Army
USAF	United States Air Force
USJFCOM	United States Joint Forces Command
USMC	United States Marine Corps
USN	United States Navy
USW	undersea warfare

V

VA	Virginia
VHF	very high frequency

W

WC	weapons coordination
WILCO	will comply

PART II TERMS AND DEFINTIONS

This Glossary provides the definitions of terms used in this MTTP or likely to be encountered in TADIL J interface operations

acknowledge. The act of notifying a unit transmitting a message that the message has been received as a valid message

active synchronization. A procedure used by a JTIDS terminal to effect and maintain fine synchronization with system time based on the Round-Trip-Timing (RTT) process

address. A number applied to an Interface Unit to associate information and directives with interface units or tracks for both digital and voice communications

air surveillance. The systematic area observation of air space by electronic, visual or other means, primarily for the purpose of identifying and determining the movements of aircraft and missiles, friendly and enemy, in the air space under observation. (Joint Pub 1-02)

airborne early warning. The detection of enemy air or surface units by radar or other equipment carried in an airborne vehicle, and the transmitting of a warning to friendly units. (Joint Pub 1-02)

area of responsibility. A geographic area assigned to a command and Control System for track reporting purposes and conduct of tactical operations

association. The automatic or manual establishment of a relationship between two or more tracks when the information on them is deemed to pertain to the same contact

bit. A binary digit. In the binary system of numbering, each digit can have only one of two values (0 or 1)

blind relay. A JTIDS terminal programmed to relay data but not initialized to access the data

category. The environment in which the associated track is operating; i.e., air, surface, subsurface, land, or space

common track. A track on which two or more interface units locally enter positional information

coarse synchronization. The state of synchronization with system time that allows a terminal to receive and process messages and to achieve fine synchronization. (System Segment Specification for JTIDS Class 2 Terminal)

combat air patrol. An aircraft patrol provided over an objective area, over the force protected, over the critical area of a combat zone, or over an air defense area, for the purpose of intercepting and destroying hostile aircraft before they reach their target. (Joint Pub 1-02)

combat direction system. Synonymous with Tactical Data System (TDS)

command and control. The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of his mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. (Joint Pub 1-02)

command and control interface unit (C2 IU). Any JU, PU, or RU except a nonC2 JU

command and control JTIDS unit (C2 JU). A JTIDS unit with command and control (C2) capability

contention access mode. A transmit access mode in which a given time slot block is assigned to more than one JU. Each JU will transmit at a specified rate in the time slot block by selecting time slots for transmission pseudo-randomly

control. The near-real-time direction of weapons systems and supporting platforms for the accomplishment of assigned missions

correlation. The determination that a system track or local sensor track data report represents the same object or point as another track and/or the process of combining two such tracks/data under one track number

data forwarding. The process of receiving data on one digital data link and outputting the data, using proper format and link protocols, to another type of digital data links. In the process, messages received on one link are translated to an appropriate message on another link. Data forwarding is accomplished by selected forwarding units simultaneously participating on more than one type of data link. Data that is forwarded is based on the data received and is not dependent upon the local system data of the data forwarding unit or its implementation of the received message or forwarded message

data link. The means of connecting one location to another for the purpose of transmitting and receiving data. See also Tactical Digital Information Link. (Joint Pub 1-02)

data link reference point. A fixed geographic reference point specified by appropriate authority from which a PU/RU can calculate the relative position of own unit and local tracks (the DLRP is the X-Y grid origin of the TADIL Interface)

data silent mode. A mode of JTIDS/MIDS terminal operation where the terminal receives but does not transmit fixed word format or variable message format messages

decorrelation. (1) the determination that locally held track data for a given track number does not represent the same object or point as a track data being received in a remote track report for the same track number

(2) the process of establishing a new track number for a local track when a remote track report with the same track number as the local track is determined to represent a different object

dedicated access mode. A JTIDS transmit access mode in which time slots are assigned to an individual JU for that JU's exclusive use

drop track. In air intercept, the unit having reporting responsibility for a particular track is dropping that track and will no longer report it. Other units holding an interest in that track may continue to report it. (Joint Pub 1-02)

dual designation. The same track being reported by two or more IUs using two or more different track numbers

duplicate track numbers. The same track number used by two or more IUs for two or more different tracks

electronic countermeasures. Actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum; includes electronic jamming and electronic deception, including manipulative deception, simulative deception, and imitative deception

environment/category. The environment in which the associated track is operating; e.g., air, space, surface, subsurface

epoch. A JTIDS TDMA 12.8-minute time interval consisting of 98,304 time slot intervals, each of 7.8125 milliseconds duration. The time slots in each epoch are organized into three sets (A, B, or C) of 32,768 time slots each. There are 112.5 epochs in a 24-hour period. (Derived from System Segment Specification for JTIDS Class 2 Terminal)

filter. A process of inhibiting data from transmission on a data link and/or inhibiting data received on a data link from entry into a unit data base

fine synchronization. The state of synchronization with system time that allows a JTIDS terminal to transmit messages. A terminal may utilize a passive or active synchronization procedure to achieve fine synchronization. (System Segment Specification for JTIDS Class 2 Terminal)

fixed word format. A 70-bit structure consisting of formalized arrangement of predefined fields of fixed length and sequence

fixed word format message. A TADIL J message utilizing FWF. An FWF message is started by an initial word which may then be followed by one or more extension and/or continuation words

force tell. The process whereby data that are being inhibited by a filter are allowed to be transmitted or received

forwarding JTIDS unit. A JTIDS unit that translates and forwards data among IUs using J-series messages and M-series messages. An FJU can function in one of the configurations defined for FJUA, FJUB, and FJUAB

forwarding JTIDS unit A. A JU communicating on both TADIL A and TADIL J while forwarding information between TADIL A and TADIL J participants

forwarding JTIDS unit AB. A JU communicating on TADIL J, TADIL A, and TADIL B while forwarding information among TADIL J, TADIL A, and TADIL B participants

forwarding JTIDS unit B. A JU communicating on both TADIL B and TADIL J while forwarding information between TADIL B and TADIL J participants

forwarding participating unit. A PU that is forwarding data between TADIL A and one or more RUs

forwarding reporting unit free text message. An RU which is forwarding data between two or more RUs bit-oriented messages whose information bits may be used to represent digitized voice, teletype, and other forms of free text information

gridlock. A procedure for determining data registration corrective values (pads) by comparing remote tracks received from a designated Gridlock Reference Unit (GRU) to local data

hand over. The passing of control authority of an aircraft or other air vehicle from one control agency to another control agency; hand over action is complete when the receiving controller acknowledges assumption of control authority

initial entry JTIDS unit (IEJU). Any JTIDS unit that transmits the Initial Entry message in the appropriate time slot

initial entry. The procedure by which a subscriber JTIDS terminal becomes a system participant initially and may achieve coarse synchronization with system time. (System Segment Specification for JTIDS Class 2 Terminal)

initial slot number (ISN). The number assigned to the first time slot in a block of time slots relative to the beginning of an epoch

interface unit (IU). A generic term that applies to JTIDS Units (JUs), Participating Units (PUs), and Reporting Units (RUs) providing information on the interface. The term C2 IU includes PUs, RUs, and C2 JUs, but not nonC2 JUs

interleaving. A pattern of orienting the data symbols of a message for transmission, applicable to Modes 1 and 2. A fixed interleaving pattern is used for Mode 4

jitter. A pseudorandom time period for varying the start of a JITDS pulse. Gives JTIDS additional resistance to jamming

Joint Tactical Information Distribution System (JTIDS). A joint-Service system which provides an Integrated communications, Navigation, and Identification (ICNI) capability. The JTIDS provides a reliable, secure, jam-resistant, high-capacity, ICNI capability through the use of direct-sequence, spread-spectrum, frequency-hopping, and error detection and correction techniques

JTIDS net. One of 128 time-division structures comprising a JTIDS network. Each net consists of a continuous stream of time intervals (time slots) with 98,304 time slots per 12.8-minute epoch, during which digital data whose signal characteristics are

determined by a cryptographic variable in conjunction with a unique net number are distributed

JTIDS network. The JTIDS structure having a total usable capacity of 98,304 time slots per epoch per net and 128 nets. All nets are synchronized so that each time slot of each net is time-coincident with the corresponding time slot (same set and number) of every other net. The signal characteristics of all data distributed within a specified multinetted structure are determined by a cryptographic variable in conjunction with a set of net numbers that define the structure

JTIDS Unit (JU). A unit communicating directly on TADIL J

JU response time. The time from new information availability at the JU to the transmission of the information on the link. This is defined for each message in the MIL-STD-6016

local track. A track established within an interface unit based on locally entered positional information. Amplifying data associated with the track may be derived locally, from supporting units, or from data links

navigation controller. The navigation controller establishes the origin and north orientation of the U, V relative grid for the relative navigation function

net control station. (1) a TADIL A station which, through switch selection on the Data Terminal Set, acts as the interrogating station in the roll call mode of operation

(2) a communications station designed to control traffic and enforce circuit discipline within a given net. Also called NCS. (Joint Pub 1-02)

net cycle time (NCT). The time required for one TADIL A net cycle; i.e., for all PUs to be polled at least once in the TADIL A roll call mode

net number. A seven-bit code that identifies each net as a decimal number (0 through 127). (System Segment Specification for JTIDS Class 2 Terminal)

net sync. A TADIL A net mode of operation for synchronizing all stations that are on the link

net. See “JTIDS Net”

network. See “JTIDS Network”

network management concepts. A set of operational concepts that deals with the allocation and assignment of JTIDS resources and functions to satisfy user requirements

network management function. An action or activity affecting the relationships, actions, or activities of the various elements of the network

network management tools. The procedures employed by a network manager to ensure effective and efficient use of the JTIDS message transmission capacity

network participation group. A unique list of applicable messages used to support an agreed-upon technical function without regard to subscriber identities; this list is a means of transmitting a common set of messages to all interested users

network time reference. A subscriber terminal that is assigned as the reference for system time for each synchronized netted system. The NTR terminal's clock time is never updated by system information and is the reference to which all other terminals synchronize their own clocks. There is only one NTR

noncommand and control JTIDS unit (nonC2 JU). A JU without command and control (C2) capability

participating unit (PU). A unit communicating directly on TADIL A

pool. One or more time slot blocks that can be used to satisfy a particular functional requirement or the total JTIDS capacity that can be divided into pools to satisfy all functional requirements

pulse (JTIDS). A 6.4-microsecond burst of carrier frequency continuous phase, shift modulated at a 5-megabit-per-second rate by the transmission symbol

radio relaying. A function for extending radio coverage based on time delay relaying where a message received during one time slot is subsequently retransmitted in another time slot

reception quality (RQ). A number from 0 through 7 which represents the quality of data reception from a particular IU by a particular IU. 0 represents no reception and 7 represents perfect reception

relative navigation. A procedure used by a terminal to determine its position and velocity in a common reference coordinate system by passive observations of position and status messages transmitted by other terminals

relay. An automatic function of the JTIDS terminal that provides retransmission of received information to extend the range beyond line of sight

relay block. One to 64 time slot blocks assigned to independently specified nets for the relay of messages. The number of time slots selected for message reception must equal the number of time slots selected for message transmission. Each block is described by set (A, B, or C), a specific time slot in the block, and the recurrence rate

remote data. Data that are derived from data link reports from another unit

remote track. A track established within an interface unit based upon positional information derived from a data link report or reports. Amplifying data associated with the track may be derived locally, from supporting units, or from data links

reporting responsibility. The requirement for the IU with the best positional data on a track to transmit track data on the interface

reporting unit (RU). A unit communicating directly on TADIL B

round-trip-timing (RTT). The process used by a JTIDS terminal to directly determine the offset between its clock and that of another JTIDS terminal. This is used to achieve and maintain fine synchronization and to improve the terminal's time quality. This process involves the exchange of RTT interrogation and reply messages

RTT message. A short, 35-bit message used by the Active synchronization method, either an RTT Interrogation message or RTT Reply message

secondary user. The general category for the majority of JTIDS subscriber terminals. Secondary user terminals generally utilize the Passive synchronization procedures for synchronizing in the Relative Navigation community. (System Segment Specification for JTIDS Class 2 Terminal) Secondary users may use RTT messages when improved time quality is needed to maintain position quality

stacked net. The coordinated use of specific blocks of time slots on different nets in a JTIDS network by different communities of users

static network management. Management of the TADIL J network in accordance with a preplanned scheme not subject to changes by a network manager during operations

subscriber. A participant in the use of the system, either actively (transmission of information) or passively (receiver of information only), or both

supporting unit (SU). A unit operating in support of a JU, a PU, or an RU which is providing data for the interface but which is not specifically identified as a data source

tactical data system (TDS). An automated real-time computer system in which tactical data are entered for storage, calculation, and/or display

tactical digital information link. A Joint Staff approved, standardized communications link suitable for transmission of digital information. Current practice is to characterize a tactical digital information link (TADIL) by its standardized message formats and transmission characteristics. TADILs interface two or more command and control or weapon systems via a single or multiple network architecture and multiple communication media for exchange of tactical information

a. TADIL A a secure, half-duplex, netted digital data link utilizing parallel transmission frame characteristics and standard message formats at either 1364 or 2250 bits per second. It is normally operated in a roll-call mode under control of a net control station to exchange digital information among airborne, land-based, and shipboard systems. NATO's equivalent is Link 11

b. TADIL B a secure, full-duplex, point-to-point digital data link utilizing serial transmission frame characteristics and standard message formats at either 2400, 1200, or of 600 bits per second. It interconnects tactical air defense and air control units. NATO's equivalent is Link 11B

c. TADIL C a unsecure, time-division digital data link utilizing serial transmission characteristics and standard message formats at 5,000 bits per second from a controlling unit to controlled aircraft. Information exchange can be one-way (controlling unit to controlled aircraft) or two-way. NATO's equivalent is Link 4

d. TADIL J a secure, high capacity, jam-resistant, nodeless data link which uses the Joint Tactical Information Distribution System (JTIDS) transmission characteristics and the protocols, conventions, and fixed-length message formats defined by the MIL-STD-6016. NATO's equivalent is Link 16

e. Army Tactical Data Link 1 (ATDL-1) a secure full-duplex, point-to-point digital data link utilizing serial transmission frame characteristics and standard message formats at a basic speed of 1200 bits per second. It interconnects tactical air control systems and Army or Marine surface-to-air missile systems

f. Interim JTIDS Message Specification (IJMS) a secure high capacity, jam-resistant, nodeless interim message specification that uses the MIL-STD-6016 transmission characteristics and the protocols, conventions, and fixed-length message formats defined by the IJMS. See also Data Link. (Joint Pub 1-02) The transmission characteristics and standards for the TADILs are set forth in the following documents:
TADIL-A = MIL-STD-6011 and MIL-STD-188-203-1A.
TADIL-B = MIL-STD-6011 and MIL-STD-188-212.
TADIL-C = MIL-STD-6004 and MIL-STD-188-203-3.
TADIL-J = MIL-STD-6016.
ATDL-1 = MIL-STD 6013
NATO Link 1 = STANAG 5501

TADIL J message. A functionally oriented, variable-length string of one or more 70-bit words in either fixed word format or variable message format

terminal (JTIDS). The integrated equipment comprised of hardware, firmware, and software elements used as the means for participating as a system subscriber

test mode. A mode of terminal operation whereby a terminal is required to transmit Test messages

time (system). The time maintained by the terminal assigned as the Network Time Reference (NTR) to which all other participating terminals are synchronized. (System Segment Specification for JTIDS Class 2 Terminal)

time (terminal). The estimate of time derived by a terminal as a result of executing either the active or a passive synchronization procedure

time slot. A 7.8125-millisecond time interval during which messages may be transmitted

time slot assignment. The designation to the JTIDS terminal of the specific time slot blocks in which it will transmit or receive messages

time slot number. A 17-bit code that identifies each full time slot, the code consisting of a 2-bit set field (set A, B, or C) and a 815-bit slot field representing the decimal numbers zero to 32,767

time slot reallocation. A transmit access mode in which each Access Mode participant periodically assigns itself time slots from a shared pool of time slots. A participant assigns transmit time slots after transmitting a Time Slot Reallocation (TSR) message and receiving TSR message and receiving TSR messages from other participants

time slot block. A collection of time slots spaced uniformly in time over each epoch and belonging to a single time slot set. A block is defined by indexing time slot number (0 to 32,767), set (A, B, or C), and a recurrence rate number (0 to 15)

time slot reuse. A method to increase the JTIDS network capacity by allowing more than one terminal to transmit in a single time slot on a single net number. This is appropriate for JUST in proximity to each other that have information to exchange; receivers will lock onto the message with the shortest time of arrival

track. (1) the graphic and/or alphanumeric representation of an object, point, or bearing whose position and/or characteristics are collated from sensors and/or other data sources

(2) a collated set of data associated with a track number for the purpose of representing the position and/or characteristics of a specific object, point, or bearing

track number (TN). The unique numeric or alphanumeric octal identifier associated with a specific set of track data representing a vehicular object, point, line of bearing, fix, or area of probability

track quality (TQ). A numerical value assigned to a track computed from data related to the past tracking performance on the track, representing the accuracy of the track position

transmit block. A time slot block assigned for the transmission of messages

variable message format. A message structure using predefined fields of fixed length employing internal syntax and a header extension. The internal syntax specifies the presence, absence, and recurrence of fields as selected by the user

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FM 6-24.8
MCWP 3-25C
NWP 6-02.5
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30 June 2000

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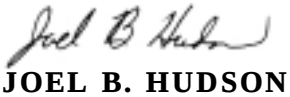

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